Richard K. Thomas

Concepts, Methods and Practical Applications in Applied Demography

An Introductory Textbook

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Chapter 1
Introduction to Applied Demography

Abstract This Chapter presents an overview of the field of demography and the place of applied demography within the broader context. It traces the development of applied demography as a sub-discipline and reviews the factors that have created growing interest in and demand for the application of demographic concepts, techniques and data inside and outside of academia.

1.1 Introduction

"Demography" comes from the Greek and means "describing people"—"demo" for people and "graphy" to write about a particular topic. Also referred to as population studies demography seeks to analyze human populations and profile them in terms of their salient characteristics and the dynamic processes that influence these characteristics.

Demography as a distinct field of study has a relatively short history. The term "demography" was coined in 1855 by Achille Guillard (2010) when he published *Elements de Statistique Humaine ou Demographie Comparee.* He combined the Greek words *demos* and *graphein* to create the discipline's name. To Guillard, the focus of demography was the mathematical knowledge of populations, their general movements, and their physical, civil, intellectual and moral state. His interest in population size and distribution, demographic processes and population structure of a population foretold modern demography.

"Demography" comes from the Greek words for people (demos) and writing about (graphe) and refers to the science of describing populations.

While it is appropriate to say that demographers are interested in the characteristics of populations, they are not interested in every characteristic. There is a certain set of attributes that are the focus of demographic analysis. Demographers are interested in characteristics that are relevant within a social and cultural context.

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Thus, demographers study biosocial traits such as age, sex and race and socio-cultural traits such as marital status, education, income, occupation and even religion. While age, sex and race may be thought of as physical attributes, each involves a significant social dimension and are thus classified as "biosocial".

Demographers do not focus on the attributes of individuals but on the characteristics of groups of people. While every individual might be considered to possess a "demographic profile", the interest of demographers is on the attributes of aggregates—a community, a state or a nation. There are situations in which a subset of a population may be the object of study, such as cohorts of child-bearing age women, senior citizens, or African-Americans, but it is still the aggregate characteristics of the group that are of significance. There will be significant variation within any group in terms of its attributes. Members of any population may exhibit a range of values for any attribute (e.g., income) so it is the "average" characteristics of the population that are of interest to the demographer.

Demography is by definition an *applied* discipline. While this text makes occasional references to demographic theory, most of the material is devoted to the study of the concepts, methods and data used in the application of demography to real-world problems. A frequent question asked of demographers when they present the facts is: This is interesting but what can you do with it? Like all disciplines, there is a basic science dimension to demography, what we might call science for science's sake. But, ultimately, most demographers use their knowledge to understand real world problems and, not just to understand them, but to help develop solutions for them. Demographers analyzing the changing age structure of the U.S. population, for example, have contributed important knowledge for addressing the challenges of funding the federal Social Security and Medicare programs. Demographers examining fertility trends have contributed to solutions for addressing such phenomena as high rates of births to unmarried women and teenagers.

In addition to proposing practical solutions to real-world problems, demographic data make an important contribution to policy setting. As in the case of Social Security and Medicare cited above, an understanding of demographic trends provides policy-makers with the background they need for establishing effective policies. There is essentially no sector of U.S. society that cannot benefit at the policy level from demographic input. Thus, education, economic development, transportation, disaster preparedness, and criminal justice, to name a few, are areas where demographic data can make a significant contribution to policy setting and program implementation.

1.2 Applied Demography

"Applied demography" involves the application of demographic theories, concepts, methods and data to the solution of practical "real world" problems. As noted by Murdock and Ellis (1991), applied demography focuses on pragmatic concerns of interests to professionals whose training and experience lie largely outside the small community of professional demographers. This often means the application of demographic methods and materials to non-demographic factors and events.

> *"Applied demography" involves the application of demographic theories, concepts, methods and data to the solution of practical "real world" problems.*

Even earlier, Rives and Serow (1984) suggested some traits that might distinguish applied demography from not only general demography but other fields. They noted that the scientific goal of applied demography focuses on prediction as opposed to description and explanation, an emphasis on current and future events rather than the past, local versus national and international demographic phenomena, an emphasis on the *implications* of demographic events, and the use of demography for decision making in areas outside of demography.

Given there is not complete agreement as to what constitutes applied demography, perhaps the best approach would be to identify what applied demographers actually *do*. A simplified depiction of the way in which demography is applied is presented in Exhibit 1.1.

Exhibit 1.1: How Demography is Applied

Data ⟶ **Information** ⟶ **Policy** ⟶ **Action**

Every scientific endeavor begins with data—i.e., the raw numbers that describe a population or phenomenon of some type. This would include, for example, the ages of every person in a defined population, the number of births each woman had in the population last year, or the citizenship status of all foreign-born residents. These raw data would essentially involve a list of numbers that do not mean much by themselves. These raw data must be converted into information that provides a description of the population in question. Thus, if we can calculate the median age for the population, the annual birth rate, or the proportion of foreign-born in the U.S. population, we now have some information that we can use. In this simplified example, having access to information allows demographers to contribute to policy making. If, for example, the median age is 40 the types of policies to be considered would be a lot different than if the median age were 18. Similarly, it makes a difference to policy makers if the fertility rate is 80 births per 1000 women of child-bearing age as opposed to 40. Finally, the proportion of foreign-born within a population—and their citizenship status—has all kinds of policy implications.

The term “policy” is used loosely here to refer any deliberations on the meaning of the statistics and any implications these statistics may have for the social, political or economic realms. An aging population, for example, raises questions about the ability of a population to replace itself and, indeed, the U.S. population is facing that dilemma today. A declining fertility rate also has implications for the same issue, in that the increasing median age of the population reflects among other things the fact that women are having fewer children. Finally, the proportion of the population that is foreign-born has implications for immigration policy, educational resources, and the job market. The significance of the foreign-born population even has implications for the population replacement situation in that recent immigrants typically exhibit higher fertility rates than the native-born.

The ultimate “application” comes at the action phase and, for these examples, actions may include developing health services for seniors (as opposed to children), introducing incentives for more births (or less, depending), and introducing English-as-a-second-language programs in public schools (or not). The impact of these actions informed by demographic analyses can be tracked over time to determine their implications for the populations in question and for the society as a whole.

1.3 Why Study Demography?

The study of demography is important for a number of reasons. For starters, nearly everything is connected to demography (Weeks, 2008). Demography describes our world—and description is the starting point for understanding the world and, ultimately, taking action to improve it. “Our world” could be any collection of people we choose to analyze—a social group, classroom, neighborhood, city, or the total world population for that matter.

The relevance of demography for an understanding of the world is reflected in the major issues making headlines in recent years:

- Increasing income inequality as the size of the middle class dwindles
- Conflict between different ethnic and religious factions in the Middle East
- The effects of climate change on various parts of the world
- The continuing issue of illegal immigration into the United States
- The unexpected election of Donald Trump as president of the United States.

These issues all have national and/or international implications—and all are directly or indirectly related to demography. In fact, there is virtually no social, economic or political issue that does not have its roots in the demographics of the population.

While the events above have captured the headlines, there are a number of other trends occurring within the U.S. population that are currently making headlines or reflect long-term changes in the social structure:

- The decline in the U.S. population below replacement levels
- The aging of the U.S. population (accompanied by growing "feminization")
- The increasing racial/ethnic diversity of the U.S. population
- The changing family structure of the U.S. population (now including same-sex marriages)
- The outsourcing of U.S. jobs to overseas workers
- Increasing death rates among some segments of the U.S. population.

These types of demographic trends have significant implications for U.S. society present and future. There is no social institution that is not impacted by these developments. The aging of the U.S. population by itself has ushered in an unprecedented period for a society that has always emphasized its youthfulness. The dramatic increase in the Hispanic population in the U.S. has wide-ranging implications for the economy, education, healthcare and the political system.

In view of developments like those above applied demography seeks to interpret the political and economic events whether at the local, national or international level. News headlines and the stories that accompany them are often complicated and difficult to decipher. However, many if not most news stories today have some type of demographic cause or consequence. We gain insights when we realize that headlines like: "Growing elderly population puts pressure on Medicare," "Aging baby-boomers threaten solvency of Social Security," or "Drop in birthrate could lead to population decline" reflect the operation of demographic processes. We can better understand both the obvious and not-so-obvious dimensions of the issue if we can apply demographic knowledge and techniques.

Applied demography provides a means of interpreting social, political and economic events at the local, national and international levels.

A case in point that has implications for each of these headlines is the oft-quoted misstatement that: Americans are living longer today. That statement is incorrect in that the length of time that a human being can live has not changed much throughout history. A more correct statement would be: More Americans are living long lives. While both of these developments would have an impact on programs for the elderly, the ultimate consequences of the respective developments would be different. The impact on society of aging is a function of many people living a long time rather than some people living a very long time.

While a good case can be made for the usefulness of applied demography as a means of interpreting and understanding social phenomena, the ultimate goal of any applied science is to effect change. Knowledge gained through the application of demographic concepts, techniques and data has some value in its own right, but the real payoff comes when this knowledge is used to solve a social problem and bring about positive change. In the cases of Medicare and Social Security cited above, demographic knowledge can offer insights into the issues at hand. For example, does the growing Medicare population mean that this government program will eventually go bankrupt as the trend line might suggest? Knowledge drawn from health demography helps to shed some light on this as we realize that the major surge in Medicare enrollees for the foreseeable future will be baby-boomers. This generation is healthier than any previous generation of seniors, has more resources to maintain their health status longer, and can generally expect to remain healthy up into their 70 and 80s. While this doesn't mean that the surge in elderly Americans will not eventually affect Medicare's viability, the situation viewed in this light does not support a "doomsday" scenario.

By analyzing trends in the demographic behavior of society members, demographers can predict the future characteristics of the population.

While a number of major trends related to demographics are affecting the society as a whole, there is a personal dimension to this as well. As Weeks (2008) points out, the demographic foundation of our lives is deep and broad. Although demographers are interested in the characteristics and behavior of groups of people, the demographic attributes of our society affect nearly every aspect of our personal lives in one way or another. In fact, the types of personal decisions that we as individuals make have a cumulative effect on population trends. Some of the decisions that affect our daily lives are:

- The decision to get married (or not) and when
- The decision to have children (or not) and when
- The neighborhood in which we choose to live
- The type of occupation we pursue
- The educational level we aspire to
- The choice of political party to support
- The health-related behaviors in which we participate.

The cumulative effect of decisions such as these made by millions of Americans is a changing demographic profile. In fact, some demographers make a living projecting the future characteristics of populations based on what is known about that population's current demographic behavior. It would not be unusual, for example, for analysts to use demographic methods to predict how long members of a certain demographic group are going to live and, in fact, determine prospectively what diseases they are likely to die from, or for demographers to predict election results based on the demographic characteristics of likely voters. The bottom line is: Knowing the demographic characteristics of a population opens the door to an understanding of a wide variety of attributes of that population.

1.4 Who Uses Demography?

People in every aspect of society employ demographic data, often without being aware of it. Increasingly we hear people speak up the "demographics" of that consumer group or the fact that a certain "demographic" always votes for a certain political party. Even though public expressions about demographics are becoming more common, the widespread use of demographic data and methods is not widely appreciated.

Members of the business community, particularly those involved in marketing, pioneered the use of demographic data in the private sector. The application of demographics to business has become so widespread that virtually no business decision is made in the corporate boardroom today without considering the relevant demographics. Whether the decision involves identifying a target audience for a new product, determining the location for a new store, or designing a sales territory, the demographics of the population under question are a critical piece of the puzzle. This process does not just relate to major corporate decisions but affects us as individuals. The fact that we receive certain catalogues, certain types of junk mail, or certain telephone solicitations reflects the information that marketers have about our demographic attributes.

While the business community was the first to recognize the importance of demographics, this sector is far from the only user of such data. In every aspect of American life demographics have become increasingly important. The allocation of government services depends on an in-depth understanding of the characteristics of the population to be served. Indeed, the original intent of the census conducted by the federal government every ten years was for the apportionment of Congressional districts. Those who aspire to political office begin their campaigns with an assessment of the demographics of their prospective constituents. Those involved in urban planning and community development start with the demographics of the geographic area under consideration. The education system depends on an understanding of the number, location and characteristics of school-aged children, and the services provided by the healthcare system are a direct reflection of the characteristics of the patient population. The military must plan to accommodate the characteristics of potential inductees, and, clearly, today's American armed forces reflect the changing demographic character of our society with the inclusion of record numbers of women and members of various racial and ethnic groups.

While the business community was the first to apply demographics in the private sector, applications of demography to real-world problems are found in every sphere of society—government, education, criminal justice, healthcare, community development and numerous others.

In most of these examples, demographics are put to good use—good for the users and good for society. But there are cases where less well-intended individuals and organizations may use demographics for less than noble purposes. Much has been made of racial and ethnic profiling used by law enforcement agencies and championed by those who oppose immigration into this country. Certain groups may be discriminated against due to their demographic characteristics—their race or ethnicity, their poverty level, religion or language. Historically, individuals have been excluded from housing developments, social clubs and occupations due to their sex, race or cultural background. As with any aspect of the human condition, demographics can be used for good or ill.

When we examine *who* applies demography to real-world problems we find, not surprisingly, that many demographers themselves are included among this number. Applied demographers work in virtually every industry, from education to manufacturing to healthcare and at agencies in all levels of government. However, it is noteworthy that most of the people applying demography to concrete problems are *not* demographers. Long before applied demography was recognized as a separate discipline, people in government, business and other fields were regularly using demographics as part of their jobs. It is perhaps a testament to the value of applied demography to find people who are not demographers in virtually every industry employing demographics in their efforts to perform their jobs.

The significance of demography to U.S. industry can be seen in the extent to which those involved in the application of demography have been elevated to roles of importance within the corporate structure. While demographic analysis was at one time relegated to the back room as a low-level technical activity, in today's economy we find those in charge of demographic analysis—albeit usually not demographers per se—seated at the table in the corporate boardroom. It is safe to say that very few business decisions in any industry are made today without considering the demographics underlying the issues and/or the demographic implications of that decision.

1.5 Demographic Perspectives and Methods

An understanding of the "demographic perspective", the concepts that define the discipline, the methods used for demographic analysis, and the data utilized in these analyses is essential. The demographic perspective involves a way of seeing the world within a demographic context or through a "demographic lens". This unique manner of viewing the world provides a framework for interpreting social phenomena and a means of linking social groups to their environments. This perspective leads to a search for interrelationships between demographic variables and other variables associated with a population.

Although we often act of our own volition to make decisions that not only affect our lives but the demographic trends that affect our society, we must remember that the relationship between demographic behavior and societal traits is a "two-way street”. All of us were essentially born into a game that was already under way making each of us in a sense a “victim” of demographic trends. The rules were written long before we were born, so the type of education we aspire to (and our ability to achieve it), the type of job that we are able to obtain, the type of person we are likely to marry, and even the political party we are likely to support, are all reflections of the position within the social structure to which we were born. Indeed, it has now been pointed out by health demographers that the best predictor of our health is the ZIP Code in which we were born. While members of society are able to control their demographic futures to a certain extent, we are all constrained by the demographic parameters surrounding our position in society.

Applying demographics to the analysis of societal phenomena allows demographers to see society from a unique perspective, using a “demographic lens” to view the attributes that characterize any population.

At the same time, however, we are the “creators” of our demographic circumstances through our behavior and the decisions that we make contribute to demographic trends. Over the course of the past few decades the behaviors that we have exhibited as a population have had significant implications for the demographic attributes of American society. We have fewer (and later in life) marriages, we are having none or fewer (and later in life) babies, we continue to die from health conditions that are preventable, and we continue to migrate out of the Northeast and Midwest to the South and West. Thus, our behaviors affect the demographic attributes of our society.

Ultimately, through our individual behaviors we make our demographic bed and then have to lie in it. The society we have created through our behaviors then has implications for our lives. Some of the situations that we as Americans have created through our behavior include the following:

- Our birth rate has dropped below replacement levels
- We are getting steadily older as a society
- We have fewer “traditional” families
- We have a predominantly female population
- Poverty is being shifted from the inner-cities to the suburbs
- We are becoming less healthy as a population in many ways.

As we consider these trends, one of the things that becomes obvious is that societies are constantly undergoing change—some slower, some faster—but change is always occurring. Often change is a result of a traumatic event—a natural disaster, disease or war. In the U.S. we have experienced continuous change in our short history. Change has been such an important aspect of our lives that we actually consider change as an important attribute of our culture. We change jobs, houses, spouses and lifestyles with startling frequency. Change is readily accepted and generally encouraged to the point that it has become part of our cultural DNA.

The changes that have occurred in recent years have led to the setting of a number of demographic records (as illustrated by Exhibit 1.2).

Exhibit 1.2: Setting (Demographic) Records
The changes have occurred in U.S. society in recent years are so significant that we are constantly setting new records. Today, for example, the American population contains:

- The largest elderly population we have ever had (both numbers and percent)
- The greatest "excess" of women we have ever had
- The lowest marriage rate we have ever had
- The largest group of single adults we have ever had (both numbers and percent)
- The most births outside of marriage we have ever had
- The largest number of single-parent households we have ever had
- The most women working outside the home we have ever had
- The highest level of immigration (both legal and illegal) we have ever had.

As a result, our American "portrait" in the early 21st century looks much different than it did only a couple of decades ago.

Another way in which demography can be thought of as a "two-way street" is through the interaction of population attributes and demographic processes. The composition of a population has implications for the various demographic processes that occur while, at the same time, the current processes have consequences for the population's attributes. If we examine, for example, the racial and ethnic makeup of the U.S. population, we see that non-Hispanic whites are the numerically dominant racial/ethnic group in society—followed at a great distance by Hispanics and African-Americans. Currently, the U.S. population is exhibiting significant differences in fertility rates as a result of its population composition. The birth rate for the non-Hispanic white population is lower than average while the rate for African-Americans, Hispanics and certain other racial and ethnic groups is higher than average. These behaviors attributed to demographically different segments of the population are having a significant impact on fertility patterns. When these trends are extrapolated into the future we see that the operation of these processes will have major implications for the future composition of the U.S. population. Thus, by 2050 it is predicted that these high-fertility minority groups will constitute the majority of the population and non-Hispanic whites will constitute a numerical minority. Numerous other examples of the interdependence of demographic traits and demographic processes will be cited throughout this text.

One conclusion generated by looking at the population through "a demographic lens" is that virtually no demographic or social attribute is randomly distributed throughout society. When we look at developments seemingly unrelated to demographic factors, we inevitably find a demographic undercurrent if not a direct causal effect. Examples ripped from the headlines related to such diverse issues as climate change, the international spread of AIDS, an increase in suicide among older Americans, the outsourcing of American jobs overseas, and bankrupt American cities all have an underlying demographic component. With the judicious application of demographic concepts, techniques and data, we can develop the demographic perspective required to clearly see the operation of these phenomena.

1.6 Major Topics in Demography

The sections that follow provide a foretaste of the topics that interest applied demographers. Each of these topics will be addressed in detail in subsequent chapters.

1.6.1 Population Size and Distribution

The first facts that a demographer looks for in a population are the number of people and their distribution. The size of the population is a key demographic variable and provides the framework for additional analysis. Equally important, however, is the distribution of that population across the geographic span of the area in question. In the U.S., for example, how are our 310 million residents distributed over the various states and among the various cities? To what extend is our population widely dispersed (e.g., in New Mexico) or tightly concentrated (e.g., in New York City)? These questions can be raised for any geographic or political unit, and patterns of population distribution have significant implications for the demographic profile of the area in question.

At the same time, the population's demographic makeup will contribute to the manner in which the population is distributed. Thus, in the U.S. we find American Indians (a racial group) primarily isolated on "reservations" in the western states, African-Americans often segregated within our urban areas, and senior citizens concentrated in popular retirement locales such as Florida and Arizona.

Demographers are not only interested in the current size and distribution of the population but in future conditions as well. For most practical purposes, it is important to develop an appreciation for the size and distribution of the population ten, twenty or even more years into the future. To this end, demographers have developed a variety of techniques for generating projections and forecasts of the size and distribution of the future populations.

1.6.2 Demographic Processes

Historically, demographers have emphasized the study of the major demographic processes—fertility, mortality and migration—and a significant portion of this book is devoted to these topics. Fertility, which refers to the process of reproduction and childbirth, is the primary way in which new members are added to a group. Thus, the number of births and the characteristics of those births are of particular interest to demographers. Mortality refers to the study of death and the characteristics surrounding the deaths within a particular society. This is the primary means through which people are subtracted from a group. The mortality characteristics of a particular society tell us a lot about that society. Migration—the process through which individuals, families and groups move from one place to another—is the third process to be considered. Migration can involve internal movement (e.g., within the U.S.) or international movement (i.e., from country to country). Obviously, migration can both add and subtract people from a society and, in today's world, migration often has more implications for society than fertility or mortality patterns.

One emerging process that will be considered to a lesser extent relates to the morbidity of a population. Morbidity refers to the health problems that characterize a population, and this topic is of increasing interest to students of demography. The fact that disease patterns are almost invariably linked to demographic attributes underscores the usefulness of demographic analysis in the study of epidemiology. The morbidity characteristics of a population have important linkages directly to mortality and indirectly to fertility; the demographically linked health disparities that exist have important social, economic and political implications.

The three key processes taken together are important in that they represent the components of population change. The size of a population is changed through a combination of births and in-migration adding members and deaths and out-migration subtracting members. As will be demonstrated later, the population in Time 2 is a result of the population in Time 1 plus births minus deaths plus/minus migration. Understandably, demographers pay a lot of attention on these processes due to their impact on the size and characteristics of any particular population.

Because demography is a dynamic science, an understanding of demographic trends is important. Changes in birth rates, death rates and patterns of migration are of major importance to demographers. They represent the moving parts of any population and not only provide a snapshot of where we are now but of where we as a people are going. These trends in turn offer an indication of the changes in the attributes of the population that can be expected to result.

1.6.3 Population Composition

Another major topic to be covered in this text is the demographic characteristics associated with human populations. These are the attributes that give a population its "character". For our purposes demographic characteristics are divided into biosocial traits and sociocultural traits in order to profile a population in terms of its key demographic characteristics.

Biosocial characteristics are so called because they are attributes that are rooted in biology but also have a social dimension. These attributes include age, sex, race and ethnicity. While age and sex represent biological states, social attributes are ascribed to persons of different ages, and a social dimension (i.e., masculinity and femininity) is associated with the respective sexes. Race is not a scientific category but exists as a social construct, thus displaying both biological and social dimensions. Ethnicity refers to one's cultural heritage and does not represent a clearly biological state per se. However, to the extent that ethnic groups tend to interbreed and maintain a distinct gene pool, ethnicity is included in the biosocial category. Note that biosocial characteristics are ascribed at birth and are not amenable to change.

Sociocultural characteristics refer to traits exhibited by individuals that refer to their position or status in society. While biosocial traits are essentially ascribed at birth, sociocultural traits are typically acquired through the actions of the individual. Sociocultural traits are important not only because they indicate one's place in society, but because of their contribution to the morbidity patterns of the population. These traits include attributes such as marital status, income, occupation, education and even religion.

1.7 Settings for Applied Demographics

One way of defining applied demography is in terms of the areas to which demography is applied. The following paragraphs summarize areas where demographic concepts, techniques and data are commonly applied.

Business. Business executives, product developers, marketers and others use demographics to support consumer research, new product development, marketing and advertising, store placement and a variety of other purposes. A company desiring to market a new product would use demographics to determine the size of the market, the characteristics of potential customers, the location of potential customers, and the best way to reach the target audience.

Education. Education planners use demographics to plan for school construction, determine staffing requirements, plan school bus routes, and budget for the provision of educational services. School administrators contemplating the construction of an additional school would use demographics to determine how many current and future school-aged children there are, where they are located, and what their characteristics are (e.g., age, ethnicity). They would also use demographics to examine future birth rates and immigration patterns that might affect the demand for schools.

Politics. Politicians, political consultants and policy makers use demographics to draw up political districts, analyze voting patterns, plan political campaigns and develop advocacy strategies, among other activities. A politician embarking on a political campaign would use demographics to profile the electorate in terms of its demographic attributes and voting patterns, determine the subset of potential voters to target, and develop a promotional strategy targeting potential voters. Demographic considerations underlie many of the programs formulated by policy makers.

Labor force development. Policy makers, government officials and education planners use demographics to calculate unemployment rates, monitor the growth/decline of various industries, predict the future demand for specific occupations, and project the future worker pool. A job training program would use demographics to profile the local workforce, determine employment/unemployment levels, identify the types of jobs needed in the local economy, and recommend job training initiatives that would equip the workforce to fill the available jobs.

Transportation planning. Transportation planners use demographics to predict the demand for roads/highways, plan for public transportation, perform cost-benefit analyses for new roads, and assess the impact of a transportation project on the community. A transportation planner conducting a study of existing public transportation to determine needed modifications would use demographics to profile the population currently using public transportation, identify additional potential users, determine current and future destinations for riders, and recommend changes in routes and schedules.

Community development. Community planners use demographics to predict the future demand for various types of housing, develop land use plans, plan public housing projects, project the level of homelessness, and determine the supply of affordable housing. A community development corporation might use demographics to assess the level of home ownership in the community, track housing sales, monitor foreclosure trends, and assess the mobility of community residents with the objective of encouraging housing stability within the community.

Social services. Social service agencies use demographics to identify vulnerable populations and profile demographically defined groups in need of social services, locate social service offices, develop welfare policies, and evaluate the effectiveness of social service programs. A government agency might use demographics to develop welfare policies, identifying the in-need population, determining this population's characteristics, examining the factors contributing to neediness, and structuring assistance programs to address these needs.

Healthcare. Health planners and administrators use demographics to identify medical service areas, determine the demand for health services, select locations for health facilities, measure disparities in health status and health services utilization, and develop marketing plans to promote health services and products. A health planner would use demographics to determine the size and characteristics of the population in a health service area, the types of health problems likely to affect this population, and the types of personnel, services and facilities required.

Criminal justice. Law enforcement officials use demographics to identify the characteristics of criminals and victims, identify high-crime areas, plan for correctional facilities, determine deployment patterns for police, and development community crime prevention programs. Law enforcement officials may use demographics to determine their priorities for enforcement, identify the types of crime that are most serious and/or prevalent, determine the spatial distribution of these crimes, calculate the cost-benefit of focusing on certain crimes rather than others, and predict the consequences of various law enforcement initiatives.

Exhibit 1.3: Demography and Public Policy

As noted in the graphic earlier in the chapter, applied demographics plays an important role in the formulation of public policy. Demographics and demographers regularly make major contributions to public policy often in ways that are not particularly obvious. "Public policies" are authoritative decisions made by legislative, executive or judicial branches of government intended to direct or influence the actions, behaviors or decisions of others. While the federal system that governs the United States does not lend itself to overarching public policies, there are examples of the influence of demographics codified in federal legislation such as No Child Left Behind, the Voting Rights Act, laws governing immigration, and, recently, the Patient Protection and Affordable Care Act.

The opportunities for applying demographics to public policy issues are endless since there are virtually no activities related to public policy that do not have a demographic dimension. One has only to examine the issues that have made the headlines for the past few years to realize the areas in which applied demography might be employed. At the national level major issues have involved the solvency of Social Security and Medicare, the implementation of the Affordable Care Act, the rise in illegal immigration, increasing income inequality, declining fertility rates, and numerous other issues. At the international level there are issues surrounding the continued high fertility rates in sub-Saharan Africa, ethnic strife in Iraq and other countries, pollution in China, and the outsourcing of U.S. jobs overseas. In these cases and others there are opportunities for the application of demography's theories, concepts, methods and data to not only facilitate an understanding of the underlying issues but to contribute to informed policy setting.

Examples of current public policy questions that demographics can address include:

- What changes should be made in the Social Security program given the lack of young workers?
- What are the future implications of high levels of immigration by illegal aliens on society's institutions?
- What impact will the aging of baby boomers have on the demand for government-funded health services?
- What does the declining fertility rate in America portend for future population growth?

- What type of policies would contribute to faster recovery from the recent recession?
- What are the implications for society of a growing excess of women?

These issues only represent a sampling of the various ways in which demographics can contribute to public policy analysis and decision making, nor do they address the myriad opportunities for demographic input into policy setting at the state and local levels. Many of these issues will be revisited later in this book as various sectors of society are addressed in more detail.

1.8 Objectives of the Book

This text has been developed as an introduction to the field of applied demography for use by both undergraduate and graduate students. It should also be useful as a manual for professionals in a variety of fields. Its primary objectives are as follows:

(1) To present a survey of the field of demography and the concepts and methods utilized by demographers (and thereby provide a foundation for the exploration of the application of demographics in various contexts)
(2) To develop an appreciation of the various types of data utilized by demographers, along with methods for finding and interpreting population statistics
(3) To develop an appreciation of demographic analysis as a tool for addressing concrete problems related to the economy, the environment and public policy
(4) To provide examples of the application of demographic materials to other fields and one's personal life
(5) To provide insights into the relationship between demographics and social, economic and political issues
(6) To provide hands-on experience applying demographic methods to real-world problems.

1.9 Organization of the Book

This first chapter has presented an overview and introduction to the field of applied demography. Chapter 2 on the methods and materials of demography describes definitions, concepts and methodologies utilized by demographers in addressing applied problems. Chapter 3 extends this discussion to address the types of data (and their sources) utilized by applied demographers. With this background, the text addresses key areas of interest to demographers, including population size, distribution and concentration (Chap. 4), population composition (Chap. 5), and demographic processes (Chaps. 6–8). Chapter 9 introduces the reader to population estimates, projections and forecasts, key techniques used in applying demographic methods to real-world problems. The following four chapters deal with the application of demographic methods to problems in selected "vertical industries", including business (Chap. 10), healthcare (Chap. 11), and politics (Chap. 12). Chapter 13 summarizes additional areas to which demographic concepts, techniques and data can be applied to real world problems. Chapters 3–13 include case studies and exercises providing hands-on examples of the application of demography to concrete problems.

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Chapter 2
The Methods and Materials of Demography

Abstract This chapter reviews the basic materials and methods of demography and their relevance for applied demography as a sub-discipline. Definitions and concepts utilized are described, and basic demographic techniques that have relevance and types of data important for real-world applications are introduced.

2.1 The Demographic Perspective

The demographic perspective provides a unique way of seeing the world. When we view the world through "a demographic lens" we see things that others do not. The "world" of course could mean literally *the world* or any population of interest. When demographers observe a classroom of students, the residents of a small town, or the citizens of the United States, for example, they do not see an amorphous mass of individuals. They see a well-ordered population with more or less sharply delineated boundaries between various subgroups.

It is a challenge for anyone to understand what has become an increasingly complex world. Demography provides us a tool for making sense of this complexity. With our demographic eyes we can segment the population we are observing into meaningful subgroups. By segmenting the population into such groups, we gain understanding into the nature of that population. This understanding allows the observer to gain insights into the behaviors observed within that population and ultimately apply demographic concepts, techniques and data to real-world problems.

Much of this text is devoted to a discussion of what demographers see when they look at a population from a demographic perspective.[1] Some of the more obvious things that demographers observe are distinctions based on age, sex and race. All of us, of course, intuitively notice basic characteristics of a group that is being observed. We note whether it is a young crowd or an old crowd, the ratio of men to women, and the extent to which the population being observed is racially mixed.

[1]Much of the material in this chapter owes a debt to the groundbreaking synthesis published by Shyrock and Siegel (1976) and subsequently revised by Swanson and Siegel (2004).

R. K. Thomas, *Concepts, Methods and Practical Applications in Applied Demography*, https://doi.org/10.1007/978-3-319-65439-3_2

Demographers notice these same attributes either directly through observation or indirectly through the compilation of statistics.

Looking at the world through "a demographic lens" allows the observer to identify patterns, trends and relationships that otherwise might go unnoticed.

Demographers take these observations a step further in that they can attribute a wide range of other characteristics to the population under study. If one knows the age composition of the population in question, for example, one knows a lot or other things about that population. Although there will be exceptions, we can make assumptions about that population's family status, their attitudes, their lifestyles and even their health status. As a specific example, health demographers could develop a profile of the health problems of that population with startling accuracy. Further, demographers can deduce other demographic characteristics from knowing the age structure of the population. They know that a young population is typically going to have an "excess" of males and that an old population is going to have an "excess" of females. By knowing the age and sex distribution of the population demographers can draw conclusions concerning marital status and household structure. By examining combinations of demographic characteristics it becomes possible to draw conclusions concerning occupational status, educational attainment, income levels and so forth.

It is possible for demographers to make these assumptions concerning the population under study because the various demographic attributes are highly interrelated. People of a certain age, for example, are likely to have attributes that set them apart from people in other age cohorts. For a variety of reasons, people who are members of a certain racial or ethnic group are likely to have characteristics that set them apart from members of other racial and ethnic groups. This is not to stereotype members of various groups, of course, and there are always going to be individual exceptions, but to underscore the fact that demographic attributes are interrelated and tend to be distributed in clusters throughout a population.

Demographic characteristics are often interrelated so, if a demographer knows one thing about a population, this opens the door to knowledge of other characteristics of that population.

Hopefully, this text will allow students to begin to view the world through demographic eyes. This is not something that always comes intuitively but hopefully enough tools will be provided in the following sections to allow the reader to begin seeing the world around him in a different light.

2.1.1 The Demographics of Birth and Death

Demography also provides observers a means of interpreting the world, of understanding social phenomena. One of the obvious insights can be gained with regard to demographic trends. As noted previously, demographics is a two-way street, with the demographic characteristics of a population determining its behavior while, at the same time, the behavior of the population ultimately determining its demographic characteristics. These relationships become clear when one examines basic demographic processes. Of particular significance is the impact of demographic characteristics on fertility or the reproductive behavior of the population. From a "free will" perspective, it could be argued that individuals in society make conscious choices with regard to reproduction. This doesn't mean that there are not unplanned pregnancies—since there clearly are—but it does suggest that the level of fertility is a function of choices made by millions of Americans on a daily basis.

From a strict demographic perspective it could be contended that the notion of individual volition when it comes to reproduction is overstated. Indeed, it could be argued that one's social circumstances (manifested in demographic attributes) are a greater predictor of fertility patterns than the vagaries of personal choice. While there are clearly childbearing-aged members of low-income minority groups in the United States who do now want to have children (and most of these avoid having children), the fact of the matter is that the likelihood of pregnancy for this segment of the population is much higher than that for virtually any other segment of the population.

While reproduction is a complicated process and a lot of factors come into play, it is clear that low-income populations have higher fertility rates than high-income populations, that certain racial and ethnic groups have higher fertility levels than other racial and ethnic groups, that immigrant groups have higher fertility rates than native-born populations, that the poorly educated have higher fertility rates than the well educated, and so forth. One would not want to assert that "demographics is destiny" but it is clear that one's demographic traits exert a considerable influence on reproductive behavior. Because of these clear-cut patterns, demographers are able to predict future fertility patterns and, perhaps more important, predict the future characteristics of the population. They know, for example, that the native-born white population is going to continue to shrink as a proportion of the population for the foreseeable future while minority populations continue to increase their share of the population.

Patterns of fertility and mortality do not exist in a vacuum but are a reflection of the demographic attributes of the population under study.

At the other end of the lifespan, mortality rates are influenced by demographics. Except in rare circumstances, individuals do not choose the time or cause of their deaths. If anything, it would be assumed that death is a somewhat unpredictable event and that mortality patterns are more a function of biological threats, environmental toxins and accidents among other causes that have little to do with either individual choice or demographic attributes. While the relationship between demographic attributes and mortality is not as clear cut as that for fertility patterns, the demographic characteristics of any population serve as reasonable predictors of both the level of mortality and the most common causes of death. In fact, the correlation between certain demographic attributes and the risk of death is so high that it is possible to calculate the odds of dying for any age group in U.S. society. Further, the cause of death for members of the particular age group can also be anticipated. As with fertility, membership in various demographic categories is associated with risk of death. We find, for example, that males are at much greater risk of death than females (and in every age cohort), that African-Americans are at much greater risk of death than whites, that members of poverty populations are at much greater risk of death than those in affluent groups and so forth. Because of these patterns, demographers are able to predict future mortality levels and the leading causes of death years in advance.

2.1.2 Demographics and Social Change

While the relationship between demographic attributes and demographic processes is fairly direct, there are also more indirect impacts of the population's demographic traits that may be less obvious. Being less obvious does not make them less significant, and it is probably safe to say that virtually every issue faced today by American society and even the world's population ultimately has demographic phenomena at its heart. The fact that the U.S. is facing challenges in funding the Social Security and Medicare programs in the future reflects the demographic fact that more people are living to a ripe old age than in the past. The impetus for the enactment of the Patient Protection and Affordable Care Act in 2010 was the growing population of uninsured citizens and the fact that thousands of Americans were dying every year due to a lack of health insurance. The fact that 2012 college graduates faced the worst job prospects of any recent cohort reflects a number of demographic trends: high rates of educational attainment, a changing job market (both in terms of total jobs and types of jobs), and immigration trends among others.

Beyond our borders international events are also driven by demographic phenomena. The high rate of immigration (especially illegal immigration) into the United States during the first decade of this century was driven by poor job prospects in sending countries and better job prospects in the U.S. At the same time, the significant drop in immigration during the first years of the second decade reflects the decline in available jobs in the U.S. These same factors are influencing worldwide immigration patterns. The transfer of jobs from developed countries to less-developed countries has significant implications for the populations on both ends of this process.

A couple of other examples should suffice to underscore the need to understand demographics if one is to interpret national and international events. Climate change has been increasingly in the news, and there is now conclusive evidence that human behavior is playing a major role in this phenomenon. A large part of the blame is placed on the economic activity of more industrialized nations. These activities are driven by demographically generated demand for energy and the goods that energy produces. In less developed parts of the world, a lot of the pressure on the environment is driven by a growing population which, based on numbers alone, requires ever increasing resources. Add to this the fact that the middle classes in many less-developed countries are growing at an unprecedented rate and this results in a perfect storm for exploiting the environment and inducing climate change. If human behavior is driving climate change, demographic change is driving that behavior.

A knowledge of demographics is important for an understanding of national and international developments, since most of these phenomena are driven by demographic trends.

One final international example involves the so-called “Arab Spring” that occurred late in the first decade of this century. During this period, “revolutions” took place in certain Middle Eastern countries, most notably in Egypt, Tunisia, Libya and Yemen and major disruptions occurred in others. Analysts have attributed the Arab Spring to clearly demographic roots. Demographers point out that the origins of this movement date back two decades when public health measures became widespread in Middle Eastern countries. These countries had historically suffered from high infant mortality rates, assuring that many infants would not survive into adulthood with a subsequent ceiling on population growth. With the introduction of public health measures, the infant mortality rate dropped precipitously. This resulted in a demographic “bulge” beginning 20 or 30 years ago. By the 21st century there was an “excess” of young adults in most Middle Eastern countries. Because there were limited jobs, the respective governments offered educational opportunities to youthful citizens. This resulted in a unprecedented young adult age cohort that was well educated and, further, had access to the Internet. Despite the resistance of various rulers, this demographic wave was able to swamp these recalcitrant politicians. Interestingly, as a footnote to the Arab Spring we now see significant societal disorganization in some of these countries that appeared to be moving toward democracy as various religious and ethnic factions (also demographic categories) vie for control of the respective governments.

The demographic perspective also provides a means for linking social groups to their environments. Virtually all demographic data are linked to some geographic unit thereby linking the population with the particular characteristics of that geography. Knowing that a population resides in the inner-city or the suburbs or a rural area has important implications for our understanding of that population and its attributes. Similarly, knowing that a population lives in an impoverished urban community rather than an affluent suburb, in single-family detached housing rather than high-density apartments, or in an isolated ethnic enclave rather than a diverse community also has implications for that population's characteristics. Segmenting a population on the basis of its geographic distribution, its type of community or its salient demographic features provides context for the future analysis of that population. This approach to understanding the population provides the basis for various types of spatial analyses.

The demographic perspective further emphasizes the importance of relationships between various demographic variables as well as other, non-demographic variables. As noted previously, many demographic variables are interrelated, and an understanding of these relationship allows for a deeper understanding of the nature of these populations. If one knows the income level for a particular population, it is possible to deduce a number of other attributes of that population, for example. Or, if one knows the age distribution of the population, an analyst can predict the types of health problems that members of that population will exhibit.

One final aspect of the demographic perspective is the emphasis placed on the ability to predict demographic characteristics and demographic trends. Demographers have advantages over those in many other disciplines for a couple of reasons. First, as indicated above, the interrelationships between demographic variables are such that it is no great leap to be able to project the future characteristics of a population based on known current characteristics. If one knows, for example, the current age and sex distribution for a population, it is possible to project the fertility and mortality patterns for that population ten or twenty years into the future. Of course, the analyst is making certain assumptions about fertility rates and mortality rates and, even more risky, about the behavior of individuals. Even so, such projections are often made and usually with surprising accuracy. If we add other variables, e.g., marital status, to the mix, the ability to predict future fertility levels is enhanced. The predictions could be further refined by profiling the population under study in terms of its racial makeup or socioeconomic status.

Demographers have an advantage when it comes to predicting the future in that they can anticipate future social change by observing current demographic trends.

One other way in which demographers have an edge over other researchers is by taking advantage of the natural aging process exhibited by a population. In the absence of high levels of in-migration or out-migration and with some knowledge of reproduction rates, it is possible to project the characteristics of a population into the future based on age distribution alone. For example, demographers can project the number of children entering kindergarten in five years because those children are already in the population (i.e., members of the population one year old or less). Similarly, demographers can project the number of youth entering college ten years from now because they know the number of eight-year-olds currently in the population. Or, demographers can project the number of new "senior citizens" that will be added to the population thirty years from now because they know how many 35-year-olds are currently in the population (as well as the number of those who are likely to die over the next 30 years). Although in each case the demographer has to make certain assumptions (e.g., college admission rates, mortality rates), the natural aging of the population allows the analyst to use "cohort analysis" to project the future characteristics of that population.

Fertility, mortality and migration are considered the primary demographic processes because of the role they play in shaping a population's attributes and driving population change.

2.2 Demographic Methods

2.2.1 Demographic Analysis

Demographic analysis is a technique used to develop an understanding of the age, sex, and racial composition of a population and how it has changed over time through the basic demographic processes of birth, death, and migration. Demographic analysis (usually abbreviated as DA) also refers to a specific set of techniques for developing national population estimates by age, sex, and race from administrative records to be used to assess the quality of the decennial census. Demographic analysis allows us to measure the dimensions and dynamics of populations.

2.2.2 Estimation and Projection

Demographers have long used population estimates and projections in the absence of actual data and a variety of techniques are utilized to generate estimates and projections. Population estimates for states, MSAs, and counties are prepared each year as a joint effort of the Census Bureau and the state agency designated by each state governor under the Federal-State Program for Local Population Estimates (FSCPE). The purpose of the program is to standardize data, and procedures so that the best quality estimates can be derived. Most states also generate population estimates and projections that are available through state agencies. However, these figures are often produced at irregular intervals, and thus may be quite dated. The reader is also encouraged to evaluate the quality of these data to the best of his or her ability. For additional information on population projections and estimates see Smith, Tayman, and Swanson (2000).

Population estimates and projections generated by government agencies have historically been the only ones available. Today, however, a number of data vendors provide these figures. These vendor-generated data are often made available down to small units of geography (e.g., the census tract) and in greater detail (e.g., sex and age breakdowns) than government-produced figures. They offer the flexibility to generate estimates and projections for "custom" geographies (e.g., a market area) not available for government-generated statistics. The drawback, of course, is that some precision is lost as one develops calculations for lower levels of geography and for population components. However, the ease of accessibility and timeliness of these vendor-generated figures have made them a mainstay for applied demography.

2.2.3 Standardization

Standardization is a method for adjusting mortality rates or other measures of vital processes for compositional factors that have an effect on those rates. For example, the number of deaths occurring in any year is a function of three components: health status, population size and demographic attributes (e.g., age). Since mortality rates are frequently used as indicators of health conditions, it is important to hold population size and age structure (and perhaps other attributes) constant when mortality rates are being constructed.

The calculation of rates addresses concerns over differences in population size and allows the analyst to compare the health status of two populations that are different demographically. The crude death rate (CDR), for example, may be used for this purpose. However, the CDR may be misleading since it is influenced by differences in the age structures of the populations in question. That is, areas with relatively young populations (and hence less risk of dying) are likely to report low death rates, while areas with relatively old populations (and greater risk of dying) are likely to report high death rates independent of the size of the respective populations. Thus, while age-specific death rates (ASDRs) are higher for all age cohorts in Mexico than in the United States, the CDR is lower in Mexico due to its very young age structure. For this reason, the unadjusted CDR is not a good measure for comparative purposes. It is possible to adjust or standardize rates in order to control for age structure and, often, other factors (e.g., race).

2.2.4 Cohort Analysis

Cohort analysis is a method used by demographers to describe an aggregate of individuals having in common a significant event in their life histories, such as year of birth (birth cohort) or year of marriage (marriage cohort). The concept of cohort is useful because occurrence rates of various forms of behavior are often influenced by the length of time elapsed since the event defining the cohort—*e.g.,* the rate of fertility is influenced by the event of marriage. The idea of cohorts is similar to that of generations, although some writers avoid the latter term because it also has other connotations.

Cohort analysis has been used most extensively in demography, especially in studies of fertility. When statistics show a rise in the total fertility rate over a given period, for example, cohort analysis may reveal that this results from a lowering of the cohort mean age of fertility rather than simply a rise in the cohort total fertility rate.

2.2.5 Spatial Analysis

Spatial analysis is a set of techniques for analyzing spatial data—that is data linked to particular geographic points. Since most demographic data are linked to a specific geography, this technique is frequently used by population scientists. Spatial statistics extends traditional statistics to support the analysis of geographic data. It includes techniques that describe the distribution of data in the geographic space (descriptive spatial statistics), analyze the spatial patterns of the data (spatial pattern analysis), identify and measure spatial relationships (spatial regression), and create a surface from sampled data (spatial interpolation, usually categorized as geostatistics). Software applications (geographic information systems) that implements spatial analysis techniques require access to both the locations of objects and their attributes.

2.2.6 Epidemiologic Analysis

Epidemiology is the study of patterns of disease occurrence and other health-related conditions in human populations and of the factors that influence these occurrences and conditions. Epidemiological studies are used to determine patterns of disease or disability across different populations, geographical areas and over time. Epidemiological studies relate observed differences in the morbidity or mortality to the spatial and temporal distribution of risk factors, lifestyles, genetic composition of groups, or occupational or environmental exposures. Analytic studies are used to test hypotheses related to epidemiological relationships.

Case Study 2.1: A Census of the Jewish Community

Representatives of the Jewish community in a medium-sized city felt that it was important that a census be conducted of their population in that community. On the one hand, there was some evidence that the size of the Jewish population was decreasing although there was little factual data to support this belief. On the other, the community was making plans for some capital investments and, at that point, was considering a facility to support the activities of the Jewish youth in the city. The organization sponsoring the project contracted with a political scientist and a demographer at a local college to conduct the census. Since it was intended to be a census rather than a sample survey, the researchers were asked to identify and profile to the extent possible all Jewish residents whether active in religious life or not.

The project represented a challenge for the researchers engaged for this project. While the sponsoring organization had the names and certain data on the families that were active in the Jewish community, they had virtually no information on those who were not. Thus, the major challenge for the census-takers was to identify and contact those residents with Jewish backgrounds that were not known to the sponsors of the survey. The researchers began by using city directories to identify any listed individuals who had the same name as those on the synagogue roles but were not on the active list. This generated an additional set of names for follow up. The most challenging part was identifying any other residents of Jewish derivation whose names were not included in the initial list. With the guidance of the sponsoring organization, the researchers developed a list of names that had a high probably of Jewish ethnicity. This list of names was used to scour city directories to identify other potential residents of Jewish ancestry.

The lists that were compiled through this process were used as the basis for the administration of a mail-out survey. Every household or unattached individual that was identified was sent a survey form that solicited basic information. The screening question related to whether or not the respondent was of Jewish ancestry and, once this was established, a series of additional questions elicited information on age, sex, family size and other information thought important by the sponsoring organization (including the types of social services desired). This approach turned out to be reasonably successful in that a number of individuals and families were identified that were not known to the mainstream Jewish community and few potential respondents were identified that were not Jewish. Obviously, an unknown number of people with Jewish backgrounds were not included but the sponsors were satisfied that virtually all of the population of interest was identified.

The researchers counted and profiled the Jewish population and developed what they felt was a reasonable approximation of the total population. The sponsoring organization did not anticipate what the census would reveal, and two major conclusions are discussed here. First, the Jewish population was much smaller than what conventional wisdom had suggested. The researchers calculated that the total population of those of Jewish heritage was 10,000. It is fair to say that many in the community were shocked by this figure. Second, the census revealed that there were very few children within this population, certainly many fewer than anyone had thought. The median age of the Jewish population was much higher than that of the total population, the proportion of senior citizens much higher, and the proportion of children much lower. The visibility of a number of large families that were active in the life of the community had apparently fostered the notion that the population was child heavy.

To the credit of the sponsoring organization, its leaders acknowledged the integrity of the census and accepted the findings. Further, they significantly revised their thinking with regard to the future emphasis of the community's social service programs. At the time of the survey, the organization had a major youth-oriented facility on the drawing board. Based on the results of the census, the organization's decision makers reversed direction and shifted to focus on newly identified needs of the Jewish population. Rather than building a center for youth recreation on the grounds of the Jewish Community Center, they instead build a high-rise facility for senior citizens.

Exercise 2.1: Identifying a Site for a Children's Toy Store

You have been engaged by the Toys-For-U chain to identify the best site for their next store in a particular state. The chain offers relatively high-end toys but not at the same level as the upscale stores found in major cities (e.g., FAO Schwarz, Build-a-Bear). Based on the information provided below, you must analyze the situation and rank the five potential sites in terms of their suitability for a new children's toy store. Be prepared to explain and justify your ranking.

	Population	Annualgrowth rate (%)	HH income	Children	(%) Children
Site 1	50,000	+5	$50,000	8000	16
Site 2	100,000	+5	$40,000	20,000	20
Site 3	100,000	+2	$20,000	25,000	25
Site 4	150,000	+2	$35,000	30,000	20
Site 5	200,000	−5	$30,000	40,000	20

Please rank these sites in terms of their potential for a Toys-For-U store:

Site 1: ____
Site 2: ____
Site 3: ____
Site 4: ____
Site 5: ____

Which factors did you think were most important in making your decision?

What criteria did you use in reaching your conclusions?

What relative importance did you place on growth rate, income and children (especially numbers vs. percentage)?

Given the upscale nature of the toys being offered, in what way did the median household income affect your decision?

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Chapter 3
Data Sources for Demography

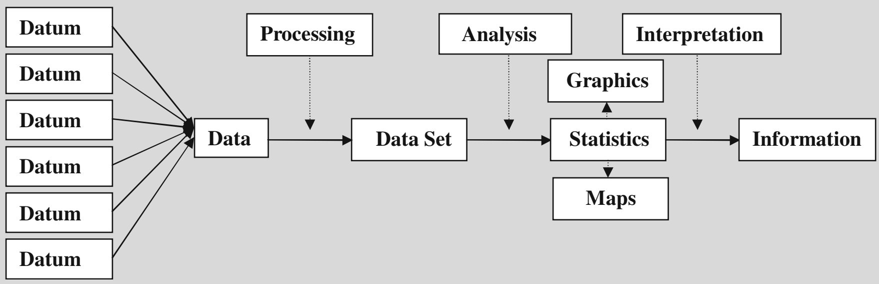
Abstract While all aspects of demography rely on data, applied demography employs a wider range of demographic data and data from other fields than do traditional demographic analyses. Understanding the nature, attributes and availability of relevant data is critical for the effective application of data to real-world problems. This chapter provides an overview of the types of data used by demographers and the sources of these data.

3.1 Introduction

The grist for the demographic mill is data, and virtually every demographic activity involves the examination of statistics for the population or topic under consideration. The purpose of this chapter is to identify and describe the broad range of data sets of use to demographers as well as others who are interested in population characteristics. While it is impossible to consider all possible types of demographic data and their sources, this article addresses the most important data resources available to demographers, the means through which the data are generated, and the ways in which the data can be accessed. Exhibit 3.1 describes the process through which raw data is converted into information for use by applied demographers.

R. K. Thomas, *Concepts, Methods and Practical Applications in Applied Demography*, https://doi.org/10.1007/978-3-319-65439-3_3

Exhibit 3.1: The Data Conversion Process



3.2 Demographic Data

Data represents the fuel for the demographic engine and virtually all demographic analyses are data heavy. An applied demographer must be familiar with various types of data, their characteristics and their sources and be something of a statistician. The following sections introduce the student to this important component of the demographic endeavor.

3.2.1 Data Types

Data utilized by demographers can take a variety of forms that include the following:

Raw data. Raw data represents the quantifiable attributes associated with any individual or group—e.g., the age of every student in a demography class. Each "record" (e.g., person, group) will have a series of attributes associated with it. Raw data by themselves are not very useful and need to be processed into "information" (as illustrated in the graphic above). Demographers conducting primary research generate raw data.

Statistics. Statistics are raw data that have been processed and subjected to some level of statistical analysis (that is, converted into information). Descriptive statistics provide a basic picture of the population (e.g., the age range and median age of the demography students) while inferential statistics examine relationships among various attributes of the population under study (e.g., the relationship between the age of students and political orientation).

Data sets. A data set is a collection of data in either raw or summary form. All of the attributes for all subjects (in raw data form) is one type of data set. The summarized data based on the raw data represents another type of data set (summary data). Data sets are typically utilized for analysis purposes when the demographer does not have access to the raw data.

Reports/Tables. Data presented in report or table form essentially represents a set of statistics. A table comparing the median age of students in all classes in the university would be presented in table form. Most secondary data is presented in table or report format.

Graphics/maps. Graphics (charts, graphs) and maps represent methods for displaying data although they may serve as the basis for analysis. Charts and graphs typically depict summary data (e.g., the proportion of students of each age in the class) but may depict the raw data (e.g., a scattergram of all ages). Maps depict the spatial (geographic) distribution of one or more attributes. Maps can typically display more information than charts and graphs and, by virtue of their link to geography, lend themselves to an examination of relationships between variables (e.g., the location of fast food restaurants relative to the distribution of the low-income population).

3.2.2 Using Demographic Data

There are a variety of ways in which demographers use data in applying their knowledge to the solution of real-world problems. It might be useful to think of this process as following a logical sequence from the initial enumeration of the population to the ultimate application of knowledge.

Counting. The first step in any demographic analysis involves counting the number of people within the population under study. The count is the first demographic fact and provides the basis for calculating a variety of other attributes.

Describing. Counting the population by itself does not provide adequate information for understanding the nature of that population. Data must be collected that describe that population in terms of its salient attributes (e.g., age distribution, racial makeup, income level).

Comparing. Numbers by themselves do not mean much unless you have some standard for comparison. Is the size of the population (e.g., 10,000 people) large or small? That depends on the standard for comparison. It is typical to compare figures for one population to another population (e.g., County A with County B) and/or compare the current population figure with a previous time period. These comparisons allow an assessment of the figure in question.

Explaining. The objective of the above steps is to allow the analyst to explain demographic phenomena that are observed within the environment under study. This is the point at which relationships between variables are identified and quantified. Thus, we can explain the declining fertility rate among the non-Hispanic white population by examining the fertility rate in relation to the population's median age. In short, non-Hispanic whites in the childbearing ages are aging out—that is, growing too old to have children.

Understanding. The identification of relationships provides the basis for interpreting the observed phenomena and developing an understanding of what is transpiring. This produces the "ah ha" moment when the meaning behind the statistics is revealed to the analyst. Based on the example above, we now understand not only *why* there are fewer births among non-Hispanic whites but why the non-Hispanic white population is shrinking as a proportion of the total population.

Predicting. The goal of any science is to be able to predict future developments and/or conditions. Much of the effort of applied demographers is directed toward predicting the size and characteristics of the population in the future. Demographers have a built-in advantage in this regard in that they can use cohort analysis to extrapolate into the future. If we know, for example, how many 55-year-olds there are in the U.S. population, we can predict how many people will be enrolling in Medicare ten years from now (minus a known attrition rate). Not only that, but we will know the characteristics of those enrolling in Medicare at that point.

Addressing. Finally, we get to the most applied aspect of applied demography. Based on all of the above steps in the analysis, what do we do with what we have found out? The knowledge that has been developed to this point can be disseminated in various ways to policy setters, lawmakers, and decision makers. It can be used to make recommendations to government agencies, private organizations and businesses. It can provide the basis for the development of new programs or the modification or elimination of existing initiatives. This is the point where the knowledge is applied directly to the resolution of real-world problems.

3.2.3 Data Timelines

While the first thought when profiling a population is to identify the current population attributes, demographers actually may consider three time periods when doing their analyses.

Past. Having data for past time periods allows the analyst to identify historical trends for the population in question. This supports comparisons over time and provides the basis for projections into the future. In demography, the past is typically (but not always) a valid basis for predicting the future.

Present. For most purposes, analysts determine the current demographic profile of a population. This is typically where the analysis begins and then works backward or forward depending on the objectives of the analysis. This “snapshot” of the current situation provides the basis for subsequent analyses.

Future. Given the importance of prediction in applied demography, most projects focus on the future. The goal is to formulate a picture of the future based on past and present data and assumptions about future developments. This activity may be as simple as predicting the number of first-graders in a school district five years from now or as complex as projecting the impact of global warming on the population of sub-Saharan Africa. The process is the same in any case, extrapolating past trends into the future.

3.3 The Importance of Geography

Virtually all demographic phenomena are linked to geography, and demographics data are invariably presented for some geographic unit (e.g., nation, state, city, census tract). This is particularly important given the fact stated above that virtually no phenomena (especially social phenomena) are randomly distributed. As noted, spatial relationships represent important information and provide the basis for much demographic and epidemiologic analysis. Geography defines the context in which demographic actors play out their roles.

A knowledge of geography is also important for demographers since different types of data are available for different geographies. This has significance for determining the geographic level at which an analysis will take place. Further, some geographic boundaries change over time (e.g., ZIP Codes, city limits, political districts), and these changes often have important implications for the reported data. (More detail on the geographic units utilized by demographers is presented in Chap. 4).

3.4 Data Collection Methods

The methods of data collection discussed below are divided into four general categories: censuses, registration systems, surveys, and synthetically-produced data. Censuses, registries, and surveys are the more traditional sources of demographic data, although synthetically produced statistics such as population estimates and projections have become standard tools for most planning, marketing and business development activities.

3.5 Census

A census involves a complete count of individuals (or entities) residing in a specific place at a specific time. The U.S. Census Bureau (within the Department of Commerce) has conducted population censuses since 1790. Subsequently expanded to the census of population and housing, it has been conducted every 10 years (in years that end in zero) since. Originally established as a means of determining the number of residents in each state for the purpose of allocating Congressional seats, the content of the census has expanded over time to include hundreds of additional data elements.

The expanded census was conducted through 2000 and included a short form administered to every household and a long form administered to one in six households. For the 2010 census the long form was discontinued and only the short form administered. The American Community Survey (ACS), described below, was instituted to replace the long form, with data collected via the ACS in 2010 used to supplement data collected via the short form. Exhibit 3.2 provides an overview of the 2010 census and discusses some of the issues surrounding its administration.

In order to assure a complete count of residents at the time of the census, the street address is used as the key locator. Using data provided by the U.S. Postal Service, the Census Bureau identifies every postal address in the country and uses this information as the basis for collecting data. For the majority of the population with a single permanent address this approach is effective, and most census forms today are returned by mail. However, there are exceptions that require additional effort on the part of the Census Bureau, the canvassing of migrant workers and homeless individuals for example. For those addresses for which no census form is returned, in-person interviews at the place of residence may be required.

By definition, a census includes a complete count of the population. However, it is increasingly difficult to strictly apply this term to the U.S. decennial census. While the census ostensibly counts every resident, it falls short of a true census in two respects. First, every decade a certain segment of the population is missed in the enumeration resulting in some level of undercount. While the undercount is typically less than 3%, its mere existence creates myriad problems. This undercount tends to be concentrated among certain segments of the population, resulting in overrepresentation of some groups and underrepresentation of others. This fact has important implications, since the results of the census are used as the basis for reallocating Congressional seats and allocating government funds. Because of the undercount, the initial release of census data every ten years produces a spate of lawsuits questioning the accuracy of the census. The controversy surrounding the undercount has only become more intense in view of the large number of undocumented residents entering the U.S. in recent years.

Exhibit 3.2: 2010 Census of Population

In 2010, the US Census Bureau administered the twenty-third decennial census. The 2010 data collection effort involved the mailing of questionnaires to every known household. Each household received a form with the ten core questions (the short form). Prior to the mailing of the questionnaires, postcards were mailed to every household to alert residents to the coming survey instrument. Included with the questionnaire were instructions for completing the form and an envelope for return mail. In addition to the mail-in option, Americans were given the option of completing the census questionnaire on line via the Internet. Other forms of the questionnaire are used for individuals with non-household living arrangements such as those living in group quarters.

The core questions in the 2010 census related to the information required for political redistricting purposes. These questions captured data on the age, sex, race/ethnicity and tenure of each household member as well as on the relationships of household members. This information was subsequently used nationally for the allocation of seats in the U.S. House of Representatives and, at the state level, for adjusting the boundaries of Congressional districts or drawing boundaries for new districts as appropriate. Information on the 2010 census and its implementation is available at www.census.gov.

In past censuses, a long form covering more than 50 topics was mailed to one in six households. That form was replaced for the 2010 census by the American Community Survey which collects data from a representative sample of households. (See Exhibit 3.3 for additional information on the American Community Survey).

The second factor diminishing the enumeration's value as a census is the fact that a large portion of the data on population characteristics is obtained from a random sample of the nation's households. In 2010, for example, only 10 questions were included on the short form that went to every household. The remaining data were obtained via the American Community Survey which involves a sample of 1 in 20 households. This small sample size means that detailed data are not as likely to be available for small geographic areas and that a large margin of error is generated. While the use of sampling significantly reduces the cost of taking a census and the ACS assures a steady flow of data between decennial censuses, it generates figures that some might assume (incorrectly) to represent complete counts.

The decennial census in the United States theoretically provides the most accurate enumeration of the population since it represents an attempt to include all residents. Because of certain shortcomings, however, the census count is supplemented by other sources of data today.

The decennial census today collects data on the number of persons residing in each living unit (e.g., house, duplex, apartment, and dormitory), their age, race/ethnicity and sex, and the relationship of those individuals to each other. On the ACS form, data are gathered on the age, race, ethnicity, marital status, income, occupation, education, employment status, and industry of employment for each resident. Questions related to the dwelling unit in which the respondent lives elicit information on the type of dwelling unit (e.g., apartment or duplex), ownership status, value of owned house, monthly rent, age of dwelling unit, and a number of other topics.

Statistics generated by virtue of the census are available for virtually every formally designated geographic unit in the United States. These statistics are disseminated for states, counties, zip codes, metropolitan areas, and cities. Statistics are also produced for specially designated areas created by the Census Bureau, including blocks, census tracts, block groups, and block numbering areas.

Very little of the results of the census are presented in print form today, although detailed data can be readily accessed via the Internet. The Census Bureau makes certain databases—referred to as summary tape files (STFs)—available to those who want to further analyze the data. These databases do not include raw data (i.e., individual records) from the census but preselected aggregations of data. Public use microdata samples (PUMS) do include raw data and are available from the 2010 census, stripped of any information that would identify individual respondents. PUMS files involve a sample of records from areas containing at least 100,000 persons.

After the 1980 census, many private data vendors began to acquire census data and sell repackaged data to the public. In fact, joint public-private projects were involved in converting census data to the ZIP Code level, a geographic unit with a great deal of utility for the business community. Private sector marketing of census data was even heavier after the 1990 census, with commercial data vendors providing population estimates and projections at the census tract level during the intercensal period. Case Study 3.1 describes the use of demographic data for political redistricting.

Case Study 3.1: Redistricting after the 2010 Census: Monterey County, California, Board of Supervisors

After each decennial U.S. Census, most jurisdictions are required to evaluate whether election districts meet the population equality requirement ("one person, one vote"). This is required not only of Congressional districts, but of any local entity that elects governing boards by district, including counties, cities, school districts, water districts, and other special districts. There is much redistricting activity after each decennial Census.

If the election districts adopted after the previous Census are not balanced using the new Census counts, they must be re-drawn. In addition to equalizing total populations, redistricting plans must meet Federal Voting Rights Act (FVRA) requirements. Among other things, the FVRA requires that members of certain protected groups, including Hispanics, be given the opportunity to elect representatives of their choice.

A demographic consultant was hired in 2011 to help the Monterey County, California, Board of Supervisors with its redistricting process. To ensure a fair and transparent process with as low a risk of litigation as possible, the Board appointed a citizens advisory committee to recommend a redistricting plan.[1] The consultant provided demographic support to the committee, and

[1]Many jurisdictions convene some sort of citizens' redistricting advisory committee to make recommendations to the governing board. In California, Proposition 11, passed in 2008, assigned the drawing of California's state and congressional election districts to a citizens committee. Such committees are charged with taking legal requirements into account, often along with placing priority on easily identifiable boundary lines and compact districts. If instructed to do so, they recommend plans with only one incumbent per election district (but sometimes are instructed to disregard incumbency altogether). Representatives of protected groups on these committees, in our experience, often advocate for the creation of election districts in which their groups can easily elect candidates of choice.

after several months of deliberation, the committee recommended a plan that made very minor modifications to the 2001 districting plan. Just two voting precincts were moved from one supervisorial district to another to equalize total populations.

Despite nearly unanimous support from the citizen's advisory committee and enthusiastic support from the Board of Supervisors, the City of Salinas (with more than one-third of the county's total population) objected to the redistricting plan. The county's plan divided Salinas among four supervisorial districts, and the city's leaders wished to be divided between only two. However, there is no legal prohibition on fragmenting large cities, so the city could not legally object to the plan on that basis. Instead, attorneys were hired by the city to support a plan that kept Salinas in two districts and featured more Hispanic-majority districts. It therefore became necessary to re-evaluate compliance with the FVRA under the county's and the city's plans, and the consultant implemented that evaluation.

The FVRA requires that districting plans allow members of protected groups that have large populations and are geographically compact, like Monterey County's Hispanics, to elect representatives of their choice. Court rulings on how to test whether this requirement is met have resulted in demographers' relying on several measures of ability to elect:

- Total population shares
- Voting age population (VAP) shares
- Citizen voting age population (CVAP) shares
- Registered voter shares
- Actual voter shares.

Figure 3.1 shows Monterey County's values and estimates for each measure. Note that in this case, the Hispanic share shrinks with each, increasingly restricted, measure. While Hispanics comprised 56% of the total county population, they comprised only 33% of those eligible to vote (CVAP) and 27% of actual voters. This means that it was rather challenging to create districting plans that potentially provided Hispanics the opportunity to elect representatives of their choice. In the consultant's experience working with many Monterey County jurisdictions since 1990, local Hispanic leaders generally preferred CVAP shares of 60% or more in order to offset Hispanics' low voter registration and turnout rates.

The County's plan created two Hispanic-majority election districts, with 63 and 65% Hispanic CVAP shares. The city of Salinas' plan created three districts, each with barely 50% Hispanic CVAP shares. The county argued that the city's plan was "retrogressive"; that is, Hispanics would have less opportunity to elect representatives than they had under the plan adopted in 2001. In the end, the county's "minimum change" plan was precleared by the U.S. Department of Justice (before the U.S. Supreme Court suspended Section 5 of the FVRA) and no lawsuit was filed by the city. Based on input

Category	Total	Hispanic	Hispanic share
Population, all ages*	405,087	225,627	56%
Voting age population (VAP)*	294,083	144,987	49%
Estimated citizen voting age population (CVAP)**	211,716	70,920	33%
Registered voters Nov 2008***	145,596	45,225	31%
Actual voters Nov 2008***	118,629	32,560	27%

* Census 2010 counts
**Based on American Community Survey 2005-2009 rates
***Totals from Monterey County Registrar of Voters, estimated Hispanic counts based on Spanish Surname estimates

Fig. 3.1 Categories used to evaluate districting plans, all of Monterey County, in 2011

from the demographic consultant, a satisfactory arrangement with regard to redistricting was achieved[2].

Source Gobalet, J., and S. Lapkoff, Lapkoff & Gobalet Demographic Research, Inc., www.demographers.com.

3.6 Economic Census

In addition to counting people, the Census Bureau also counts businesses. Economic censuses can be traced back to the early nineteenth century, although it was not until 1929 that continuous data gathering for a broad range of business entities was begun. The modern economic census was initiated in 1954 and is conducted every five years (currently in years ending in 2 and 7). The census covers businesses engaged in retail trade, wholesale trade, service activities, mineral industries, transportation, construction, manufacturing, and agriculture, as well as government services. The information collected through the economic census includes data on sales, employment, and payroll, along with other, more specialized data. These data are available for a variety of geographic units, including states, metropolitan areas, counties, and incorporated places of 2500 or more population.

Every business is classified using the North American Industrial Classification system (NAIC). The assigned NAIC code allows businesses to be grouped into standard categories for statistical purposes. Aggregated information on businesses within the NAIC categories is available at the county level with distribution primarily through the Internet. For example, for a particular U.S. county the 2007 economic census found 1740 physician offices with 16,176 employees and payrolls of $2.6

[2]Shelby County vs. Holder, 570 U.S. 2 (2013).

billion, 234 chiropractic offices with 994 employees and payrolls of $33 million, and 122 medical laboratories with 1772 employees and payrolls of over $92 million.

3.7 Registration Systems

A second method of data collection that generates information for demographers is represented by registration systems. A registration system involves the systematic compilation, recording, and reporting of a set of events, institutions, or individuals. The implied characteristics of a registry include the regular and timely recording of the phenomenon in question. Most registration systems relevant to this discussion are maintained by some branch of government, although other sponsors of registration systems exist as well.

For demographers the best-known registration activities in the United States are those related to "vital events", such as births, deaths, marriages, and divorces. The most extensive registration systems are maintained by the National Center for Health Statistics and the Centers for Disease Control and Prevention (CDC). Other useful systems are maintained by the Social Security Administration (SSA), the Centers for Medicare and Medicaid Services (CMS), and Immigration and Customs Enforcement (ICE). Lists maintained on members by trade groups and professional associations (such as the American Medical Association and the American Hospital Association) are placed in this category because such lists have many of the characteristics of registries.

A variation on registration systems increasingly deployed by demographers involves administrative records. Administrative records systems are not necessarily intended to be registries of all enrollees or members of a group of events, organizations, or individuals but to provide a record of the transactions of those included with that group. Thus, the list of all Medicare beneficiaries (enrollees) would constitute a registry but the data generated by virtue of the beneficiaries encounters with the healthcare system would be considered administrative records (since not all beneficiaries would use services during a given time period).

Administrative records can serve a useful function to the extent that they provide access to sources of data not otherwise available. However, unlike other forms of data generation such as censuses and surveys, the raw data are not strictly under the control of those who establish the data file. Administrative records may be submitted by a variety of parties, creating inherent problems in data quality and standardization. A great deal of effort is currently being expended to improve the accessibility of data maintained by federal agencies. For example, Medicare data on the number of current enrollees are now available for all U.S. counties, as are year-to-year migration data from the Internal Revenue Service. The Census Bureau is exploring the use of registries and administrative records as sources of data to supplement its traditional data gathering activities.

3.7.1 Vital Statistics

As noted above, vital statistics include data on births, deaths, marriages, and divorces. The collection of vital data has a long history in the United States, predating the Declaration of Independence by many years. The collection of data on vital events is initially the responsibility of local government (i.e., city or county government). A local court clerk's office is responsible for the recording of marriages and divorces, while the local health department is the primary collector of birth and death statistics. Data collected at the local level are forwarded to the appropriate vital statistic registry within the respective state governments. The state agency compiles the data from the various localities and subsequently transfers the data (in the case of births and deaths) to the National Center for Health Statistics (NCHS). The NCHS has responsibility for compiling and publishing vital statistics for the nation and its various political subdivisions.

A standard birth certificate is used in the United States to collect data on the time and date of birth, place of occurrence and the mother's residence, birth weight, pregnancy complications, mother's pregnancy history, mother's and father's age and race/ethnicity, and mother's education and marital status. Information gathered on the standard death certificate includes age, race/ethnicity, sex, place of residence, usual occupation, and industry of the decedent, along with the location where the death took place. In addition, data are collected on the immediate and secondary causes of death, as well as on any other significant conditions. A separate certificate is used for fetal deaths. There is some variation in the content of birth and death certificates from state to state, although there are certain data elements that are always collected.

Birth and death statistics are traditionally available in government publications and increasingly electronically via the internet. The compiled statistics are typically presented for both the place of occurrence of the vital event (e.g., the location of the hospital) and the place of residence of the effected individual. Considerable detail is provided by the NCHS for a wide range of geographic units including states, metropolitan statistical areas (MSAs), counties, and urban places. Data for other geographic areas may be available through state and local governmental agencies. Yearly summary reports are produced and published by the National Center for Health Statistics, and periodic updates are available through the monthly vital statistics reports. Local and state health departments are increasingly making birth and death statistics available on line.

Marriage and divorce registration areas (MRAs and DRAs) are established using the same criteria as birth and death registration systems. Standard data collected on the marriage certificate includes age of spouses, type of ceremony (civil or religious), and previous marital status of spouses, as well as race and educational status of the bride and groom. The data available on marriages and divorces varies from state to state and, since the NCHS discontinued its marriage and divorce registries, there is no nationwide system for aggregating marriage and divorce data.

3.7.2 *Immigration Data*

Data on immigration patterns and the characteristics of immigrants historically have been of interest to demographers because of the implications of these phenomena for population change. Today, however, data on immigration are of increasing interest due to the growth of illegal immigration and concerns over the impact of immigration on other demographic processes and attributes. Monitoring international migration is a responsibility of the federal government, and the agency responsible for monitoring and reporting on immigration trends is the Immigration and Customs Enforcement (ICE) agency, formerly the Immigration and Naturalization Service (INS), now within the Department of Homeland Security. Data are collected related to legalization applications, refugees, asylum applicants, nonimmigrant entries, naturalizations, and enforcement activities and made available by means of published reports and the Internet. Because of the increase in illegal immigration, a growing amount of data is generated as a result of border monitoring and internal police activities. Annual estimates of illegal immigration are generated by ICE. Additional data on immigration can be obtained from www.ice.gov.

Data on visas issued is maintained by the Department of State, and data on immigrant visas are available on everyone legally entering the United States. After a person is admitted to this country, visa and adjustment forms are forwarded to the ICE data-capture facility for processing. Information collected includes port of admission, country of birth, last residence, nationality, age, sex, occupation, and the ZIP Code of the immigrant‘s intended residence.

Data on immigration are made available through yearly statistical summaries, more frequent shorter reports, and via the Internet. While the published reports contain data for states and MSAs, tabulations by county and zip code are possible by accessing ICE data files.

3.8 Surveys

A sample survey involves the administration of an interview form to a portion of a target population that has been systematically selected. The sample is designed so that the respondents are representative of the population being examined. This allows conclusions to be drawn for the total population based on the data collected from a sample.

The use of sample surveys has several advantages relative to the census and registry methods. Two of the major advantages are more frequent data collection and the ability to probe more deeply into the subject under study. The relatively small sample sizes for such surveys have the additional advantages of quicker turnaround time and easier manipulation than large-scale operations such as the census.

On the other hand, surveys have their disadvantages. Since they involve a sample, figures generated are estimates resulting in some slippage in accuracy relative to censuses. Other potential problems include interviewer bias, misinterpretation of survey items or inaccurate or dishonest responses on the part of respondents. Perhaps the most serious shortcoming related to demographic analysis is the inability to compile adequate data for small geographic units due to small sample sizes.

Much of what demographers know about the demographic attributes of a population is based on sample surveys conducted by various government agencies, research institutes and private vendors.

The federal government is the major source of survey data related to a variety of topics. Through various agencies, the federal government administers a number of ongoing surveys that involve information of interest to demographers. The National Institutes of Health and the Centers for Disease Control and Prevention conduct surveys that generate data of interest to health demographers. The Census Bureau conducts surveys related to population characteristics, housing and economic trends. The Department of Labor conducts surveys related to employment, occupational trends and so forth.

As previously noted, the American Community Survey (ACS) was introduced by the Census Bureau as a replacement for the long-form data collection instrument for the decennial census. Increasingly, demographers and others have come to rely on data from the ACS for a wide variety of uses despite the shortcomings of this survey. Exhibit 3.3 presents information on the ACS.

A number of private organizations also conduct surveys of interest to demographers. There are research institutes and "think tanks" that collect data on reproductive practices, immigrant characteristics, consumer behavior patterns and other topics. The results of these surveys are typically not available for levels of geography below the nation, although some may generate state-level data. Demographic-oriented organizations like the Population Reference Bureau may also conduct surveys, although they typically repackage data from other surveys.

Commercial data vendors also conduct surveys that contain data useful to demographers. Various surveys are conducted on consumer behavior and these invariably have information on the demographics of respondents. At least two vendors conduct national surveys annually on health-related characteristics and health behavior. Other data vendors may extract health-related data from national syndicated surveys and package this information with their demographic data. Some of these data sets are considered proprietary and generally are only available to established clients. Other data may be available for sale to the public.

Exhibit 3.3: The American Community Survey

The American Community Survey (ACS) is an ongoing survey that collects data every year on most U.S. communities. The ACS includes 69 questions on topics such as income, household expenses, employment, education, and work commutes. With full implementation in 2005, the sample included 3 million addresses throughout the U.S. and another 36,000 in Puerto Rico. In 2006, approximately 20,000 group quarters were added to the ACS database. Approximately 250,000 interviews are conducted each month with some 2.5% of the population administered the ACS in any given year.

Unlike the decennial census, the ACS involves continuous measurement of the topics under study. Continuous measurement has long been viewed as a possible alternative method for collecting detailed information on the characteristics of population and housing; however, it was not considered a practical alternative to the decennial census long form until the early 1990s. At that time, demands for current, nationally consistent data from a wide variety of users led federal government policymakers to consider the feasibility of collecting social, economic, and housing data continuously throughout the decade. The benefits of providing current data, along with the anticipated cost savings from a scaled-back census and more efficient operations, led the Census Bureau to plan the implementation of what came to be called the American Community Survey (ACS).

The following criteria were considered important for an effective on-going survey:

- Data would be collected continuously by using independent monthly samples.
- Three modes of data collection would be used: mail-out, telephone non-response follow-up, and personal visit non-response follow-up.
- The survey reference date for establishing housing unit occupancy status and for many characteristics would be the day the data were collected. Certain data items would refer to a longer reference period (for example, "last week," or "past 12 months").
- The survey's estimates would be controlled to intercensal population and housing estimates.
- All estimates would be produced by aggregating data collected in the monthly surveys over a period of time so that they would be reported annually based on the calendar year.

Data generated by the ACS are presented for various levels of census geography, with the lowest level being the census block group. Since the sample is not large enough to produce accurate estimates for all geographies in any particular year, the results of the ACS are published in three temporal versions: 1-year data, combined 3-year data, and combined 5-year data. The more years that are combined the greater the sample size and the more reliable the estimates.. For larger geographies, one year of data may suffice but more often than not a smaller community or lower level of geography will necessitate the combining of years. Combined data, of course, have the disadvantage of representing different time periods, sometimes combining data separated by four years in time.

While the ACS does not have the statistical power of the one-in-six household long form used by the Census Bureau in the past and demographic purists raise some issues with the methodology, the benefit of having continuous data collection outweighs any drawbacks. The most direct way to access data from the American Community Survey is through the "American Factfinder" function on the Census Bureau website accessed at www.census.gov.

3.9 Synthetic Data

Synthetic data refers to statistics that are produced in the absence of actual data using models that simulate reality. Synthetic data are generated by merging existing demographic data with assumptions about population change to produce estimates, projections, and forecasts. These data are particularly valuable given that census and survey activities are constricted because of budgeting and time considerations. Further, there are situations in which no actual data are available for a particular population, geographic unit or time period. Consequently, there is a large and growing demand for information between years when data are actually collected. This demand is being met by government agencies and commercial data vendors, with private data vendors generally providing more detail and data for smaller geographic units than government agencies.

Demographers have long used population estimates and projections in the absence of actual data, and a variety of techniques are utilized to generate estimates and projections. Population estimates for states, MSAs, and counties are prepared each year as a joint effort of the Census Bureau and the state agency designated by each state governor under the Federal-State Program for Local Population Estimates (FSCPE). The purpose of the program is to standardize data and procedures so that the best quality estimates can be derived. Most states also generate population estimates and projections that are available through state agencies. However, these figures are often produced at irregular intervals, and thus may be quite dated. The reader is also encouraged to evaluate the quality of these data to the best of his or her ability. For additional information on population projections and estimates see Smith, Tayman, & Swanson, (2002).

In situations where the required demographic data are not available it may be necessary to generate "synthetic data" by means of estimates and projections.

Population estimates and projections generated by government agencies have historically been the only ones available. Today, however, a number of data vendors provide these figures. These vendor-generated data are often made available down to small units of geography (e.g., the census tract) and in greater detail (e.g., sex and age breakdowns) than government-produced figures. They offer the ability to generate estimates and projections for "custom" geographies (e.g., for a market area) not available for government-generated statistics. The drawback, of course, is that some precision is lost as one develops calculations for lower levels of geography and for subsets of the population. However, the ease of accessibility and timeliness of these vendor-generated figures have made them a mainstay for those requiring demographic data for various levels of geography.

Issues have been raised concerning the quality of the synthetic data produced by both government agencies and commercial data vendors. Data users typically need the latest information possible, and in an effort to be expedient the question of quality sometimes has become a secondary concern. Any evaluation of the quality of synthetic data requires an understanding of the currency and quality of the historical data being used as a basis for the estimates and projections. Furthermore, attention must be paid to the methods and assumptions utilized to generate the figures. If, for example, one assumes that population growth in an area is gradual and can be described by a simple mathematical function, population estimates and projections will be reasonably accurate as long as the assumptions hold. However, to the extent that an assumption is wrong, the (incorrect) mathematical function will yield inaccurate estimates and projections. While it is not possible to be aware of all the nuances of data quality and method, users are urged to evaluate underlying assumptions critically and to ascertain the accuracy of the synthetic data that are available. (Additional information on estimates and projections is provided in Chap. 9).

3.10 Sources of Data for Demographers

There are numerous sources of demographic data available today and the number of sources continues to grow. The sections below group these sources into four main categories: government agencies, professional associations, private organizations, and commercial data vendors.

It should be noted that the "products" available from these sources fall into two categories: (1) reports that summarize the data and (2) the actual data sets themselves. Historically, data access was essentially limited to summary tables provided by the organization, agency or vendor. Today, however, there is a trend toward providing the entire data set for use by planners and other data users. In reviewing the sources that follow, this distinction in format should be kept in mind. Exhibit 3.4 specifies sources of specific categories of data.

3.10.1 Government Agencies

Governments at all levels are involved in the generation, compilation, manipulation and/or dissemination of demographic data. The federal government, through the decennial census and related activities, is the world's largest processor of demographic data. Other federal agencies are major managers of data for the related topics of fertility, morbidity, mortality, employment and occupations, and migration. Various federal agencies compile and/or generate data of interest to demographers and often facilitate the dissemination of such data.

State and local governments are also major sources of data useful to demographers. State governments generate a certain amount of demographic data, with each state having a state data center for demographic projections. Vital statistics data can often be obtained in the most timely fashion at the state level, in fact. States vary, however, in the types and quality of data they generate. University data centers may also be involved in the processing of demographic data. Local governments may generate demographic data for use in various planning functions. City and county governments may produce population projections, while county health departments are responsible for the collection and dissemination of vital statistics data.

3.10.2 Professional Associations

In recent years, many professional associations have made an increasing amount of information on their members available to the research and business communities. Not only do such organizations have an interest in exchanging information with related groups, but they also have recognized the revenue generation potential of such databases. Some of the databases provide by professional associations include only basic information, while others offer a wealth of detail. In addition, some professional associations may conduct surveys or otherwise compile industry data that may be useful to demographers.

3.10.3 Private Organizations

Many private organizations (mostly not-for-profit) collect and/or disseminate demographic data. Voluntary associations often compile, repackage and/or disseminate such data. The American Cancer Society, for example, distributes morbidity and mortality data as it relates to its areas of interest. Some organizations, like Planned Parenthood, may commission special studies on fertility or related issues and subsequently publish this information.

Many organizations repackage data collected elsewhere (e.g., from the Census Bureau or the National Center for Health Statistics) and present it within a specialized context. The Population Reference Bureau, a private not-for-profit research institute, distributes population statistics in various forms, for example. Some, like the American Association of Retired Persons (AARP), not only compile and disseminate secondary data but are actively involved in primary data collection, as well as the sponsorship of numerous studies that include some form of data collection.

3.10.4 Commercial Data Vendors

Commercial data vendors represent a fourth category of sources of demographic databases. These organizations have emerged to fill perceived gaps in the availability of various categories of data. These include commercial data vendors that establish and maintain their own proprietary databases, as well as those that reprocess and/or repackage existing data. For example, there are vendors that maintain databases that make this information available in a variety of forms. Major data vendors that do not necessarily create databases may incorporate demographic data into their business database systems. Some data vendors conduct major nationwide health consumer surveys. Some researchers have raised questions with regard to the quality of data produced by commercial vendors and with the lack of oversight related to confidentiality (Swanson, 2013).

3.11 Future Prospects for Demographic Data

The success of the demographic enterprise depends on the availability of accurate, timely and detailed data. Fortunately, the sources of demographic data have become more plentiful and more accessible over time. Various federal agencies post data in various forms on the Internet and make information available in a variety of formats (usually electronic today with few print reports now being generated).

The use of the American Community Survey for the collection of data originally collected through the decennial census relies on a smaller sample of the population than the one-in-six-household long form from the census, but the more frequent data collection improves the timeliness if not the accuracy of the data. It is anticipated that the Census Bureau will take advantage of non-census sources of data in the future, accessing data from other federal agencies (e.g., Social Security, Medicare files) and interfacing with non-government databases. It is also anticipated that use of sophisticated modeling techniques will become more common in an effort to close associated with gaps in traditional data collection techniques.

The acquisition of accurate, timely and detailed demographic data will continue to be a challenge. Various federal initiatives encourage more data sharing, and over time better access to data is anticipated. Here, too, data modeling will be increasingly important since the most common types of data related to many areas of interest to demographers are never going to be compiled in any but very incomplete data sets. Persistent gaps in key data elements will require greater emphasis on modeling techniques for the generation of demographic data. Geographic information systems are expected to find an increasing range of applications in demography. Exhibit 3.4 summarizes the various sources for different categories of demographic data.

Exhibit 3.4: Selected Sources of Demographic Data

Information category	Source
Population data	
Size	ACS, Census, CPS, Vendors
Characteristics	ACS, Census, CPS, Vendors
Estimates and projections	Census, CPS, Vendors
Vital statistics	
Births	NCHS
Deaths	NCHS
Marriages	NCHS
Divorces	NCHS
Legal induced abortion	NCHS
Fertility	NCHS
Mortality	NCHS
Migration data	
Internal migration	ACS, Census, CPS, IRS
Immigration	ICE
Morbidity data	
Disease surveillance	CDC
Incidence/prevalence	NCHS
Health status	NCHS
Health risks	NCHS, BRFSS

Legend:
ACS = American Community Survey
BRFSS = Behavioral Risk Factor Surveillance System
Census = Decennial census
CDC = Centers for Disease Control and Prevention
CPS = Current Population Survey
ICE = Immigration and Customs Enforcement
IRS = Internal Revenue Service
NCHS = National Center for Health Statistics

Exercise 3.1: Data Available from the Census Bureau
The U.S. Census Bureau is the largest data collection organization in the world. Much of the data collected by this federal agency is useful for applied demography. A large portion of the data is collected through the decennial census and through the on-going American Community Survey. However, there are a number of other surveys administered by the Census Bureau of relevance to demographers. There are also registration systems and other means of tracking data utilized by the Bureau.

For this exercise, students should access www.census.gov and spend some time perusing the site and familiarizing themselves with the types of data that are available. Then, each student should compile a list of the various data elements that are available to allow them to develop an in-depth profile of their respective communities. Much of this will be the types of demographic data discussed this chapter. However, it is impossible to describe all of the data available, so students should develop a list of all of the types of data that might be useful in proofing a community.

References

Source: Gobalet, J., and S. Lapkoff, Lapkoff & Gobalet Demographic Research, Inc., www.demographers.com. Unpublished case study.

Smith, S. K., Tayman, J., & Swanson, D. A. (2002). State and local population projections: Methodology and analysis. *European Journal of Population, 18*(3), 303–305.

Swanson, D. (2013). Consumer demographics: Welcome to the dark side of statistics. *Radical Statistics, 108,* 38–46.

Additional Resources

Bureau of Labor Statistics (Department of Labor) website: www.bls.gov.

Census Bureau (Department of Commerce) website: www.census.gov.

Centers for Disease Control and Prevention (Department of Health and Human Services) website: www.cdc.gov.

ESRI website: www.esri.gov (for GIS applications to demography).

Immigration and Customs Enforcement (Department of Justice) website: www.ice.gov.

National Center for Health Statistics (Department of Health and Human Services) website: www.cdc.gov/nchs.

United States government statistical website: www.fedstats.gov.

Wombold, Lynn (2008). "Sample Size Matters: Caveats for Users of ACS Tabulations," *ArcUser* (Winter).

Chapter 4
Population Size, Distribution and Concentration

Abstract The size of a population is typically the first demographic fact that a demographer would obtain for an area or population under study. In addition to population size it is important to consider the manner in which this population is distributed throughout the geographic area and to discern patterns of concentration or dispersion. In addition to examining population size, distribution and concentration, this chapter describes the various geographic units and the various community types considered in demographic analyses.

4.1 Introduction

The size of a population within a geographic area—typically measured in terms of the number of people—is the simplest and most straightforward of demographic attributes. And, for many purposes, it is the most important. Not only is the size of a population important in its own right but many of the calculations utilized in generating demographic measures depend on this information. After size, the pattern of distribution and concentration of persons within geographic areas are probably next in importance for anyone examining the interface of demographics and other population attributes.

Demographers generally begin telling the "demographic story" about a population by presenting information on its size in very basic terms. Significant population increases (or decreases) often make the headlines and, when the census of population is conducted every ten years, reports on population gains and losses are eagerly awaited since a primary (and legally mandated) function of the census count is to determine Congressional representation. The significance of population size for the various states is demonstrated by the fact that, after the 2010 census, one state (Texas) gained four Congressional representatives and one state (Florida) gained two additional Congressional seats. On the other hand, eight states (Illinois, Iowa, Louisiana, Massachusetts, Michigan, Missouri, New Jersey, and Pennsylvania) lost one seat, and two states (New York and Ohio) lost two seats. Data on the size and location of the population also provide the basis for descriptive statistics such as rates and ratios.

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Size is typically the first demographic "fact" obtained for a population, with the size of the population revealing a lot about the characteristics of the population and providing the basis for the calculation of a number of demographic measures.

4.2 Defining and Measuring Size, Distribution and Concentration

4.2.1 Population Size

The first demographic "fact" usually employed in describing a population is its size. Size is typically measured in terms of the number of individuals who reside within a defined geography at a specified time. The size of a population is an important consideration with regard to virtually every issue to be addressed, with size having significant implications for the population's social structure and concomitant demographic attributes. The fact that the United States has a population of over 300 million individuals has important national and international implications, as does the fact that Denmark has a population of less than 6 million residents (and is, thus, smaller than 17 U.S. states). The size of a population determines the level of need for various services and influences population dynamics.

While size is typically measured in terms of the number of individuals within a population in contemporary developed societies, the individual is not the only unit that might be considered. The size of a population might be determined based on the number of households or families for example. In societies that emphasize communal life and deemphasize the individual, they may see the world as made up of families rather than individual people. Other societies may see the household (which may or may not correspond with the number of families) as the unit for measurement. While measuring size in terms of individual group members is technically the most accurate method, the perspectives of other cultures with regard to their "demographic map" should not be ignored.

The most complete count of a population is performed by means of a census. As noted in Chap. 3, a census involves an attempt to count (and describe) each individual "officially" residing in the country (or other geographic area) at a particular point in time. In the U.S., a census is conducted every ten years, with the 2010 census being the more recent. (More detail on the decennial census is provided in Chap. 3.) Censuses at different times and different places vary in the types of data collected, but all attempt to enumerate every resident.

Data collection for census purposes in the U.S. is keyed to individual street addresses (provided by the United States Postal Service in the runup to the census). This address represents the "living unit" for enumeration purposes. For individuals who live in group quarters such as a nursing home, college dormitory or prison, the institution would be identified for enumeration purposes (although ultimately related to a physical address). Data from individual living units collected via the census are associated with a specific geographic area with the data subsequently aggregated by the Census Bureau to various levels of geography.

Demographers and other users of census data are typically not interested in data on specific individuals and households (and, indeed, this information is not made available). Information on individuals is aggregated up to various levels of geography, with the smallest reported unit being the census block and the largest the United States as a whole. As demonstrated below there are various levels of aggregation that occur between the smallest and largest units, and the level of aggregation most suitable for a particular analysis depends on the circumstances.

The decennial census elicits information from the entire population for basic demographic variables while the American Community Survey collects detailed data for years in between censuses.

Several issues must be addressed in the counting of the population. The first concerns which individuals are to be counted. Censuses are designed to count every individual residing within the nation regardless of their legal status. There has not always been total agreement, however, as to who is a resident of the U.S. and, thus, eligible to be counted. In the early days of the census, there was debate at various times over whether to count children, women, slaves and American Indians. Today, with the increase in undocumented immigrants, new questions have emerged with regard to the counting of that population. The Census Bureau has established rules that determine who is eligible for enumeration. So, for example, U.S. military personnel and diplomats stationed abroad are counted as U.S. residents while foreign tourists visiting in the U.S. on census day are not.

The assigned location of individuals in terms of geography is also of concern, with people generally counted at their usual place of residence. Since the place of residence is defined as the location where the individual usually sleeps and eats, the usual place of residence is easy to establish for the vast majority of the population (and the postal address thus used as the basis for the census enumeration process). Definitional complications may arise, however, for subpopulations such as college students, migrant workers, persons with two or more residences and the homeless. While college students are typically assigned to the location of their educational institution, the determination of usual residence for the remaining groups involves the application of specific rules, enumerator judgment, and special counting attempts (e.g., visiting rescue missions to count the homeless).

A further distinction between an individual's usual place of residence (nighttime) and his workplace location (daytime) is important. The downtown areas and industrial complexes of many U.S. cities teem with people during working hours only to become virtual ghost towns in the evening. The opposite is often true for residential areas. For some purposes, information on the location of the daytime population may be more useful than information on one's place of residence. Locational decisions relating to medical emergency facilities, vehicles, and staffing, for example, require a sensitivity to differentials in daytime and nighttime populations as does disaster planning. The ability to provide at least minimal services to all parts of the community requires either a count or an estimate of these distinct populations. Estimates of the daytime population for a geographic area can be estimated using such information as commuting patterns (e.g., from the American Community Survey) and commercial concentrations (e.g., from the Census Bureau's economic survey).

4.2.2 Population Distribution

While the size of a population is an important consideration, the manner in which that population is distributed within a geographic area is equally important. It is one thing to know that the United States has a population of over 300 million residents, it is another to realize that these residents are unequally distributed throughout the country's various regions, states and communities. An understanding of the population's spatial distribution is important since both population characteristics and demographic processes are likely to be affected by distribution patterns.

One way of measuring population distribution is in terms of the proportion of the total population living in specified geographic areas and subareas. For example, the nation's 310 million residents in 2010 are unevenly distributed among the various states. The *numbers* of residents reported for each state is useful information but for many purposes it may be beneficial to think in terms of the *proportion* of the population accounted for by the respective states. It is one thing to understand that California contained more than 37 million residents, but this takes on more meaning when it is realized that these residents account for approximately 12% of the country's population. The numerical and percentage distributions for the various states are presented in Exhibit 4.1.

Examining the total population can be complicated enough when distribution is considered but, typically, researchers analyzing population distribution are going to be interested in the distribution of subpopulations based on demographic attributes (e.g., various racial or ethnic groups, poverty populations, age cohorts, etc.). The distributions of these subgroups are likely to differ in some cases significantly from the distribution of the general population. Thus, a health demographer studying the distribution of the poverty population across the U.S. will find a geographic distribution much different from that of the population as a whole.

> *While the size of a population is an important statistic, an examination of the distribution of this population within its geographic area provides additional information.*

Measures of population distribution assume both accurate population counts and relatively stable geographic boundaries. The proportion of the population associated with a subarea can only be successfully calculated if the population figures for the subarea and the total population are reasonably accurate. Similarly, the proportion allocated to a particular geography can only be consistently determined if the boundaries remain constant. Thus, year-to-year state population estimates are not likely to be problematic since there are virtually never any changes in state boundaries. On the other hand, it is not unusual for the U.S. Postal Service to modify ZIP Code boundaries in response to service demands. This means the number and proportion of residents allocated to a particular ZIP Code could change over time. Similarly, cities may modify their boundaries over time while the boundaries for metropolitan statistical areas may expand through the addition of counties. These types of boundary changes make tracking changes from one period of time to another a challenge (illustrated in Case Study 4.1).

Exhibit 4.1: U.S. Population Distribution by State April 1, 2010

Alabama	4,779,736	Montana	989,415
Alaska	710,231	Nebraska	1,826,341
Arizona	6,392,017	Nevada	2,700,551
Arkansas	2,915,918	New Hampshire	1,316,470
California	37,253,951	New Jersey	8,791,884
Colorado	5,029,196	New Mexico	2,059,179
Connecticut	3,405,565	New York	19,378,102
Delaware	897,934	North Carolina	9,535,483
District of Columbia	601,723	North Dakota	672,591
Florida	18,801,310	Ohio	11,536,504
Georgia	9,687,653	Oklahoma	3,751,351
Hawaii	1,360,301	Oregon	3,831,074
Idaho	1,567,582	Pennsylvania	12,702,379
Illinois	12,830,632	Rhode Island	1,052,267
Indiana	6,483,802	South Carolina	4,625,364
Iowa	3,046,355	South Dakota	814,180
Kansas	2,853,118	Tennessee	6,346,105
Kentucky	4,339,367	Texas	25,145,561
Louisiana	4,533,372	Utah	2,763,885
Maine	1,328,361	Vermont	625,741
Maryland	5,773,552	Virginia	8,001,024
Massachusetts	6,547,629	Washington	6,724,540
Michigan	9,883,640	West Virginia	1,852,994
Minnesota	5,303,925	Wisconsin	5,686,986
Mississippi	2,962,297	Wyoming	563,626
Missouri	5,908,927		

Source U.S. Census Bureau

A variety of different geographic units are used by demographers in their examination of population distribution. These units may be as small as a census block or as large as a nation. They may be in easily recognized hierarchies that divide the nation into states and the states into counties or county equivalents. Other sets may include less familiar units such as census block groups or county subdivisions. Some sets of geographic units can be easily converted to other units (e.g., census tracts to counties), while it may be difficult to relate some units to others (e.g., census tracts to ZIP Codes). In any case, an understanding of the geographic distribution of the population begins with an understanding of the various spatial units utilized as a framework for population distribution. Exhibit 4.2 summarizes the various types of geographic units that might be of use to demographers.

Exhibit 4.2: Units of Geography for Demography

The geographical units used for demographic analysis can be divided into four categories: political or administrative units, operational units, statistical units, and a residual category of units that do not fit into either of these categories.

Political Units

Political or administrative divisions are the most commonly used geographical units for most demographic analyses. Political units typically constitute nested hierarchies that are easily understood (e.g., states "nested" inside the United States, counties within their respective states). Most relevant data are routinely collected for political units as part of their normal activities, and the permanence of virtually all political boundaries is an advantage. Political units also are useful in spatial analysis, as many statistics are compiled on the basis of political boundaries. The following political and administrative units are frequently used in applied demography.

Nation

The nation (in this case, the United States) is defined by national boundaries. Some analyses may be conducted at the national level (e.g., international comparisons), but most analyses focus on lower levels of geography. However, national averages (e.g., mortality rates) are often important as a standard to which other levels of geography might be compared, and the U.S. population is typically used as basis for data standardization.

States

The major subnational political unit is the state, with data typically available for 50 states, the District of Columbia, and several U.S. territories. Because the individual states have responsibility for a broad range of administrative functions, many useful types of data are compiled at the state level, making state agencies a major source of demographic data. However, each state compiles data independent of other jurisdictions, resulting in uneven data reporting from state to state.

Counties

The county (or, in some areas, county equivalents) represents the primary unit of local government. The nation is divided into more than 3,100 county units (including some cities politically designated as counties). The county is a critical unit for analyses because many organizations view their home county as their primary service area. States typically report most of their statistics at the county level. Even when regional phenomena are being considered, the county is likely to be considered the building block for data collection.

Cities

Cites are officially incorporated urban areas delineated by boundaries that may or may not coincide with other political boundaries. Although cities typically are contained within a particular county, many city boundaries extend across county lines. Because cities are incorporated in keeping with the laws of the particular state, little standardization with regard to boundary delineation exists. For this reason cities are limited in their usefulness for demographic analyses. In many cases, however, city governments are involved in data collection activities that may be useful to demographers.

Congressional Districts

Congressional districts are established by state-specific procedures and approved by the federal government. These districts are typically delineated by means of political compromise and do not correspond well with any other geographical units. Although the Census Bureau reports its data for congressional districts, limited data are collected at the congressional district level. In addition, the boundaries tend to change over time, making these units not particularly suited for use in demographic analysis.

State Legislative Districts

State legislative districts have similar characteristics to congressional districts. They are drawn up by the states based primarily on political compromise. Although the Census Bureau reports its data for state legislative districts, virtually no other data are collected for such districts. Furthermore, their boundaries are subject to periodic change. For these reasons state legislative districts are not very useful as units for purposes of demographic analysis.

Operational Units

Operational units are areas drawn up for purposes of managing the operations of some entity. They may or may not have a formal regulatory designation and, because they are responsive to the needs of a particular entity are more susceptible to change than some other types of units.

ZIP Codes

Unlike the geographical units previously discussed, ZIP Codes are not considered formal government designations (with the United States Postal Service operating as an independent agency). ZIP Code boundaries are set by the USPS and are subject to change as population shifts occur or the needs of the Postal Service dictate. This lack of stability often means that ZIP Codes have limited value for historical analyses or tracking phenomena over a long period. Furthermore, ZIP Codes seldom coincide with census tracts or other political or statistical boundaries, making the synthesis of data for various geographies extremely difficult. Despite these shortcomings ZIP Code-level data are frequently used in analyses due to the fact that virtually every relevant type of data is associated with a ZIP Code because almost no social transaction takes place today without ZIP Code data being collected.

Utility Districts

Utility districts are designated for purposes of distributing power, water and gas and for disposing of garbage and other by-products of human activity. These districts tend to reflect the spheres of influence of various utility companies and may or may not correspond with other boundaries. Such data are of limited use for general demographic analyses but may be useful inputs into the calculation of estimates and projections. (see Chap. 9.)

School Districts

School districts are established for the operation of school systems and are reflective of the educational needs of the local population. Although theoretically reflecting the distribution of school-aged children within the population, other factors may play a role in determining the configuration of school districts within a community. In older communities, school districts may be well established, but for most parts of the U.S. continuous population shifts mean that the boundaries for school districts must be frequently adjusted.

Statistical Units

Statistical areas are established to allow various agencies of government to collect and report data in a useful and consistent manner. The guidelines for establishing most statistical units are promulgated by the federal government. The most important statistical units for purposes of demographic analysis are discussed below.

Regions

Regions are established for statistical purposes by the federal government by combining states into logical groupings. Four regions have been established by grouping states based on geographical proximity and economic and social homogeneity. Although statistics are sometimes reported at the regional level by federal agencies, they are typically considered too large for most applications of demographic methods, even though some important metrics (e.g., migration trends) are reported at the regional level. (The term “region” is also used informally to refer to a group of counties or states delineated for some other purpose than data compilation as noted below.)

Divisions

For statistical purposes the federal government divides the nation’s four regions into nine divisions. Each division includes several states, providing a finer breakdown of the nation’s geography. Since the combining of states into divisions is based more on proximity than meaningful attributes, divisions are seldom used as a basis for demographic analysis.

Metropolitan Statistical Areas

Metropolitan statistical areas (MSA) are delineated by the federal government as a means of standardizing the boundaries of cities and urbanized areas. Because each state has different criteria for the incorporation of cities, the MSA concept provides a mechanism for creating comparable statistical units. An MSA includes a central city, central county, and any contiguous counties that could logically be included within the urbanized area. MSAs are revised as necessary after each decennial census with component counties included representing interdependent attributes. An increasing amount of data are available on MSAs, and this unit is often used to define a distinct urban conglomerate.

Urbanized Areas

An urbanized area as defined by the Census Bureau includes the entire densely settled area in and around each large city, regardless of whether the area is within the corporate limits. The urbanized area might be considered more "organic" in that it reflects the actual pattern of urban development independent of any political boundaries. Although limited amounts of data are available for urbanized areas, knowledge about urbanized areas is important in developing a full understanding of the population distribution within a metropolitan area.

Census Tracts

Census tracts are small statistical subdivisions of a county established by the Census Bureau for data collection purposes. In theory census tracts contain relatively homogeneous populations ranging in size from 1500 to 8000. For many purposes the census tract is the ideal unit for compiling demographic data. It is large enough to be a meaningful geographical unit and small enough to contribute to a fine-grained view of larger areas. The Census Bureau collects extensive data at the census tract level primarily today through the American Community Survey (ACS).

Census Block Groups

Census tracts are subdivided into census block groups that include approximately 1000 residents. A tract is composed of a number of block groups, each containing several blocks. The block group provides an even finer-grained picture of a community than the tract level, although fewer data elements are likely to be compiled at the block group level. This represents the lowest level at which ACS data are presented.

Census Blocks

Census block groups are subdivided into census blocks, the smallest unit of census geography. The term *block* comes from the fact that the typical block is bounded on four sides by streets, although some other visible feature (e.g., railroad track, stream) or nonvisible feature (e.g., city limits) may serve as a boundary. Census blocks tend to be the most homogeneous of any unit of census geography, with the average block composed of approximately 30 households. Only a limited amount of demographic data is available for census blocks.

ZIP Code Tabulation Areas

ZIP Code tabulation areas (ZCTA) were developed by the Census Bureau to overcome the difficulties in precisely defining the land area covered by each ZIP Code used by the U.S. Postal Service. ZCTAs are generalized area representations of U.S. Postal Service ZIP Code service areas and are created by aggregating the census blocks whose addresses use a given ZIP Code into a ZCTA. The Census Bureau's intent was to create ZIP Code–like areas that would retain more stability from census to census.

Other Units of Geography

Natural Region

There are certain geographic regions that are distinguished enough in terms of some physical, social or economic trait to be recognized as a distinct area. Some such areas may have been historically recognized as unique geographic areas and these may occasionally be formally labeled as such for some practical purpose (e.g., the "South" or the "rust belt"). Examples of regions that have been identified based on their distinct cultures and a history of geographic and/or social isolation from others include Appalachia and the Mississippi Delta. The federal government has formally recognized these two natural regions through the establishment of federal agencies (regional commissions) for addressing problems facing the respective regions.

Areas of Dominant Influence

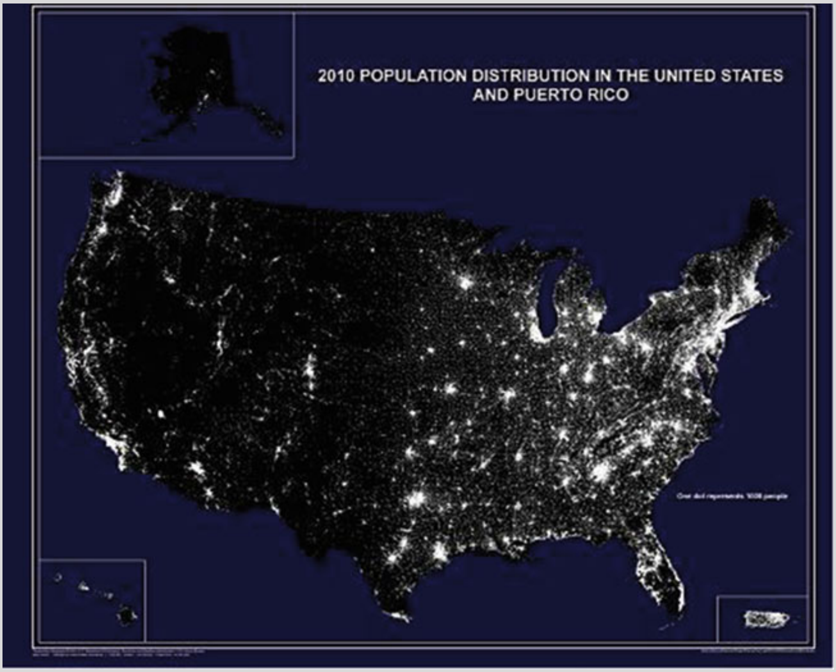
Taken from media advertising, the *area of dominant influence*, or ADI, refers to the geographic territory (typically a group of counties) over which a form of media (e.g., television, newspaper) maintains predominance. Advertisers and others determine the demographic makeup of the ADI as a means of understanding economic potential among other factors. This concept is useful when economic demographers, for example, are interested in patterns of consumer behavior.

One way to assess population distribution is by examining the settlement patterns displayed by the population under study. Obviously, communities are not settled randomly and there are a number of factors that play a role in how the population distributes itself. There are rare occasions when a population may be evenly dispersed over an area (such as the case of a purely agrarian society where each householder has a piece of property some distance from other property owners). It is more likely that settlement patterns will follow one or more of the standard arrangements that have been identified by demographers and others. Settlements tend to concentrate on coastlines and waterways, on transportation routes or at transportation nodes, on fertile land as opposed to infertile land and/or in relation to various vital resources. There are a few communities that were established due to some random event but these are uncommon.

Human populations display a variety of settlement patterns, and these patterns demonstrate the extent to which populations are concentrated or dispersed.

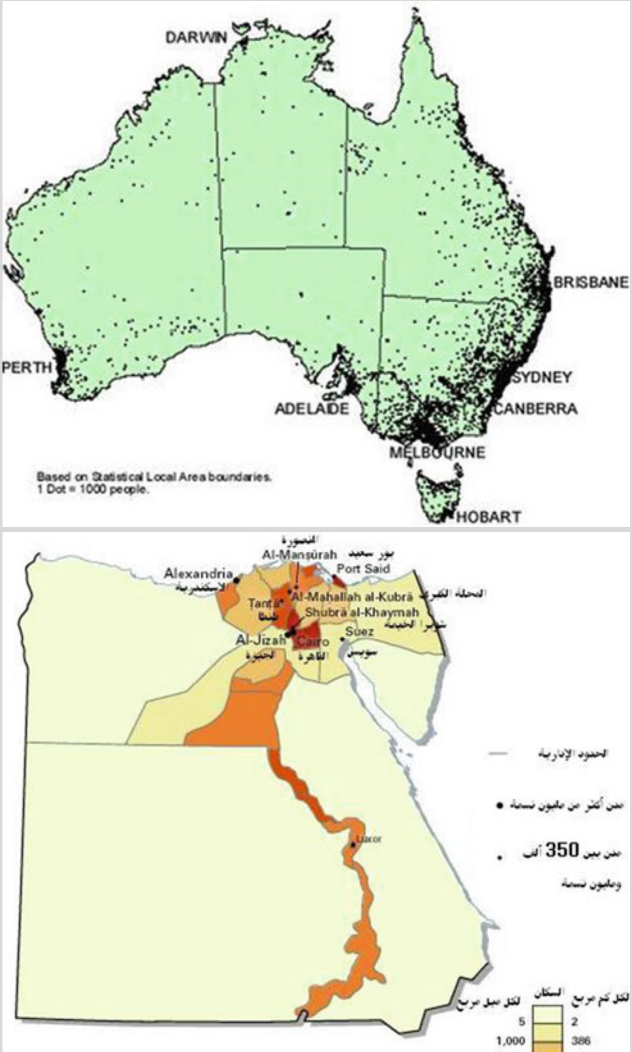
The satellite map exhibited in Exhibit 4.3 displays settlement patterns in the U.S. based on the light sensed by satellite cameras. It is hard to imagine a more meaningful display of settlement patterns. It is clear from this map that there are major differences in population density across the nation—from some of the world's most densely populated communities to some of the least. It can be seen that the eastern portion of the U.S. is much more densely populated than the western portion. It is also clear that the coasts are much more densely populated than the interior of the country. Although it cannot be determined from this map, we also find that every major city in the U.S. is located on a waterway of some type (with the exception of Atlanta, Georgia).

Exhibit 4.3: Midnight in America: Settlement Patterns via Satellite Photographs



The U.S. with its large land mass is characterized with a wide variety of settlement patterns reflecting the diversity of its geography and cultures. Most other societies exhibit less complex settlement arrangements and more easily discerned patterns of population distribution. Two examples that might be considered are Australia and Egypt. Exhibit 4.4 illustrates the situation in Australia where virtually all of the settlement is on the coast and the case of Egypt in which 90% of the population is settled adjacent to the Nile River. These two quite different examples illustrate the variety that can be found in terms of human settlements and subsequent population distribution patterns.

Exhibit 4.4: Settlement Patterns for Australia and Egypt



Sources U.S. Department of State (Australia); University of Edinburgh (Egypt)

4.2.3 Population Concentration

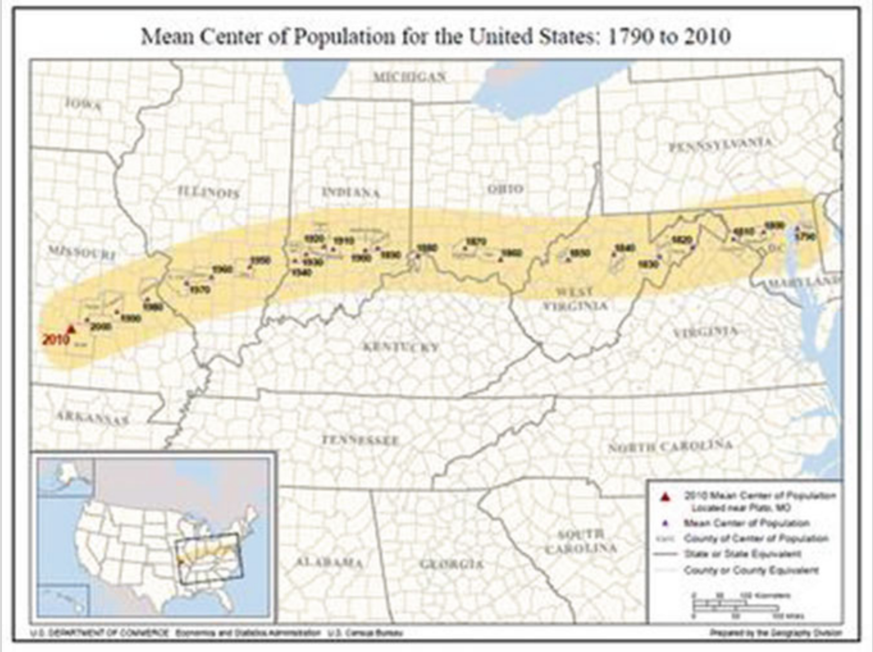
The concentration of the population represents a measure of distribution and indicates the level of concentration or dispersion characterizing its population. Concentration is usually measured in terms of density, with this specialized measure of distribution providing insight into a population's dispersion within a particular geographic area. Concentration is usually measured in the U.S. in terms of persons per square mile, while in other countries density may be stated in terms of square kilometers, hectares, acres or some other areal measure. Population density can be computed for any area—as long as one knows the size of the land area and the population within that area. Note that land area is emphasized since bodies of water are typically excluded when calculating density. Similarly, any areas where habitation is restricted (e.g., national parks) may also be excluded from the denominator in density calculations.

The population density of cities, states, entire continents, and even the world can be computed. Monaco, with an area of less than one square mile, has the world's highest population density or almost 43,000 people per square mile. Mongolia is the world's least densely populated country with only 4.3 people per square mile. Australia is a close second with 6.4 people per square mile. The United States, with its extensive territory, has a current population density of around 87 per square mile.

Population concentration in the U.S. is calculated by dividing the population by the land area to generate the population per square mile.

Another way of looking at concentration is in terms of an area's mean center of population. This is the point at which the population is equally distributed in all directions so that the area would balance like a plate set on top of a stick. At the time of the first U.S. census in 1790 the mean center of population was in Maryland; today it is in Missouri. During the 20th century the mean center of population shifted 324 miles to the west and 101 miles to the south (as illustrated in Exhibit 4.5).

Exhibit 4.5



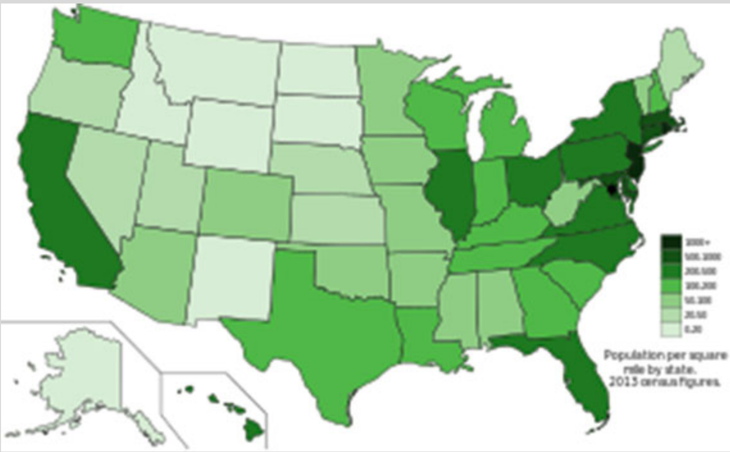
Obviously, in the U.S. and in much of the world for that matter, population has become more concentrated, with the number of persons per square mile in the U.S. and most other nations increasing over time. The estimated population density for the U.S. in 2010 was around 87 persons per square mile (i.e., 309 million residents divided by 38 million square miles), but this figure masks the state-by-state differences that exist. The most highly concentrated state population is found in New Jersey, with nearly 1200 persons per square mile in 2010; the least highly concentrated state population is found in Alaska, with barely one person per square mile. The borough of Manhattan in New York City is considered the highest concentration of population within the U.S., with approximately 20,000 persons per square mile. Exhibit 4.6 illustrates the population density for each of the U.S. states.

Human populations are virtually never randomly distributed but exhibit patterns of distribution that reflect a variety of geographic, social and economic factors.

Exhibit 4.7 illustrates the distribution of population worldwide in terms of density. As can be seen about 90% of the earth's people live on 10% of the land. Additionally, about 90% of the people live north of the equator. The coasts are generally the areas of highest population concentration although there are some exceptions (e.g., Europe). Areas of greatest concentration are clearly identified and include south Asia, the Pacific rim and Europe. The world's population distribution is not stable and there are continuous shifts in concentration throughout much of the world especially with the current high level of migration.

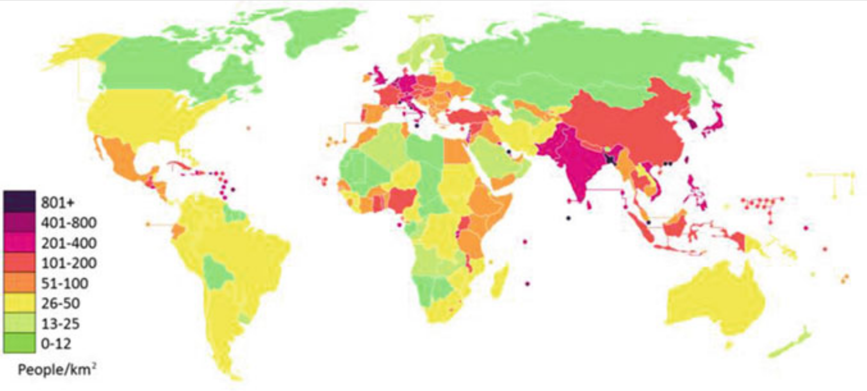
Like distribution, measures of concentration assume reasonably accurate population counts and fixed geographic boundaries. For most units of geography (e.g., states, counties, census tracts) the boundaries and, hence, the area typically do not change. For other units such as ZIP Codes and school districts the boundaries are more subject to change.

Exhibit 4.6: Population Density United States 2013



Source U.S. Census Bureau

Exhibit 4.7: World Population Density 2015



Source Wikipedia Commons

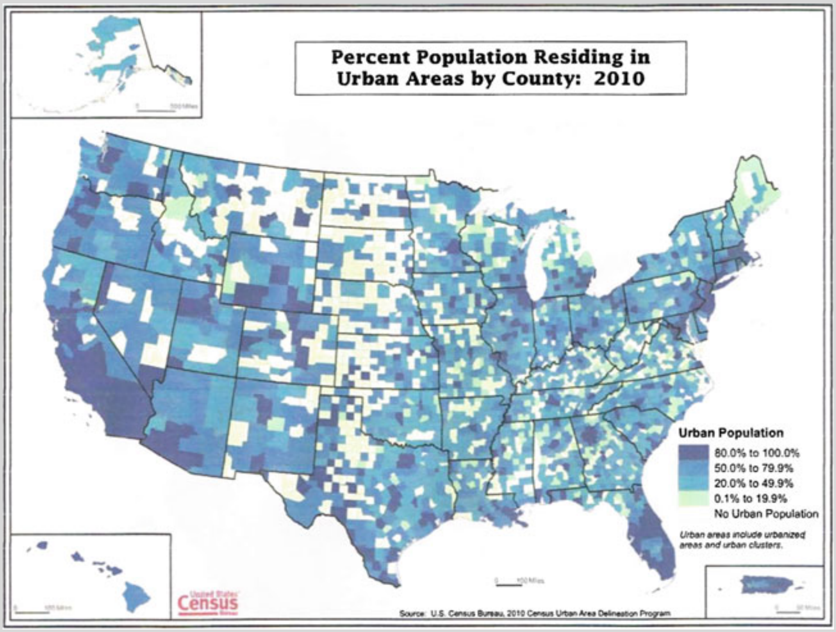
4.3 Community Type

Demographers classify populations in terms of the types of communities they occupy. While the type of community is addressed somewhat by the geographic units discussed above, there are other less formal community types that demographers may employ in their analyses. These are important not only because they describe the nature of population distribution, but because they reflect differences in lifestyles and various demographic characteristics. Further, different demographic attributes are associated with different community types.

A basic distinction developed by the Census Bureau is between rural areas and urban areas. The Bureau identifies two types of urban areas: urbanized areas (UAs) of 50,000 or more people and urban clusters (UCs) of at least 2500 and less than 50,000 people. "Rural" encompasses all population, housing, and territory not included within an urban area. Technically, from the Census Bureau perspective rural areas are geographic areas containing less than 2500 residents. The Bureau further divides rural areas into rural farm areas and rural non-farm areas. Even with this low threshold for being classified as rural, a few states are still predominantly rural today. Exhibit 4.8 illustrates the distribution of urban populations (both "urbanized areas" and "urban clusters").

Generally speaking, communities of 2500 or more residents (with at least a certain population density) and less than 50,000 residents are considered "small towns" or just "towns" in popular parlance. It is usual to have small towns scattered around rural areas; however, increasingly, the suburbs and exurbs of metropolitan areas also contain previously isolated small towns.

Exhibit 4.8: Urban Areas in the United States 2010



Typically, communities of 50,000 or more are considered to be “cities”, with social, cultural and economic characteristics that separate them from towns. Cities can be further classified as small cities, medium cities and large cities, with essentially no upper limit on the population size. The thresholds for different sizes of cities vary based on who is establishing the classification.

The Census Bureau categorizes population as either “rural” or “urban” depending on population size and density.

Cities of any significant size are classified by the Census Bureau as metropolitan statistical areas, micropolitan statistical areas, or combined statistical areas. The first two invariably contain a central city of 50,000 or more for a metropolitan area or 10,000 or more for a micropolitan area. With rare exceptions, these urban areas contain a central county which houses the central city and adjacent counties that comprise the metro- or micro-area. These adjacent counties are typically referred to as suburban counties and the urban communities within there borders referred to as suburbs. Further, the central county often includes suburbs that are politically distinct from the central city. Combined statistical areas (CSAs) are metropolitan or micropolitan statistical areas that retain their metro- or micro- identity while being included in a larger metropolitan area.

In certain parts of the country, most notably the East Coast and West Coast, there are unbroken stretches of urban development in which metropolitan areas actually merge with each other. These are referred to as consolidated metropolitan statistical areas and may contain tens of million residents.

The central city is also often subdivided into an urban core (that typically includes a central business district) and surrounding suburban areas (which may or may not be within the city limits). Older cities may have two or more successive rings of suburban development, often encouraged by the establishment of highway "loops". Finally, communities and counties that exist beyond the suburban counties of a metro- or micro-area are referred to as exurbs. These may include rural areas, small towns and/or cities that are somewhat beyond the Census Bureau-recognized limits for consideration as part of the metro- or micro-area.

Since the criteria for drawing city boundaries vary from state to state, "metropolitan statistical areas" have been established as a standard designation to allow for comparison of one urban area with another.

Understanding these various gradations of both official and unofficial community types would benefit from a concrete example. Officially part of the Washington-Arlington-Alexandria, D.C., Virgina, Maryland and West Virginia Metropolitan Statistical Area, the Washington, D.C., area illustrates the various community types. The District of Columbia, while not techically a county, essentially has the status of the central county in the MSA. Washington is the central city in that "county" which contains other, smaller cities (e.g., Georgetown). This central county is surrounded by counties in three states—five in Maryland, ten in Virgina, and one in West Virginia. These "suburban" counties include cities of various sizes (e.g., Arlington, Virginia, and Silver Springs, Maryland), towns of various sizes (some incorporated, others unincorporated) and rural areas (including some rural farm areas). There are an additional eight counties in Maryland and Virginia that are considered exurban (i.e., not part of the metropolitan area but nevertheless interconnected). Finally, the Washington metropolitan statistical area is combined with the Baltimore Metropolitan Statistical Area to form the Washington-Baltimore Consolidated Statistical Area. (See Exhibit 4.9 for a map showing certain aspects of the Washington MSA and Exhibit 4.10 for a practical example of the use of geographic units for demographic analysis.)

Exhibit 4.9: Washington, DC, Metropolitan Statistical Area

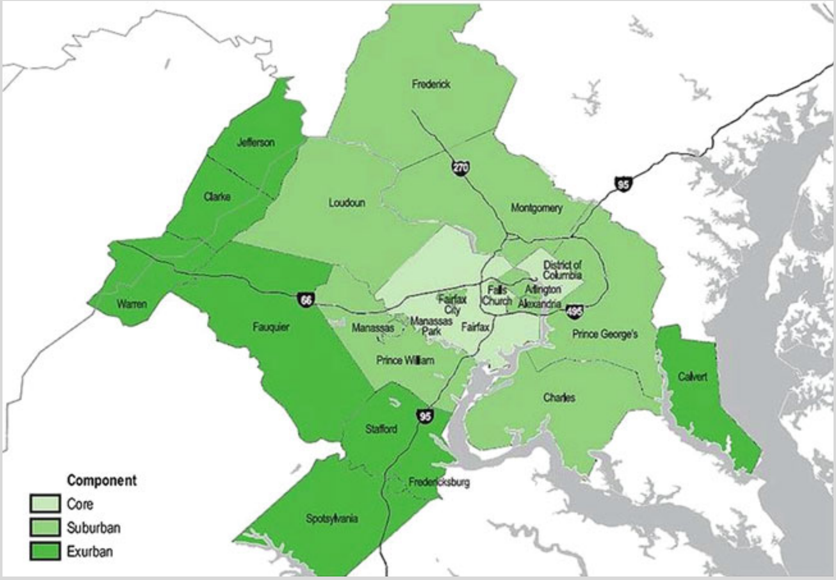


Exhibit 4.10: Choosing the Geographic Unit For an Applied Healthcare Analysis

Toward the end of the 20th century, the healthcare arena became increasingly competitive, providing new opportunities and challenges for health demographers. This new healthcare environment demanded that healthcare providers understand the characteristics and distribution of their patients and potential patients. This development prompted hospitals and other providers to access demographic resources in order to get a handle on the geographic distribution of their patients (and perhaps those of their competitors). All administrative record systems maintain street address and ZIP Code identifiers for patients for billing purposes if for no other reason. The obvious first step for these organizations was to determine where their patients were coming from based on ZIP Code or some other unit of geography.

By accessing ZIP Code-level data, health professionals are able to acquire insights into the distribution of those who use health services. The wide use of ZIP Codes by healthcare administrators and planners reflects the fact that

ZIP Code data are widely available and easy to understand. Further, a number of data vendors make estimates and projections available at the ZIP Code level between censuses. If a certain segment of the population is to be targeted for a promotional campaign by a healthcare organization, it is likely that the mailing lists requested will be made available at the ZIP Code level.

On the minus side, ZIP Codes tend to be relatively large in terms of both population and geographic area, making them unwieldy in some cases. They may not correspond to the boundaries of an identified market area. The fact that ZIP Code boundaries are subject to change also limits their usefulness given the importance of measuring change in the characteristics of targeted populations.

Regional hospitals and other healthcare providers that serve multicounty or multistate markets may find the ZIP Code or even the county level of geography to be adequate. However, most healthcare providers, particularly those in urban areas, are more local in their orientation. Smaller urban hospitals as well as clinics often cater to a certain segment of the community that demonstrates a more narrow geographic distribution. The practices of primary care physicians, for example, are likely to serve a limited geographic area.

While ZIP Code-level data give an indication of the socioeconomic status of the patient, a lower level of geography is often required by healthcare providers. The next lowest level after the ZIP Code is the census tract, with a ZIP Code typically encompassing a number of census tracts. Unfortunately, since ZIP Codes and census tracts have been developed independently, there is little correspondence between the boundaries of the two types of units. Census tract-level data allow a much more granular analysis, and plotting one's customers on a map by census tract presents much more detail than can be achieved using ZIP Codes. Further, if the healthcare organization is federally funded (e.g., a federally qualified health center) or is seeking federal grant funding, the federal agency involved will require that data be provided at the census tract level.

There may be rare occasions where an analyst requires data at a lower level than the census tract (e.g., census block or census block group). At the block group level, a substantial amount of data is available for use by the analyst. However, the breadth of data available at the block level is, understandably, limited to a few basic variables.

Ultimately, the choice of geographic level to be used for an analysis depends on: (1) the objectives of the analysis; (2) the degree of granularity required; (3) the implications of crossing political boundaries; and (4) the type of data required. The last criterion is worth expanding upon, since data of different types and levels of granularity vary with geographic level. At the national level, for example, health-related data can be obtained in great detail for virtually any desired variable. These data are readily available and can be disaggregated for any relevant demographic category (e.g., Hispanics, frail elderly, baby boomers). Similarly, at the state level a wide range of data is available and, in some cases, exceeds in scope what data may be available at the national level due to state-specific programs that are in place. At the county level, a considerable amount of data is available, with counties being the initial source of vital statistics. Of course, data collected through the decennial census are available for all of these levels, although it quickly becomes dated. (See the discussion on the American Community Survey in this regard.) While the Census Bureau does allocate census data to the ZIP Code level, an alternate source of data at this level is the commercial data vendors who specialize in generating estimates and projections at the ZIP Code level.

Case Study 4.1: How *Not* to Plan for Retail Expansion

In the mid-1980s a "big box" retail chain was looking to expand its operations and assigned an eager young market analyst the task of identifying new store locations. The strategy involved identifying communities that already had a successfully operating store and determine if there were additional opportunities for expansion.

In casting about for opportunities the analyst included Memphis, Tennessee, on his list of potential communities for expansion. There was an existing store there in an older part of the city and the population appeared to be growing. The analyst compiled data on the city's historical population growth in order to determine the potential for store expansion. His research revealed that the population for the city of Memphis appeared to be growing at a substantial rate. Based on data from previous censuses it was found that the city's population in 1960 was 497,500, in 1970 was 623,500 and in 1980 was 646,300. Although the growth appeared to be slowing somewhat over previous years the population was still showing a healthy increase as of 1980.

Based on these figures the analyst recommended that three new stores be added in what were considered the fastest growing areas. Based on these recommendations three new stores were opened in Memphis. Within two years all three of them had to be closed due to lack of business. How could the market research have been so wrong?

As it turns out, the analyst failed to consider the boundaries that defined the city of Memphis and how they might have changed over time. In the state of Tennessee it was very easy for a city to incorporate surrounding communities within its boundaries, while in many states this is almost impossible to do. Over the course of the three decades under study the city had been aggressively absorbing surrounding communities within its boundaries.

Because of this pattern of urban development the city was actually incorporating *existing* communities and adding existing populations to the city's total. The increase in population was a mirage since the city was simply changing its boundaries to incorporate more territory. In reality, the city's population growth was well below that of comparable cities and, rather than being an opportunity for expansion, Memphis was barely able to support the current store due to its meager growth. Needless to say, the market analyst did have a very long career in retail planning.

Exercise 4.1: Identifying Metropolitan and Micropolitan Areas
Metropolitan and micropolitan areas have been established for each state by federal agencies based on the demographic characteristics of the population. Students should access the Internet to obtain a base map for their state. Using information from www.census.gov students should identify for their states the location of metropolitan counties and micropolitan counties. Using colored pencils or other markers indicate on the map the locations of the urban concentrations as represented by metropolitan areas and micropolitan areas. Indicate when appropriate where metropolitan areas extend into adjacent states.

Exercise 4.2: Geographic Unit Identification
For this exercise, students will access the Census Bureau website in order to identify various units of geography with which they should be familiar. Follow the steps below and identify the geographic units requested relevant to your residence.

(1) Access the Census Bureau website at www.census.gov.
(2) Go to the bottom of the page and choose "American FactFinder" off the FIND DATA list.
(3) Click on "Address Search" in the right-hand column.
(4) Enter home address in the boxes provided.
(5) Click on "Go" and a table will be displayed.
(6) Extract the following information from the first column of the table for your address:

- Region: ________________
- Division: ________________
- Census tract: ________________
- Census block group: ___________
- Census block: _________________
- County: _________________
- Metropolitan statistical area (if applicable): _______________
- Congressional District: _________________
- ZIP Code Tabulation Area (5-digit): _________________

(7) Select Map tab at top of Table
(8) Enter address and click "Go".
(9) Click on the "stack" on the right-hand menu.
(10) Change the date to 2010.
(11) Check the boxes for Block, Census Tract, and Block group.
(12) Click on "Update"
(13) Verify the following information from above on the map:

- Census tract: ___________
- Census block group: _____________
- Census block: ______________

Exercise 4.3: Calculating and Displaying Population Density
The table below presents the 2010 population for each of the 50 U.S. states and the area for each stated in square miles. For the first part of the exercise, students are to calculate the population density for each state, creating a table that includes the population per square mile. For the second part of the exercise, students are to create a map of the United States that displays the densities generated for the table. After examining the densities students are to determine how many intervals there should be and then shade the intervals with various colors to indicate different categories of density. (Convention calls for making intervals with higher values a darker color.) The resulting map should provide an overview of population density for the United States.

Alabama	4,779,736	50,645.33	Montana	989,415	145,545.80
Alaska	710,231	570,640.95	Nebraska	1,826,341	76,824.17
Arizona	6,392,017	113,594.08	Nevada	2,700,551	109,781.18
Arkansas	2,915,918	52,035.48	New Hampshire	1,316,470	8,952.65
California	37,253,956	155,779.22	New Jersey	8,791,894	7,354.22
Colorado	5,029,196	103,641.89	New Mexico	2,059,179	1,21,298.15
Connecticut	3,574,097	4,842.36	New York	19,378,102	47,126.40
Delaware	897,934	1,948.54	North Carolina	9,535,483	48,617.91
Florida	18,801,310	53,624.76	North Dakota	672,591	69,000.80
Georgia	9,687,653	57,513.49	Ohio	11,536,504	40,860.69
Hawaii	1,360,301	6,422.63	Oklahoma	3,751,351	40,860.69
Idaho	1,567,582	82,643.12	Oregon	3,831,074	95,988.01
Illinois	12,830,632	55,518.93	Pennsylvania	12,702,379	44,742.70
Indiana	6,483,802	35,826.11	Rhode Island	1,052,567	1,033.81
Iowa	3,046,355	55,857.13	South Carolina	4,625,364	30,060.70

(continued)

(continued)

Kansas	2,853,118	81,758.72	South Dakota	814,180	75,811.00
Kentucky	4,339,367	39,486.34	Tennessee	6,346,105	41,234.90
Louisiana	4,533,372	43,203.90	Texas	25,145,561	261,231.71
Maine	1,328,361	30,842.92	Utah	2,763,885	82,169.62
Maryland	5,773,552	9,707.24	Vermont	625,741	9,216.66
Massachusetts	6,547,629	7,800.06	Virginia	8,001,024	39,490.09
Michigan	9,883,640	56,538.90	Washington	6,724,540	66,455.52
Minnesota	5,303,925	79,626.74	West Virginia	1,852,994	24,038.21
Mississippi	2,967,297	46,923.27	Wisconsin	5,686,986	54,157.80
Missouri	5,988,927	68,741.52	Wyoming	563,626	97,093.14

Source U.S. Census Bureau

Additional Resources

Information Turkey (2016). *World population density video*. Downloaded from URL: https://www.youtube.com/watch?v=5B5mj9UZaQM.

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The World Bank (2017). *Population density*. Downloaded from URL: http://data.worldbank.org/indicator/EN.POP.DNST.

Chapter 5
Population Composition

Abstract This chapter reviews the various components of population composition and the ways these data are used to describe populations. The various measures used for profiling a population in terms of its attributes are discussed and relevant techniques used in demographic analysis (e.g., cohort analysis, standardization) are described.

5.1 Introduction

Population composition refers to the combined demographic characteristics of persons within a geographic area. These characteristics create a profile of the population and are the attributes that give a population its particular character. The population composition of New York City sets it apart from Memphis, Tennessee, and Omaha, Nebraska, more so than its size. Compositional variables are primarily descriptive in nature. Their usefulness is derived from their ability to profile a population in terms of its relevant attributes. An area's age distribution, racial makeup, income level, and dominant religion are the types of characteristics that give a population its "personality." Because of the breadth of information related to population composition the first part of the chapter will present an overview followed by a section on applied examples.

5.2 Compositional Variables

Compositional variables can be divided into two categories: biosocial characteristics and sociocultural characteristics. *Biosocial characteristics* are those that have an underlying biological or physical component. As such, they tend to be "ascribed" characteristics present at birth and not amenable to change. Biosocial factors include age, sex, race and ethnicity, and with the exception of ethnicity all are rooted squarely in biology. Ethnicity has its basis in a common cultural heritage, but

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endogenous marriage within ethnic groups often results in the development of a gene pool that fosters common physical characteristics.

Biosocial attributes are characterized by an underlying biological or physical component accompanied by significant social connotations.

Biosocial characteristics have significant social connotations in that society ascribes certain attributes to people based on their biosocial classification. For example, while being male or female is a biological state, society attaches certain attributes to men (i.e., masculine traits) and to women (i.e., feminine traits). In fact, demographers use the term "sex" to refer to biological differences and "gender" to refer to socially ascribed differences. Similarly, we speak in terms of age-appropriate behavior to indicate that age is not just a matter of years lived but that there are certain social attributes associated with different ages.

Sociocultural factors reflect the positions society members occupy within the social structure. Sociocultural factors, in U.S. society at least, are primarily "acquired" rather than ascribed. These are not traits one is born with in a biological sense but those that are acquired (voluntarily or involuntarily) through participation in the social system. These factors are "cultural" in that those affected take on characteristics assigned by society. Sociocultural factors include marital status, income, education, occupation, and religion among others. Each variable is discussed in turn in the sections that follow.

Sociocultural attributes reflect the position of society members occupy within the social structure and, as such, represent acquired rather than ascribed characteristics.

5.2.1 Biosocial Characteristics

Age. For many purposes, the age distributions of a population represents the most significant compositional variable. After population size, the age distribution is the most important factor in determining a society's character and for calculating many of the rates used by demographers. Age is measured in chronological terms beginning at a person's date of birth. Age data in the United States are generally thought to be of high quality, though some age "heaping" is seen in self-reported data for milestone years such as 21, 62, 65, 100, and years that end in zero.

Although age data may sometimes be presented in single years (e.g., 1, 2, 3, etc.), ages for a population are typically grouped into intervals to simplify data presentation. Five-year and 10-year intervals are generally used by demographers, with exceptions sometimes made for the youngest intervals (under 1, 1–4), and the oldest intervals (age 85 and above). However, there is no substantive reason for utilizing these intervals, and others that are more relevant to the issue at hand may be more useful. It may even be appropriate to create "functional" intervals, such as 0–14, 15–24, 25–44, 45–64 and 65 and older. In addition, age-based cohorts may be carved out in order to focus on specific sub-populations such as teenagers (i.e., 13–19), child-bearing age women (i.e., 15–44), and the young-old (i.e., 65–74). It is important to examine the age distribution of a population to develop an understanding of the importance of various age groups.

Means and medians are often used as summary indicators of the overall age distribution. The median age is most commonly used since it provides the best indicator of the mid-point of the age distribution. The current median age of the U.S. population is around 37 years. This contrasts with a population like that of Uganda with a median age of 15 years. Obviously, the difference in median age between the U.S. and Uganda has all manner of implications for the respective societies. For example, younger populations have proportionally more women in their childbearing years, and therefore produce more births. It is common to separately calculate the median age for males and females as well as for other demographically meaningful subgroups.

The mean age (or arithmetic average) of the population is sometimes used as an indicator of "average" age, although the mean is much more sensitive to extreme values than the median and, thus, considered less meaningful. By comparison the mean age for the U.S. population is 38.5 years, somewhat higher than the median due to "outliers" on the high end of the distribution. Measures of statistical dispersion (e.g., standard deviation) may also be used to describe a population's age distribution. Exhibit 5.1 contains detailed age data for the US population in 2010. This would be considered a "mature" population distribution because of the relatively high median age and due to the fact that there are similar proportions within all age groups except for the very oldest.

Exhibit 5.1: Age Distribution of US Population: 2010 (In Thousands)

Age Category	Population	Percent
Under 5 years	20,201	6.5
5–9 years	20,349	6.6
10–14 years	20,677	6.7
15–19 years	22,042	7.1
20–24 years	21,586	7.0
25–29 years	21,102	6.8
30–34 years	19,962	6.5
35–39 years	20,180	6.5
40–44 years	20,891	6.8
45–49 years	22,709	7.4
50–54 years	22,298	7.2
55–59 years	19,665	6.4
60–64 years	16,818	5.4
65–69 years	12,435	4.0
70–74 years	9278	3.0
75–79 years	7318	2.4
80–84 years	5743	1.9
85 years and over	5493	1.8
Total	308,745	
Median age	37.2	

Source U.S. Census Bureau, American FactFinder. Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1. October 1, 2012

Sex. The *sex* or *gender* of an individual is perhaps the most straightforward attribute to determine, given that there are only two possible categories, male and female. The sex distribution is typically presented in terms of raw numbers (e.g., 5200 females and 4800 males), percentages (e.g., 52% female and 48% male), or converted into a "sex ratio". The sex ratio indicates the number of males per 100 females. Based on these raw numbers, a sex ratio of 92.3 would be generated, meaning that for this population there are only around 92 males for every 100 females. In most developed countries the sex ratio is less than 100, indicating fewer males than females. Interestingly, in the U.S. today the sex ratio varies over the lifecycle reflecting a biological weakness in males. The sex ratio at conception is 108 (i.e., 108 males for every 100 females) and drops to 103 at birth. Parity (sex ratio = 100) is reached around age 20 with the sex ratio remaining under 100 for subsequent age cohorts and rapidly declining. At the oldest ages the sex ratio drops to 40 reflecting the higher attrition rate for males. For the age range 85 and over there are essentially two women for every man.

> *The sex ratio is reflective of a number of factors including the age distribution, economic conditions, migration patterns and, in some populations, preferences for one sex over the other.*

Race and Ethnicity. Race and ethnicity are at the same time biologically determined and socially constructed. Racial identity is based on physical characteristics such as skin color. Ethnic identity, on the other hand, is based on a common cultural heritage. Both "race" and "ethnicity" are social constructs with race, in particular, having no scientific basis. Thus, the number of racial groups and the basis for racial categorization vary from society to society. In the US racial groups include whites, African-Americans, Asian-Americans, American Indians (including Alaska natives), and Hawaiians and Pacific Islanders. The decennial census is the major source of data on the racial composition of the U.S. population and in recent censuses it has been possible to claim two or more races.

Ethnic identification may be determined by members of a subgroup or ascribed by the larger society. Members of many ethnic groups view themselves as distinct from the larger society; others many not see themselves as different at all. Thus, while the Census Bureau may categorize all residents of Hispanic background as "Hispanic", few Mexicans, Cubans or Puerto Ricans would apply that label to themselves. When the US population's racial/ethnic composition is examined, Hispanics are classified as ethnic group members as well as in terms of their race.

> *Over the past 25 years trends in the racial and ethnic makeup of the U.S. population have created a much more diverse population than previously existed.*

The only ethnic group officially recognized by the Census Bureau is Hispanics, although there are other ethnic groups within U.S. society that could be identified. Jews and Arabs could both be considered ethnic groups as could subgroups identified based on their national heritage (e.g., Southeast Asians, east Indians, Ukrainians). Of course, to be considered as an ethnic group, the subpopulation must retain significant aspects of its traditional culture.

Exhibit 5.2 presents a breakdown of the current racial and ethnic distribution for the US population. Note that the total exceeds 100% since Hispanic-origin persons are double counted—i.e., as members of an ethnic group also assigned to various racial groups. The data show that more than one-third, 35.6%, of the U.S. population is made up of persons classified as a racial or ethnic minority. This figure has been rising and will continue to grow given the differences in age structure and fertility behaviors across all groups.

Exhibit 5.2: Racial and Ethnic Composition of the US Population: 2010 (In Thousands)

Race/ethnicity category	Number	Percent
Total population	304,060	
White alone	223,553	72.4
Black or African American alone	38,929	12.6
American Indian, Alaska native alone	2932	0.9
Asian alone	14,674	4.8
Native Hawaiian/Pacific Islander alone	543	0.2
Two or more races	9009	2.9
Hispanic origin	50,478	16.3

Source U.S. Census Bureau, American FactFinder. Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1. October 1, 2012

5.2.2 Sociocultural Characteristics

Marital Status/Living Arrangements/Family Structure. Marital status, living arrangements, and family structure are all ways of looking at household characteristics. In the past, marital status was thought by demographers to be the best indicator of household relationships. However, as the traditional family has given way to new and different types of households, other measures of household characteristics have become more salient.

Over the past 50 years the United States population has experienced a shift from one of the developed world's highest marriage rates to one of its lowest.

Individuals are typically grouped into four marital status categories: never married, married, widowed, and divorced. "Never married" refers to individuals who are single and, as the term implies, have not been married. (Widowed and divorced individuals are also technically single.) The Census Bureau also recognizes a "married but separated category", although this does not constitute a formal marital status in all states. Demographers are interested in a range of characteristics related to marital status (e.g., age at marriage, race/ethnicity of bride and groom) Historically, most Americans married when they entered adulthood and virtually everyone married. However, beginning in the 1960s the rate of marriage began to drop and this decline has continued to the point that barely one-half of American adults are married today. While the slim majority of adults are married, the proportions never married, widowed and divorced have all increased. Exhibit 5.3 shows the current marital status of the U.S. population.

Exhibit 5.3: Marital Status of the US Population 15 Years and Over United States: 2010 (In Thousands)

	Number	Percent (%)
Never married	79,640	32.1
Married	126,446	51.0
Widowed	14,944	6.0
Divorced	27,026	10.9

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YRDP02&prodType=table. October 1, 2012

In addition to marital status it is important to determine the living arrangements and family status for members of a population. A *household* is made up of one or more persons living in a housing unit. A *housing unit* is defined as one or more rooms that comprise separate living quarters with access from the outside or through a common hall along with a kitchen or cooking equipment for exclusive use. Thus, individual apartments and duplex units are considered separate housing units, while dormitories and military barracks are not; the latter are referred to as *group quarters*.

Determining whether or not persons in a housing unit or elsewhere constitute a family is also important. A *family* is defined as two or more persons related by blood, marriage, or adoption who live together. Two persons living in the same housing unit are considered to be a household regardless of the relationship; if they are related to each other they are classified as both a household and a family. Because of this distinction, households are assigned to either the family or non-family category.

The distinctions between different types of household structures are important for a number of reasons. Family households, for example, have legal standing, while nonfamily households typically do not. Further, family households are likely to differ from nonfamily households in a number of ways unrelated to the size or nature of the relationship. In healthcare, the health service needs of nonfamily households are likely to differ from those of families.

One additional residential category to be considered is group quarters. Group quarters are defined by the U.S. Census Bureau as living arrangements for groups not living in conventional housing units or groups living in housing units containing ten or more unrelated people or nine or more people unrelated to the person in charge. Group quarters are owned or managed by an entity or organization providing housing and/or services for the residents. These services may include custodial or medical care as well as other types of assistance, and residency is commonly restricted to those receiving these services. People living in group quarters are usually not related to each other. Group quarters include such places as college residence halls, residential treatment centers, skilled nursing facilities, assisted living facilities, group homes, military barracks, correctional facilities, and workers' dormitories. As the US population continues to age, the number and percentage of Americans living in group facilities is expected to increase.

Over the past 25 years the changes in household structure have been so dramatic that some demographers have referred to it as a second demographic transition.

The proportion of households considered family households (two or more persons who are related) has declined while female- and male-headed families have increased proportionately. Moreover, there has been a rise in the proportion of single-person households over the past quarter century. Exhibit 5.4 provides data on household composition of the U.S. for 2010.

Exhibit 5.4: Household Composition of the United States: 2010 (In Thousands)

Number of households	114,567	
Persons per household	2.63	
Persons per family household	3.23	
Family households	76,089	66.4%
Married couple households	34,031	48.6%
Male-headed households (no spouse)	5386	4.7%
Female-headed households (no spouse)	14,998	13.1%
Nonfamily households	38,478	33.6%
One-person households	31,403	27.4%

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YRDP02&prodType=table. October 1, 2012

Income. *Income* refers to the amount of money taken in by individuals and households during a specified time period (usually a year). Income statistics generally refer to income in the previous year with income reported in absolute dollars (i.e., $23,550) or grouped into intervals (e.g., $20,000–$24,999, $25,000–$29,999). In most cases, income data are collected for the household whether it is a family household or a group of unrelated individuals (i.e., family income vs. household income). In addition to the amount of income, data may be collected on the source of income (e.g., wages and salaries, interest, and royalties).

While income data presented in intervals provide a useful perspective on the distribution of income for a population, summary indicators are typically used. Thus, for all households it is common to report the median household income with the mean household income sometimes also being reported. Similarly, demographers may present the median (or mean) family income in which case only family households are counted. Median household and median family incomes represent the mid-point of household income and are calculated by determining the point at which half of the households or families are above and half are below the mid-point.

The mean income represents the arithmetic average for all households or families. This indicator is used less frequently than the median since it is more sensitive to extremes in reported income. For example, for a small population, one household with a million dollars in income could badly skew the mean toward the high end.

One other indicator of income level that is frequently used is per capita income. This indicator is calculated differently in that total income for a population is established and then divided by the number of individuals in that population regardless of their contribution to income generation. Per capita income is not considered as useful as household-based indicators because the per capita income can be influenced by a number of factors that might make such an average misleading. (Exhibit 5.5 presents a sample income distribution with associated measures of concentration.)

One other indicator of a population's income is its *poverty* level, or the extent to which individuals, families or populations are economically deprived. Poverty can be measured in absolute or relative terms, depending on the intent. In the U.S. the federal government establishes the criteria for the "official" poverty threshold. The poverty threshold is based on the amount of money required to cover basic living expenses (e.g., housing, food, clothing). The Census Bureau generates a set of money income thresholds that vary by family size and composition to determine who is in poverty. If a family's total income is less than the family's threshold, then that family and every individual in it is considered in poverty. The official poverty definition uses money income before taxes and does not include capital gains or noncash benefits (such as public housing, Medicaid, and food stamps) in its calculations.

Over the past 20 years the gap between the richest and poorest in the U.S. population has expanded resulting in an increased number of Americans living in poverty.

In 2010, the poverty threshold for an urban family of four was around $23,000 and an estimated 13% of Americans currently live at or below the poverty level. Relative poverty is measured in terms of the household or population's relationship to the median household income. Thus, if the nation's median household income is $50,000, a household with an income of $25,000 would be considered to be 50% below the median.

Exhibit 5.5: Household Income Distribution in the US: 2010 (In Thousands)

	Number	Percent
Total households	114,567	
Less than $10,000	8757	7.8
$10,000–$14,999	6668	5.8
$15,000–$24,999	13,165	11.5
$25,000–$34,999	12,323	10.8
$35,000–$49,999	16,312	14.2
$50,000–$74,999	20,941	18.3
$75,000–$99,999	13,526	11.8
$100,000–$149,999	13,545	11.8
$150,000–$199,999	4810	4.2
$200,000 or more	4518	3.9
Median household income	$50,046	
Total family households	75,089	
Less than $10,000	3824	5.0
$10,000–$14,999	2661	3.5
$15,000–$24,999	6771	8.9
$25,000–$34,999	7332	9.6
$35,000–$49,999	10,578	13.9
$50,000–$74,999	14,991	19.7
$75,000–$99,999	10,638	14.0
$100,000–$149,999	11,262	14.8
$150,000–$199,999	4131	5.4
$200,000 or more	3901	5.1
Median household income	$60,609	

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_DP03&prodType=table. October 1, 2012

Education. *Education* refers to the average amount of schooling a population has attained. The educational status of a population is typically stated in terms of the number of school years completed and/or the types of degrees earned. Thus, as part of the American Community Survey respondents are asked to report the highest diploma or degree they have earned (e.g., high school diploma, master's degree). Educational attainment is sometimes expressed in mean or median years completed. Exhibit 5.6 presents the current educational breakdown for the United States population.

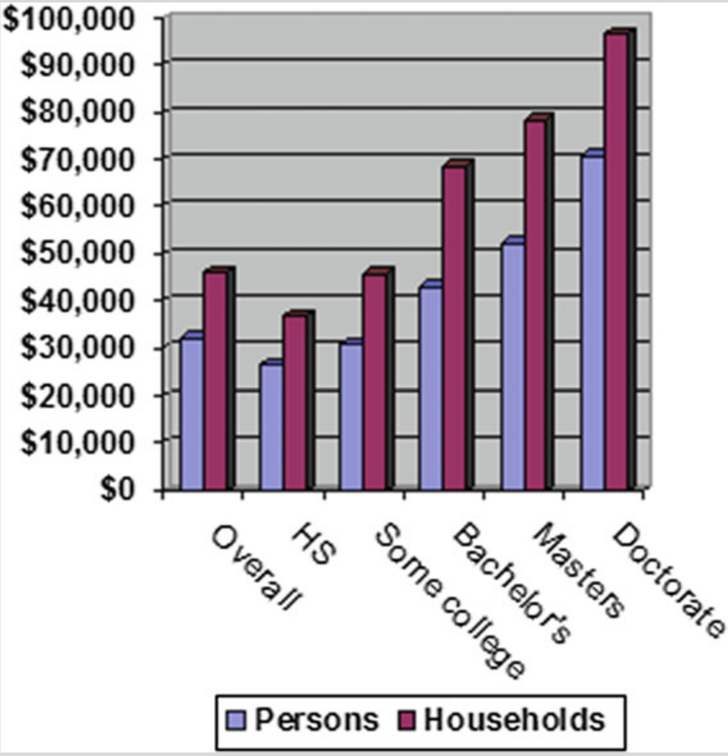
Exhibit 5.6: Educational Attainment for the US Population 25 and Over: 2010 (In Thousands)

	Number	Percent
Less than high school	29,463	14.4
High school graduate only	58,226	28.5
Some college, no degree	43,469	21.3
Bachelor's degree or more	26,244	17.7
Graduate or professional degree	21,334	10.4

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YRDP02&prodType=table. October 1, 2012

The impact of education on income in the U.S. is noteworthy and historically there has been a direct relationship between educational attainment and income. As can be seen in Exhibit 5.7 a college education is associated with higher than average income and as the amount of education increases so does the average income. (Since these figures were published by the Census Bureau there is evidence that the relationship between education and income has weakened somewhat.)

Exhibit 5.7: Education and Income: United States: 2006



Source U.S. Census Bureau

Work Status/Occupation/Industry. *Work status*, *occupation*, and *industry* data all relate to one's position in the labor force. Work status includes information on labor force participation and employment status. For individuals who are employed, additional information on the number of hours worked may be collected. Part-time and full-time classifications may be used based upon the number of hours per week and weeks per year worked. The unemployment rate is indicative of the economic "health" of the population. While the term underemployment is frequently used today, there is no commonly agreed upon definition. Exhibit 5.8 presents recent data on labor force participation.

Exhibit 5.8: Labor Force Statistics: United States: 2014

	Percent
Population in labor force	64
Male population labor force	69
Female population in labor force	57
Women in labor force with children	67
Unemployment rate	6.5

Source Bureau of Labor Statistics, US Department of Commerce

Occupation refers to the kind of work a person normally does (that is, the "job"). Examples of specific occupations include registered nurse, gasoline engine assembler, and teacher's aide. Each occupation is assigned a code from the dictionary of occupational titles (DOC), and individual workers are assigned to an occupation by the Census Bureau. The hundreds of occupations are aggregated into 9 or 10 major groupings, such as professional and technical, sales, and management.

The distribution of workers among various industries changed dramatically as a manufacturing economy was displaced by a service economy.

Industry refers to the business or industry where the occupation resides. For the examples above, the registered nurse would be assigned to health and social services, the gasoline engine assembler to manufacturing, and the teacher's aide to educational services. On the other hand a secretary could be assigned to virtually any industry. Industries are classified based on the North American Industrial Code (NAIC) system. The distribution of workers by industry provides a profile of the population's economic structure with changes in the size of the respective industries reflecting changes in the economy. Exhibit 5.9 presents the current distribution of jobs among different occupational categories, and Exhibit 5.10 presents the current distribution of jobs among different industries.

Exhibit 5.9: Employment by Major Occupational Category in the US: 2010 (In Thousands)

	Number	Percent
Management/business/sciences/arts	49,976	35.9
Service occupations	25,059	18.2
Sales and office occupations	34,711	25.0
Natural resources/construction/maintenance	12,697	9.1
Production/transportation/material moving	16,560	11.9

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_DP03&prodType=table. October 1, 2012

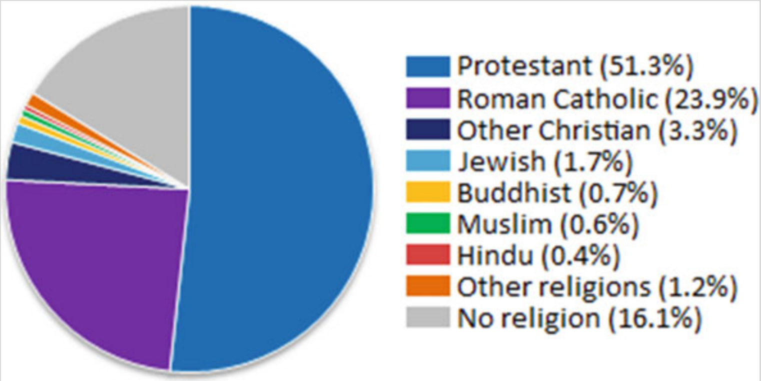
Exhibit 5.10: Employment by Industry in the US: 2010 (In Thousands)

	Number	Percent
Agriculture/forestry/fishing	2647	1.9
Construction	8687	6.2
Manufacturing	14,440	10.4
Wholesale trade	3941	2.8
Retail trade	16,203	11.7
Transportation/warehousing/utilities	6844	4.9
Information	3016	2.3
Finance/insurance/real estate	9275	6.7
Professional/scientific/management	14,710	10.6
Educational services/healthcare/social assistance	32,311	23.2
Arts/entertainment/recreation	12,860	9.2
Other services	6913	5.0
Public administration	7187	5.2

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_DP03&prodType=table. October 1, 2012

Religion. Despite the importance of religion in American society, religion is one of the least reported compositional variables. Questions regarding religious affiliation or the levels of religiosity are not included in censuses or government-sponsored surveys. However, sample surveys, church registries, and qualitative data can provide partial information on religious affiliation. The types of questions usually asked concern religious affiliation (e.g., Roman Catholic), attendance (e.g., number of times attending per month), and religiosity (e.g., depth of religious commitment). Exhibit 5.11 presents the distribution of members of the US population based on religious affiliation.

Exhibit 5.11: Distribution of Religion in U.S. Population: 2009



Source Haire Dunya.

5.3 Displaying and Analyzing Compositional Variables

5.3.1 Descriptive Statistics

Data on compositional variables will be typically generated as raw data, and it is up to the analyst to convert these data into meaningful information. This section describes some of the ways in which demographic data might be displayed and classified and the types of analysis used to compare different geographies in terms of their compositional attributes. Since various geographies will record populations of differing sizes, it is difficult to compare one geography or population to another using raw data. Therefore, it is necessary to convert raw data into a form that allows for meaningful comparison. For example, knowing that 10,000 deaths occurred in Florida and 2000 deaths occurred in North Dakota in 2005 does not really allow us to compare the health status of the respective states. But, if we convert these into death rates and generate a crude death rate of 8.5 per 1000 population for Florida and a rate of 9.5 per 1000 for North Dakota, we have a basis for comparison.

Compositional traits are often expressed in proportional terms (e.g., 25% of the population in Orange County, Florida, has a college education or above) along with summary measures such as means and medians. The use of any of these summary measures can result in useful insights, though sometimes the statistics presented are misleading. When using percentage distribution information, it is generally better to include data for several categories (perhaps the entire distribution), even though the focus may be on only one level of aggregation. This will give the user/reader a more complete picture of the conditions being addressed.

Since the mean refers to the arithmetic average and the median to the midpoint of a distribution, these two measures of central tendency are likely to be used for different purposes. It is generally better to rely on the latter, though the use of both of these statistics, along with an examination of the entire distribution, is the best approach. A given mean or median may be the result of an infinite number of combinations of distributional data. Therefore, utilizing the mean or median without analyzing the distribution from which those figures are derived may result in an incomplete understanding of the data.

5.3.2 Population Pyramids

Population distributions are sometimes presented visually in the form of *population pyramids*. The age/sex distribution of a population is presented in a series of stacked bars, though other combinations of characteristics can be used. Each bar represents the percentage or number of the total population in that age cohort. The left side displays the percentage of males in each age cohort and the right side the percentage of females in each age cohort. Pyramids that are "bottom heavy" reveal younger age structures, while old age structures demonstrate more constant age-to-age percentages and appear bullet shaped. Exhibits 5.12 and 5.13 present the population pyramids for Garfield and Sarpy Counties in Nebraska for 2010.

Exhibit 5.12

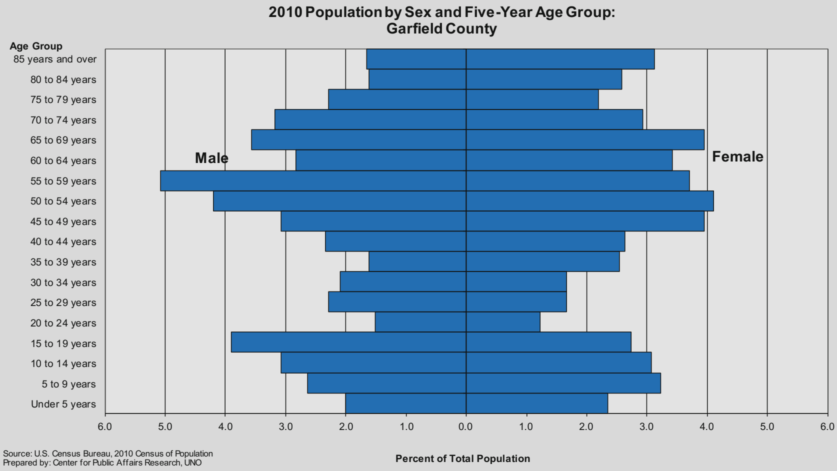
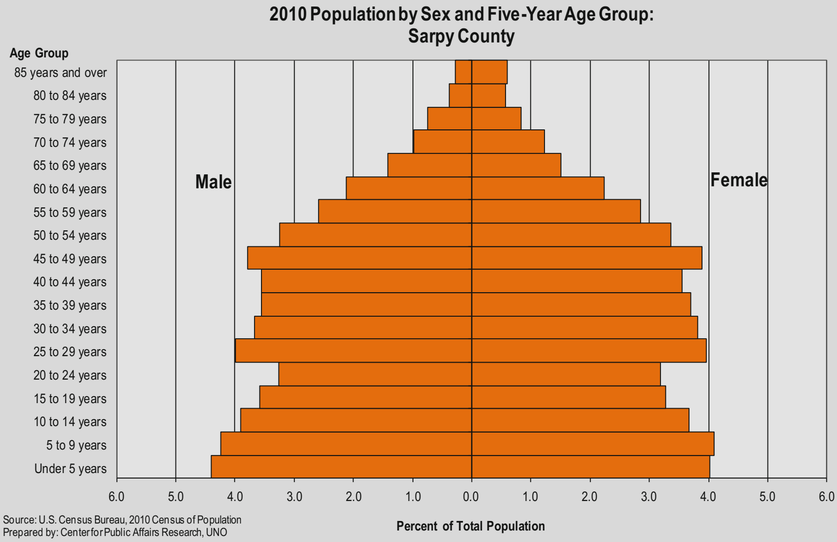


Exhibit 5.13



5.3.3 Dependency Ratios

Age data can be used to calculate *dependency ratios*, or the quotient of an area's dependent population divided by its "supporting" population. Dependent and supporting populations are defined in terms of economic dependence and independence. The supporting population in the United States is usually considered those individuals between the ages of 18 (or 20) and 64, while dependent populations are those under age 18 (or 20) and over age 64. Dependency and support are general notions regarding economic activity, and the population aged 18 (or 20) to 64 is considered to be economically active (income earning).

The *youth dependency ratio* for the United States in 2008 can be calculated as follows:

$$\frac{\text{number of persons under age 18}}{\text{number of persons 18–64}} = \frac{73{,}942{,}000}{191{,}248{,}000} = 0.39$$

This ratio of 0.39 converts to 2.56 persons of approximate working age for every person under age 18. Since 1950 this ratio has declined from 0.58 (1.72 persons of approximate working age for each person under age 18) reflecting the decline in the proportion of children within the U.S. population.

The *age dependency ratio* for 2008 can be calculated as follows:

$$\frac{\text{number of persons aged 65 and over}}{\text{number of persons 18–64}} = \frac{38{,}870{,}000}{191{,}248{,}000} = 0.20$$

This ratio of 0.20 converts to 5.00 persons of approximate working age for each person age 65 and over. Since 1950 this ratio has increased from 0.14 (7.14 persons of approximately working age for each person 65 and older). The age dependency ratio is used to illustrate the ability of a population to support its "non-productive" seniors as well as the growing impact of persons aged 65 and over on the U.S. Social Security system.

The *total dependency ratio* takes the sum of both dependent populations (under age 18 and over age 65) and divides by the number of persons aged 18 to 64. In 2008, the total dependency ratio was 0.59, or 1.69 persons of approximate working age for every person under age 18 or over age 64. Interestingly, the total dependency ratio has not changed much in 50 years; the tremendous growth in the elderly population has been offset by a significant decline in the youth population.

These ratios exhibit a great deal of variability across geographic areas, and this variation has important implications for the demand for services of various types. In 2010, for example, the youth dependency ratios for Garfield and Sarpy Counties, Nebraska, were 0.48 and 0.46, respectively. In contrast, the age dependency ratios were 0.52 and 0.12, respectively. In other words, Garfield County had approximately two workers for every person age 65 and over, while Sarpy County had eight.

5.3.4 Cohort Analysis

Another way of examining compositional data is through *cohort analysis*. A cohort is a group of persons with a common characteristic or characteristics. Age is the most frequent basis for cohort identification used by demographers, with cohorts established by grouping together persons of similar age. It is assumed, although not always correctly, that persons within a cohort share experiences and behavior because of this common characteristic. Cohort analysis typically involves following a cohort over time to measure the effects of exposure to various events, conditions, etc., such as American soldiers exposed to Agent Orange during the Vietnam War or patients undergoing a particular medical procedure.

One benefit of cohort analysis is the insights that can be provided into the future. If one knows the age distribution for a particular point in time, it becomes possible to make predictions concerning the future. For example, if one wants to know how many children will enter the first grade five years from now, we already know how many one-year-olds there are in the population. Of if we want to know how much the Medicare roll will swell in ten years, we already know how many 55-year-olds there are in the population. Of course, assumptions have to be made concerning death rates, birth rates and migration patterns depending on the circumstances. But within limits, cohort analysis provides demographers a tool for predicting future characteristics of the population.

Cohort analysis is sometimes used as a basis for ascribing experiences and behavior patterns to a cohort when individual data are not available. Cohort analysis can range from measuring the change in number and proportion of persons in various age groupings over time to ascertaining how cohort experiences affect different types of behavior (Swanson & Siegal, 2004). Cohort-to-cohort comparisons allow an assessment of change in cohort behavior over time.

Cohort analysis can be particularly useful in a healthcare setting. Since health problems are frequently age specific, cohort analysis can determine future patterns of morbidity and mortality. Age cohorts also exhibit varying types of health-related behavior or levels of exposure to a particular type of carcinogen that is unique to the population in question. Such a cohort could be tracked over time to provide insights, for example, into disease prevalence. Studying the transition or aging of a cohort from one period to the next may involve the use of mortality data and survival analysis. For example, the cohort aged 65–69 in 2010 is made up of those persons aged 60–64 in 2005 minus those who died during the interval (not accounting for immigration). Tracking change in cohort size tells the analyst a great deal about health service demands that are likely to characterize this cohort in the future.

5.4 Data Standardization

Population sizes vary among different geographic areas and, without some way of standardizing the phenomena being evaluated, comparisons between two or more populations can be misleading. Rates can be used to control for differences in size, allowing for the comparison of data for two or more regions, states, metropolitan areas, or market areas. However, even a simple comparison of rates can lead to incorrect conclusions.

For example, if two communities of 10,000 people were being compared and analysts found that one had twice the breast cancer prevalence rate as the other, it would be logical to assume that morbidity levels are higher for one population than the other. While variations in morbidity levels may be able to provide some explanation for the observed differential, demographic explanations must be considered as well. The simplest demographic analysis would determine if there were marked sex differences between the two communities. In other words, a heavily female community would clearly be expected to have more cases of breast cancer and, hence, a higher prevalence rate. Or suppose that one community has a much older age structure than the other. Since breast cancer is more common among older women, the older community would be expected to report more cases of breast cancer.

Up until this point, it has been argued that the age/sex structure differences in the two communities must be studied before cancer prevalence is evaluated. Are there any other demographic variables that might help explain why there is a breast cancer rate difference between the two communities? The researcher may want to consider racial-ethnic compositional differences and/or any other demographic factors known to be associated with breast cancer (e.g., childbearing history). The ultimate goal is to hold constant or control for as many of these factors as possible in order to eliminate competing explanations.

Exhibit 5.14 illustrates the advantages of accounting for age differences through age standardization. For the community under study age-specific prevalence rates were calculated in order to generate the number of breast cancer cases for the year in question. The observed prevalence was 1.72 cases per 1000 women, generating 86 cases of breast cancer within this population. This rate is higher than the 1.20 for the nation. Since this rate is higher than the national average its validity can be assessed by adjusting the population cohorts to resemble a standard population. If the 50,000 residents of this community exhibited the same age distribution as the nation, the incidence rate would be adjusted to 1.40 cases per 1000 and generate 70 cases. By using age standardization it becomes possible to determine whether the community truly has a higher than average prevalence rate. The adjusted rate of 1.40 is substantial lower than the observed rate (although still higher than the national average). This process allows for the generation of a more accurate indication of breast cancer incidence.

Exhibit 5.14: Age Composition and Incidence of Breast Cancer for Fictitious Community

Age group	Observed prevalence			Adjusted prevalence		
	Actual population			Standard population		
	Females	Rate[a]	Cases[b]	Females	Rate[a]	Cases[b]
0–24	13,000	0.02	0.26	16,500	0.02	0.33
25–44	12,000	0.50	2.00	13,000	0.50	6.50
45–64	13,000	2.50	32.50	12,500	2.50	31.25
65+	12,000	4.25	51.00	7500	4.25	31.88
Total	50,000	1.72	85.75	50,000	1.40	69.96

[a]Rate per 1000 female population
[b]Diagnosed cases of breast cancer

Exercise 5.1: Population Composition

For this exercise, students will access the Census Bureau site in order to locate data on population composition with which they should be familiar. Follow the steps below and obtain the data relevant to a city or county of your choice.

(1) Access the Census Bureau website at www.census.gov/quickfacts.
(2) Select a county from the menu box.
(3) Using the pulldown menu (All Topics) find the following information for the selected county.

- Total population (2016 estimate): ________________
- Population change (from 2010 to 2016): _________%
- Percent male: ____%
- Percent of the population that is under 5 years: _______%
- Number of people under 5 years (calculate): _________
- Percent of population that is 65 years or older: ________%
- Percent of the population that is white: ________%
- Percent of the population that is Hispanic: ________%
- Percent of the population that is foreign born: ________%
- Percent of the population (1 year and older) living in the same house last year: ______%
- Percent of the population (25 and older) with less than a high school education: ______%
- Percent of the population (25 and older) with a bachelor's degree: ______%
- Percent of homes owned by their occupants: ______%
- Average number of persons per household: ______

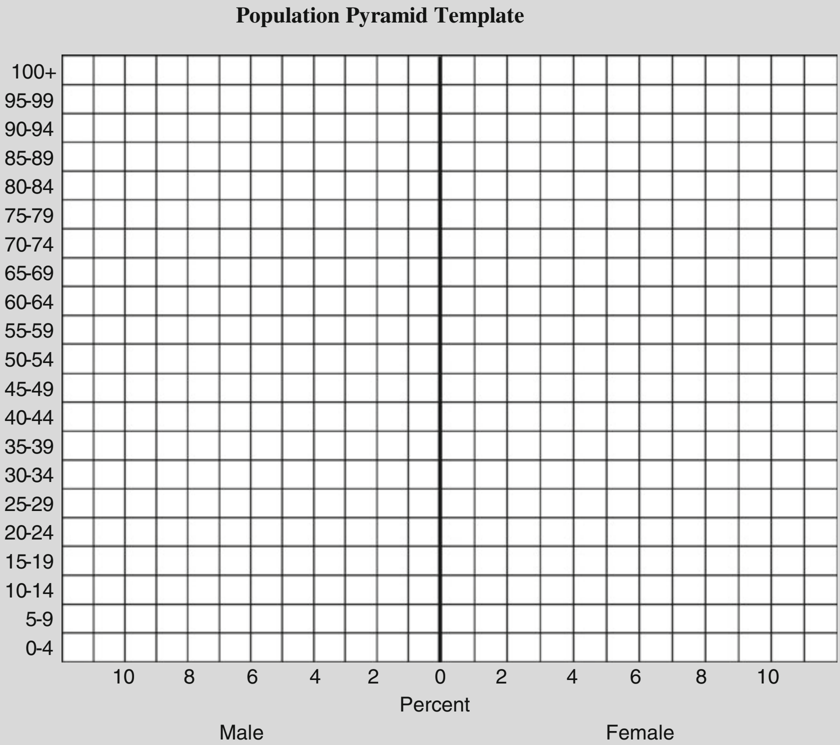
- Median household income: $________
- Percent of persons below poverty level: _______%
- Percent of businesses owned by women: ______ %
- Persons per square mile: ______

Exercise 5.2: Population Pyramid Exercise

The table below presents the age and sex distribution for the populations of five different countries. For this exercise students will produce two population pyramids—one for one of the first four countries (i.e., Afghanistan, Denmark, Russian Federation, Mexico) and one for the United States. Students will use the template provided below. The two population pyramids should be superimposed on one another in order to make comparisons possible.

Age	Country									
	Afghanistan		Denmark		Russian Federation		Mexico		United States	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
100+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
95–99	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
90–95	0.0	0.0	0.3	0.1	0.0	0.2	0.0	0.1	1.0	0.2
85–89	0.0	0.0	0.4	0.8	0.1	0.6	0.1	0.2	0.3	0.6
80–84	0.1	0.1	1.3	2.5	0.4	1.6	0.4	0.6	1.0	2.1
75–79	0.2	0.2	1.2	1.8	0.5	1.6	0.4	0.6	1.0	1.5
70–74	0.3	0.3	1.6	1.9	1.4	2.7	0.6	0.8	1.3	1.7
65–69	0.5	0.5	1.9	2.1	1.5	2.5	0.9	1.0	1.5	1.8
60–64	0.8	0.7	2.3	2.4	2.4	3.4	1.1	1.1	1.8	2.0
55–59	1.0	1.0	3.1	3.1	1.6	2.1	1.4	1.4	2.3	2.4
50–54	1.4	1.3	3.6	3.5	2.7	3.2	1.6	1.7	3.0	3.1
45–49	1.6	1.5	3.3	3.3	3.6	4.0	2.2	2.3	3.4	3.5
40–44	2.0	1.8	3.4	3.3	4.1	4.3	2.7	2.8	3.8	3.9
35–39	2.5	2.2	3.8	3.6	3.8	3.9	3.2	3.3	3.9	3.9
30–34	3.0	2.8	3.8	3.6	3.2	3.2	3.7	3.9	3.6	3.5
25–29	3.7	3.4	3.5	3.4	3.5	3.4	4.4	4.6	3.3	3.3
20–24	4.4	4.1	3.0	3.0	3.7	3.6	4.8	4.9	3.4	3.2
15–19	5.4	5.0	2.6	2.5	4.1	4.0	5.0	5.1	3.6	3.4
10–14	6.6	6.1	2.8	2.7	4.1	3.9	5.4	5.3	3.6	3.4
5–9	8.0	7.5	3.2	3.0	2.8	2.7	5.7	5.5	3.6	3.4
0–4	10.2	9.6	3.1	3.0	2.2	2.1	5.5	5.3	3.4	3.2

Population Pyramid Template



Exercise 5.3: Age Standardization Exercise

Using the data supplied below, calculate the crude death rate and the age-adjusted death rate for this community in Florida:

	Crude death	Original		Adjusted	
Age Category	Rate	Population (%)	Deaths	Population (%)	Deaths
0–15	2/100	1000 (12.5%)	____	1500 (18.8%)	____
15–29	1/100	1000 (12.5%)	____	1500 (18.8%)	____
30–44	3/100	1000 (12.5%)	____	1500 (18.8%)	____
45–59	5/100	2000 (25.0%)	____	1500 (18.8%)	____
60–74	15/100	2000 (25.0%)	____	1000 (12.5%)	____
75+	30/100	1000 (12.5%)	____	500 (6%)	____
Total		8000	____	8000	____

(continued)

(continued)

	Crude death	Original		Adjusted	
Age Category	Rate	Population (%)	Deaths	Population (%)	Deaths
Crude death rate:		Deaths per 100 persons =			____
Age-adjusted death rate:		Deaths per 100 persons =			_____

Additional Resources

American Community Survey. http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

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Chapter 6
Demographic Processes: Fertility

Abstract Fertility patterns are a major focus for demographic analysis. This chapter reviews the factors that demographers address when analyzing the fertility patterns associated with a population along with the measures used for describing fertility patterns. The demographic correlates of fertility are explored along with the ways in which demographers can contribute to our understanding of the reproductive process.

6.1 Introduction

Fertility refers to the reproductive experience of a population. The reproductive experience involves all factors related to sexual behavior, pregnancy, and birth outcome. The number of births as well as the characteristics of those births, along with characteristics of the individuals involved in reproductive activities constitute the basis for fertility analysis.

Fertility is a social process requiring the biological interaction of two persons within a defined economic, social and/or political context. Fertility behavior is viewed broadly here and includes pre-pregnancy behavior, prenatal care, health-related activities during pregnancy (e.g., cigarette smoking), pregnancy outcome (e.g., birth, miscarriage and induced abortion), and short-term post-natal care. The demographic perspective emphasizes the interplay of culture, technology and economic conditions with fertility behavior.

Fertility plays an important role in shaping the size and demographic makeup of a population. For most populations fertility is the primary driver of population growth. Various non-biological factors contribute to a population's fertility pattern, making an understanding of the demographic dimension critical.

R. K. Thomas, *Concepts, Methods and Practical Applications in Applied Demography*, https://doi.org/10.1007/978-3-319-65439-3_6

6.2 Concepts and Measures

Fertility is most often measured in terms of the number of births that occur within a population. For most purposes the number of births within a specified year is considered. Total births are typically broken out on the basis of race and ethnicity as well as other attributes. Year-to-year changes in the number of births represents a fertility trend.

Since virtually all births in the U.S. today are recorded on a standard birth certificate demographers have access to extensive data related to the birth experience, and a number of characteristics of mother, father and newborn are considered by demographers who study fertility. Although the birth certificate technically describes the newborn, much of the information therein relates to the mother. While the physical attributes of the newborn are considered, data are also included on the physical, social and economic attributes (including marital status) of the mother. Less detail—although still important—is collected on the father. Information on the circumstances associated with this birth and previous births is also collected. (More detail on the content of the birth certificate is found later in this chapter.)

Certain factors related to the status of the population vis-à-vis reproduction are considered by demographers. The physical potential for reproduction characterizing a given population is referred to as *fecundity* (in contrast to fertility which is the actual reproductive experience). Fecundity is determined by physiological constraints while fertility is driven primarily by social considerations.

To more accurately determine the level of fertility birth rates are calculated. The calculation of rates facilitates the comparison of fertility levels across areas that differ in size and/or other characteristics. Comparing the number of births for two cities with populations of 100,000 and 1,000,000 respectively, makes little sense given that the base population producing births is 10 times larger in the latter city.

The *crude birth rate* (CBR) is the most basic measure of fertility. It is calculated by dividing the total number of births for a given year (or the average over three years) by the midyear total population for that year (the midyear in the range if a three-year average of births is taken). This quotient is then expressed as the number of births per 1000 population. The crude birth rate for the U.S. was 23.7 births per 1000 persons in 1960 and fell to 12.5 by 2015 (Martin, Hamilton, Osterman, et al. 2017).

The crude birth rate is the simplest measure of fertility but, because it is "crude", it is refined by calculating the general fertility rate that focuses on women of child-bearing age rather than the total population.

While the CBR is adequate for making very general comparisons and has the advantage of requiring only two pieces of information, it has two major shortcomings. First, the denominator includes people who are not *at-risk* of having a birth. Males, very young females, and females beyond menopause are not at-risk of giving birth, yet they appear in the denominator of the rate. Second, the CBR masks differences between the age composition of populations. Fertility rates are greatly affected by age composition, particularly for women, and the CBR cannot account for this. Two populations of the same size could easily have dissimilar CBRs simply because females in the childbearing ages accounted for 20% of one population but 35% of the other. As a result of these shortcomings, more refined measures of fertility have been developed.

The *general fertility rate* (GFR), sometimes referred to simply as the *fertility rate*, represents a refinement of the CBR. It adjusts the denominator of the rate by focusing on the *population at risk*. It is expressed in terms of births per 1000 females aged 15–44 (or 15–49). In 1960, the GFR was 118 births per 1000 women aged 15–44, and by the mid-1990s it had declined to less than 60. The GFR reached a "modern" high of 69 in 2007 but has been declining since then (Ventura et al., 1999; Martin et al., 2017).

While the GFR expresses fertility in terms of births per 1000 women in the at-risk age group, it provides no information on fertility for specific age intervals (e.g., women aged 15–19). Additional information can be provided by calculating *age-specific birth rates*. Age-specific birth rates are essential in that changes in fertility levels specific to certain ages provide the analyst with much needed information regarding trends in service demand. For example, in 2008 12.4% of all births to women under age 15 were low birth weight, less than 2500 grams, compared to 7.4% of all women 25–29 (Martin, Hamilton, Sutton et al., 2010). Exhibit 6.1 presents the formulas utilized in the calculation of fertility rates.

Exhibit 6.1: Calculating Fertility Rates

Fertility rates are relatively easy to calculate, and in most instances the required data are readily available. Birth data (numerators) are available from vital statistics registries, and population figures (denominators) can be drawn from Census Bureau counts or estimates generated by other sources. These basic rates can be adjusted to reflect other factors such as age and marital status as desired.

$$\text{Crude birth rate (CBR)} = \frac{\text{Number of births in year X}}{\text{Population at midpoint (July 1) in year X}} \times 1000$$

$$\text{General fertility rate (GFR)} = \frac{\text{Number of births in year X}}{\text{Number of women age 15 to 44 (or 49) at midpoint (July 1) in year X}} \times 1000$$

$$\text{Age-specific fertility rate (ASDFR)} = \frac{\text{Number of births in year X to women age y to y + n}}{\text{Number of women age y to y + n at midpoint (July 1) in year X}} \times 1000$$

$$\text{Total fertility rate (TFR)} = \frac{\text{Sum of ASFRs} \times 5}{1000}$$

$$\text{Gross Reproduction Rate (GRR)} = \frac{\text{Female births}}{\text{Female + male births}} \times \text{Total fertility rate}$$

$$\text{Net reproduction rate (NRR)} = \text{Gross reproduction rate adjusted for female mortality}$$

The calculations below illustrate the process for generating various fertility rates for some of the more common metrics:

$$\text{Crude birth rate (CBR)} = \frac{100}{10,000} \times 1000 = 10/1000 \text{ population}$$

$$\text{General fertility rate (GFR)} = \frac{100}{2500} \times 1000 = 40/1000 \text{ women}$$

$$\text{Age - specific fertility rate (ASDFR)} = \frac{45}{1000 \text{ women } 25-29} \times 1000 = 45/1000 \text{ women } 25-29$$

$$\text{Total fertility rate (TFR)} = \frac{386.2 \times 5}{1000} = \frac{1931}{1000} = 1.931 \text{ lifetime births}$$

Demographers typically calculate age-specific fertility rates using five-year age intervals. Five-year intervals are used for convenience and, in cases like adolescent fertility measurement, narrower age intervals may be used. The age-specific fertility rate (ASFR) for women 20–24 years of age, for example, is derived by dividing the number of births to women who are 20–24 years of age by the number of women in the group (mid-year population). The rate is usually calculated for one year (or an average is taken for three consecutive years), and fertility is expressed in terms of births per 1000 women in the given age range. Exhibit 6.2 presents age-specific fertility rates for the United States in 2013. As can be seen, there are wide differences in the rates with the mode being the 25–29 age group. The rates for women under age 20 and 40 and over are understandably much smaller than those for women age 20–39.

Exhibit 6.2: Age-Specific Birth Rates: United States: 2013

Age group	Rate per 1000 women
10–14	0.3
15–19	26.5
20–24	80.7
25–29	105.5
30–34	98.0
35–39	49.3
40–44	10.4
45.49	0.8

Source National Center of Health Statistics

It is important to recognize that historically ASFRs have shown considerable short-term fertility variation. For example, in 1960 (during the peak of the baby boom) the ASFR for 20- to 24-year-olds was 258 (258 births per 1000 women in this age cohort). By 2013 this rate had declined to 106. While ASFRs have declined markedly since 1960 across the board, a somewhat different trend emerged toward the end of the century that involved an increase in ASFRs at the age intervals 30–34 and 35–39. These increases represent births to baby boom women who had postponed childbirth for various reasons. This development was essentially unanticipated by demographers and illustrates the elasticity that characterizes fertility rates.

There is considerable variation in age-specific fertility rates over time reflecting the social and cultural developments within society.

The *total fertility rate* (TFR) is sometimes utilized as a summary measure for age-specific fertility rates. The TFR reflects hypothetical completed fertility for a population. Technically, the only way to accurately determine how many children a cohort of young women (e.g., those currently under age 15) will have over their lifetimes is to wait 30 or more years until they have completed their childbearing. Therefore, hypothetical measures that allow an analyst to project the completed fertility of a specified cohort without the long wait have been developed. The calculation of the TFR assumes that a group of 15-year-old females will experience the same age-specific fertility rates throughout their lifetimes (e.g., at ages 15–19 56.8 births per 1000 women per year). Adding up all the ASFRs (multiplied by 5) produces a hypothetical total number of births per 1000 women. The TFR calculation yields figures of 1.8 births per woman for 1987, 2.08 for 2008, and 1.9 for 2013, for example.

The TFR has been further modified and refined by demographers. One modification, the *gross reproduction rate* (GRR), adjusts the TFR to include only female births. This adjustment makes intuitive sense since it is only females who can bear children. *Replacement-level fertility*, the number of births required for females to exactly replace themselves, is about one birth per woman over a lifetime, or a GRR of approximately one. While the first reaction with regard to arriving at the GRR might be to multiple TFR by 0.5, to do so would result in an overestimate of the GRR. Instead, the TFR must be multiplied by the inverse of the sex ratio at birth, which is about 105 male births for every 100 female births. In other words, the TFR should be multiplied by 0.488 in order to arrive at the GRR. More detailed calculations can be performed depending upon the need for precision in the GRR.

The total fertility rate is an estimate of the total average number of births for women in society over their lifetime and must equal at least 2.1 births on average in order to maintain replacement levels.

While the GRR meets the demand for a measure of replacement, it fails to account for the mortality experience of both children and mothers. Therefore, an additional refinement, the *net reproduction rate* (NRR), has been created in order to adjust the measure of replacement by accounting for the deaths to women and female children that are known to occur. Adjusting for mortality results in NRRs that are smaller than GRRs. However, replacement fertility remains at 1; that is, the NRR must be 1 to have a replacement-level fertility. The factors used to adjust the GRR are derived from observed mortality data and the life tables that are based on these data.

6.3 Trends in Fertility in the U.S.

A number of important fertility-related trends can be identified for the United States population. The number of births increased from 2.9 million in 1945 to 4.3 million annually for 1957 through 1961. The period from 1946 to 1964 is generally recognized as the era of the *post-World War II baby boom*; until 1989, 1964 was the last year in which there were at least 4 million births in the United States. The interval 1965–1972 is seen as the transition to the *baby bust* that lasted from 1972 to 1978. Although some regard post-1978 fertility as evidence of a baby boomlet, a better explanation is to note that there was an *echo baby boom*. In other words, there was an increase in births due to the rapid rise in the number of potential and then actual mothers as the early baby boomers reached their childbearing years.

After 1987 there was an increase in the number of births that could not be explained by the echo effect. The number gradually increased through the end of the twentieth century and continued to rise in the early part of the twenty-first century.

By 2007, the figure for annual births had reached 4.3 million, a number not realized since the 1957–1961 period. Since the latter figure is generated by a population with a much larger base, the increase in births represented an actual decline in the fertility rate. This figure dropped below 4 million in 2010. It should be noted that changes in fertility are increasingly being driven by growing non-white racial and ethnic groups. Exhibits 6.3, 6.4 and 6.5 present trends in the number of births and birth rates for the U.S.

The fertility rate is highly elastic and fluctuates in response to social, economic and political developments within society.

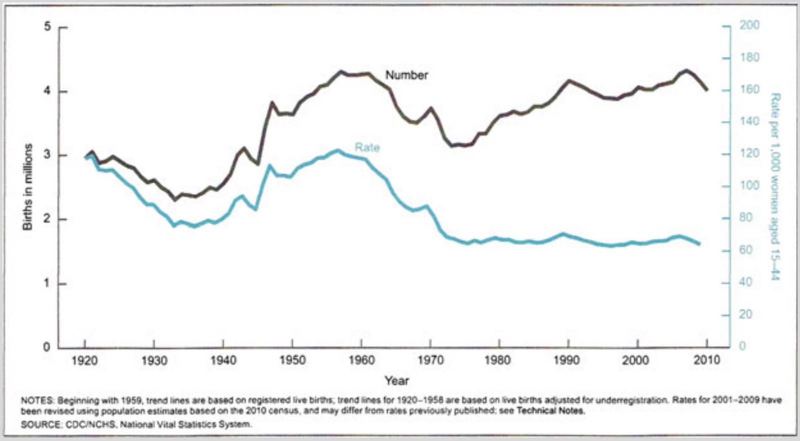
Longer-term fluctuations in the number of births translate into changes in the size of age cohorts over time. Fewer births result in the shrinking of the population at younger ages (e.g., 15–24 years of age). Projections beyond 2010 indicate reductions in the size of other age groups (e.g., 35–50), and this downturn is largely driven by a decline in the number of births at an earlier time. The continued trend toward smaller households and families as well as the reduction in the proportion of persons living in families means that there will be other as yet indiscernible changes in the age distribution in the future.

Exhibit 6.3: Number of Births (000 s)

2014	3932
2010	3999
2000	4058
1990	4158
1980	3612
1970	3700
1960	4300
1950	3600

Source National Center of Health Statistics

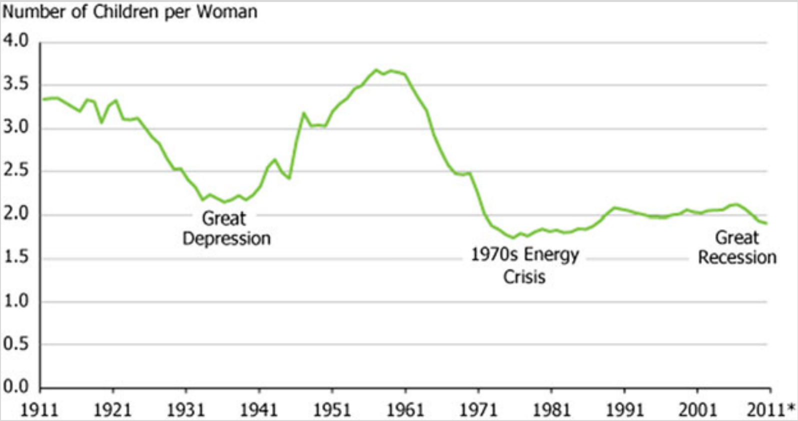
Exhibit 6.4: Annual Births and Fertility Rates: U.S., 1945–2010



Source Martin, Hamilton, Ventura, et al. (2012)

At the state and local levels, fertility patterns may vary significantly from those at the national level. For example, the number of births in Florida and California increased from approximately 115,000 and 363,000 in 1970 to 231,000 and 552,000, respectively, in 2008 (Martin, Hamilton, Sutton et al., 2010). Thus, the annual number of births in these areas increased by 100% and 52%, respectively. Births in Ohio and New York, on the other hand, declined from 200,000 and 318,000 to 141,000 and 250,000, respectively, during the same time interval. These figures represent decreases of 29% and 21%, respectively. Such variation in fertility trends have clear implications for population growth in the respective states.

Exhibit 6.5: Total Fertility Rate: United States: 1911–2011



*Estimated by Population Reference Bureau
Source National Center for Health Statistics

Exhibit 6.6 presents age specific fertility rates for three years: 1960, 1980 and 2010. The variation in age specific birth rates is marked. During the post war baby boom all rates were high, with peak figures at ages 20–24 and 25–29. Twenty years later, during the baby bust, almost all rates had fallen, and by a large margin. However, the figures for 2010 show a shift in pattern. Rates for ages 25 and above all show an increase from those seen in 1980 and for the ages 30 and above the upward movement is substantial.

As noted earlier, a TFR of 2.1 is considered to be replacement level fertility. Very low TFRs, less than 2.1, over a longer period of time result in an aging population and eventual population decline if there is not counter-balancing immigration flow in place. The TFR for the U.S. has been below 2.1 since the mid-1970s, and without significant immigration the U.S. population would achieve zero population growth and subsequent population decline once population momentum was lost. The most recent trends in the TFR in the U.S. show a small increase from 1.9 in 1990 to 2.08 around the turn of the century and back to 1.9 today. Fertility rates for the African American and Hispanic populations are somewhat higher than that for whites, and as the U.S. population becomes more heavily populated by these two minority groups the TFR will rise without any real change in fertility. In 2015, the TFR for whites was 1.89, followed by African Americans, 1.85, and Hispanics, 2.12 (Martin et al., 2017).

Exhibit 6.6: Age Specific Birth Rates in the United States: 1960–2010

Age category	1960[a]	1980[a]	2010[a]
10–14	0.8	1.1	0.6
15–19	89.1	53.0	41.5
20–24	258.1	115.1	103.0
25–29	197.4	112.9	115.1
30–34	112.7	61.9	99.3
35–39	56.2	19.8	46.9
40–44	15.5	3.9	9.8
45–49	0.9	0.2	0.7

[a]Number of Births per 1000 women in age category
Sources Martin et al. (2012); U.S. Bureau of the Census (1996)

There are several trends in factors related to birth outcomes that are important to consider. These factors help explain the hows and whys of fertility variations and trends. With regard to the likelihood of conception, several trends are worthy of note. Not only has contraceptive use increased since the 1970s, but the pattern of use has changed over time. Nearly 62% of women of childbearing age use some type of nonsurgical contraceptive (e.g., oral contraception, intrauterine device [IUD] or diaphragm). Nearly 17% have been sterilized (U.S. Census Bureau, 2010). Reliance on the pill, IUD, and diaphragm has declined since the 1970s, while sterilization as a means of contraception has become increasingly common. There remains a large number of women who do not use contraceptives, leaving them at risk of pregnancy (either wanted and unwanted).

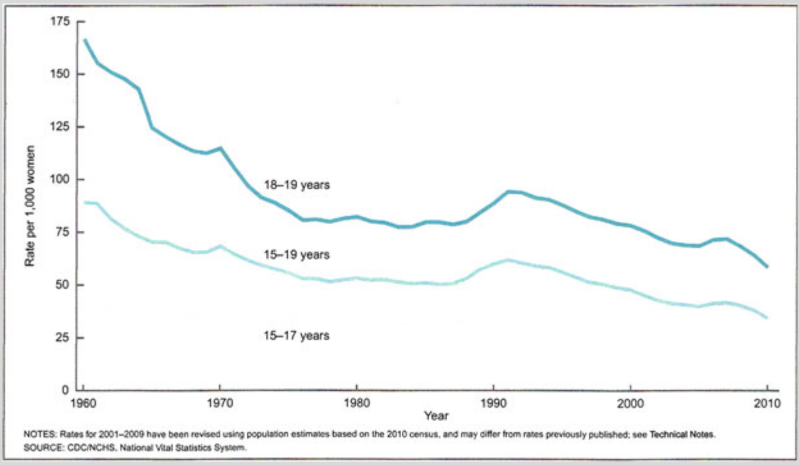
Contemporary U.S. fertility patterns represent a departure from historic patterns reflecting changes in age-specific fertility, births to unmarried women and overall lower fertility among other trends.

A change in the average age at first intercourse can have important implications for the health of a population. Premarital intercourse on the part of teenagers has increased markedly since the 1970s, with earlier age of first intercourse resulting in a rise in the risk of pregnancy and increased exposure to sexually transmitted diseases. Despite the increasingly younger age of first intercourse the birth rate for women 15–19 has steadily declined largely due to increases in the proportion using contraceptives. Exhibit 6.7 presents trends in births to teenagers in the U.S.

Another major trend in fertility variation relates to children born to unmarried women. In 2015, nearly 40% of all births in the United States were to unmarried mothers. Approximately 71% of all African-American births were to women who were unmarried, but only 29% of non-Hispanic white births were so classified

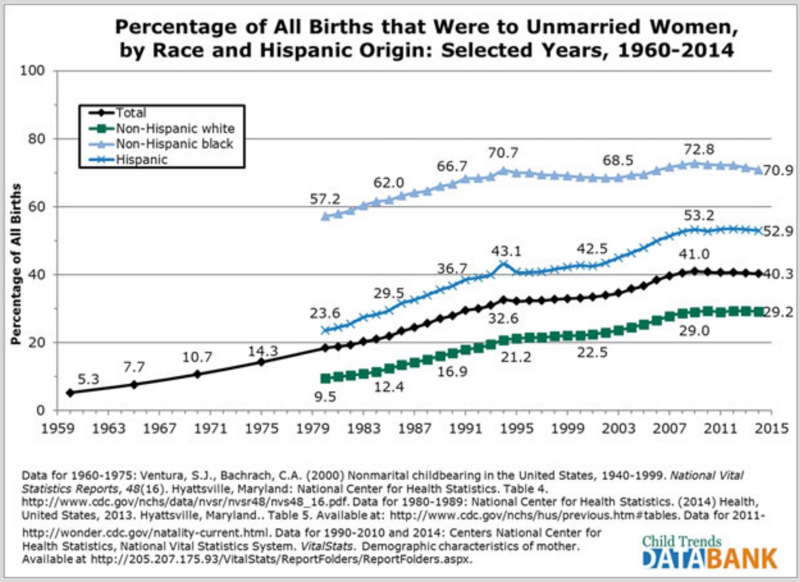
(Child Trends, 2014). Since 2007 the proportion of births occurring out of wedlock appears to have leveled off across the board. When the age of the mother is adjusted for race and ethnicity the differential narrows. At ages 15–19, 82% and 98% of all white and African-American births, respectively, are to mothers who are unmarried. At ages 30–34, 11% of white births and 19% of African-American births are to unmarried mothers.

Exhibit 6.7: Trends in Births to Teenagers: United States: 1960–2010



The fertility trend with perhaps the most implications in terms of future population characteristics is the shift in the preponderance of births from non-Hispanic whites to various racial and ethnic minorities that has occurred over the past 20 years. In 2015 the white population recorded a lower fertility rate than any racial or ethnic minority group tracked but American Indians. This trend has already led to a predominance of minority children over majority children within the U.S. population. This pattern can expect to be maintained for the foreseeable future as the size of the minority population continues to increase relative to the non-Hispanic white population and fertility rates continue to favor various racial and ethnic minorities. Exhibit 6.8 presents recent trends in the percentage of births to mothers who are unmarried by race and ethnicity.

Exhibit 6.8: Births to Unmarried Women By Race and Hispanic Origin, 1960–2014



One of the more controversial trends related to fertility in the United States is the growth in the number of annual abortions since that procedure was declared legal in the 1970s. The number of legal abortions climbed steadily from the liberalization of abortion laws from 200,000 in 1970 to a high of around 1.6 million in 1980. Since 1980 the number has steadily decreased, representing a decline of about 400,000 annually. Exhibit 6.9 describes some of the issues associated with reproductive health.

Exhibit 6.9: Reproductive Health Issues

The U.S. population is plagued by a number of issues related to reproductive health. These issues are particularly glaring when comparisons are made with other developed countries. The health of American women and their children should be a concern based on the available statistics.

Despite all of the advantages available to the U.S. population nearly 12% of the births in 2014 involved low birth-weight babies. This is actually a somewhat higher figure than five years earlier. The majority of these low-birth weight babies were delivered to non-white mothers. The proportion of low birth-babies is viewed unfavorably in international comparisons with the U.S. rate being worse than most countries in Europe, Latin America and the Caribbean and even some countries in Africa.

Low birth-weight is often associated with prematurity, and the U.S. compares unfavorably here as well. Although the number of preterm births (before 37 weeks of pregnancy) has declined since 2007, nearly 10% of U.S. infants were born prematurely in 2014. The earlier an infant is born, the more likely he or she is to require intensive and prolonged hospitalization and have higher medical costs. Further, premature infants are also more likely to have lifelong health problems. Infant death rates related to preterm birth are three times higher for black infants than for white infants. Approximately two-thirds of the world's countries exhibit lower rates for premature births than the U.S.

In 2014, the teen birth rate (women aged 15–19 years) for the U.S. was 24.2 per 1000 women. Although this is an historic low for U.S. teens and a drop of 9% from 2013, it is still high by international standards. Although the reasons for the decline are not clear, it is thought that more teens are delaying or reducing sexual activity, and more sexually active teens are using birth control than in previous years. Still, racial/ethnic and geographic disparities in teen birth rates persist. Black and Hispanic teen birth rates are more than two times higher than those for non-Hispanic white teens; American Indian/Alaska Native teen birth rates remained more than one and a half times higher than the non-Hispanic white teen birth rate. The U.S. teen pregnancy rate is substantially higher than in other western industrialized nations. In fact, the U.S. rate is twice that of the next closest country and five times the rate of some other developed countries.

Despite widespread access to contraceptives the U.S. population still records a relatively high rate of unwanted and/or unintended pregnancies. An unintended pregnancy is a pregnancy that is reported to have been either unwanted (that is, the pregnancy occurred when no children, or no more children, were desired) or mistimed (that is, the pregnancy occurred earlier than desired). Unintended pregnancy is associated with an increased risk of problems for both mother and baby. Nearly half of the births in the U.S. today are unintended. African-American women are three times as likely as white women to experience an unintended pregnancy, and low-income Latinas are nearly twice as likely as low-income white women to have an unintended pregnancy. The rate of unintended pregnancy in the U.S. is significantly higher than the world average and nearly twice the European average.

In 2014 40% of U.S. births were attributed to unmarried women. Some 71% of black births were out-of-wedlock births compared to 29% of the white births. To the extent that being an unmarried mother carries health risks for both mother and child, it is found that Hispanics record the highest rate of births to unmarried mothers, followed closely by African-Americans. The proportion of births to unmarried women has grown steadily since the 1950s and only leveled off since 2007. While the U.S. rate is comparable to the average for participants in the Organisation for Economic Co-operation and

Development (OECD), 19 OECD countries report lower rates of out-of-wedlock births.

The infant mortality rate for the U.S. has declined steadily over time and has leveled off with around 6 deaths/1000 live births recorded in 2014. The leading causes of infant death are birth defects, preterm birth or low birth weight, maternal complications of pregnancy, sudden infant death syndrome (SIDS), and unintentional injuries. When it comes to infant mortality African-Americans stand out for their high rates, followed by American Indians and Hispanics (Matthews and MacDorman, 2013). The U.S. infant mortality rate is worse than 25 other countries and two or more times that of other developed countries.

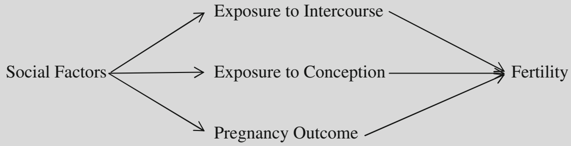
Despite advances in medicine and medical technologies, the rate of pregnancy-related deaths in the United States has increased over the past 25 years, with the maternal mortality rate in the U.S. more than doubling between 2000 and 2010. Much of the mortality (and particularly the recent uptick) can be can be attributed primarily to the black population (although poorly educated whites have also exhibited an increase). The U.S. is the only developed country to experience such an uptick in modern times. There are 48 countries with more favorable maternal mortality rates than the U.S.

6.4 Factors Affecting Fertility

Fertility rates are highly elastic and a number of social factors affect them. A model for understanding these factors was developed during the 1950s by Davis and Blake (1956) and is still useful today. The model as presented in Exhibit 6.10 illustrates the factors influencing fertility outcomes. These factors do not act independently of each other, although each category represents a separate stage in the fertility process. That is, intercourse must occur first, followed by conception, and last, by successful gestation. The intercourse variable is operationalized in terms of age at first intercourse, frequency of intercourse, time spent in and out of marriage, and age at first marriage.

The second set of factors, "exposure to conception," reflects the level of contraceptive use, sterilization, and infertility. The last group of factors focuses on pregnancy outcomes measured in terms of frequency of normal deliveries as well as miscarriages, stillbirths, and induced abortions. Together with social factors such as age, socioeconomic status, race-ethnicity, and marital status of mothers, these factors determine the level of fertility for a defined population. Note that the focus of the Davis-Blake model, as well as that for most fertility analyses, is on the study of women. Few data are available on men in this regard, and the interest in fertility analysis from a male perspective is a relatively recent phenomenon (e.g., Zhang, 2011).

Exhibit 6.10: Factors Affecting Fertility



Source Davis and Blake (1956).

There is a close correlation between fertility patterns and demographic attributes. The implications of the age distribution of women within a population for fertility have previously been addressed, but a number of other demographic attributes play into fertility patterns. The racial and ethnic makeup of a population is an important consideration when it comes to fertility rates, with several differences in fertility patterns apparent. In 2015, the general fertility rate for white women aged 15–44 was 63.1 births per 1000, compared to 64.0 for African Americans and 62.5 for Hispanics (Martin et al., 2017). Even among these major groupings there is variation with the rate for Hispanics ranging from 52.1 for Cuban-Americans to 95.0 for those of Central and South American origin. The fertility rates generated for 2015 indicate a narrowing of differences in fertility for various racial and ethnic groups. However, the long-term trend suggests a decline in fertility for non-Hispanic whites and continued relatively high fertility for most other racial and ethnic groups.

Fertility differences based on the educational attainment of the mother are even greater than those for race and ethnicity. Women with less than a high school education will have the most children over their lifetimes, followed by high school graduates and college graduates, with those with an advanced degree recording half the number of births over their lifetimes as those without a high school diploma. College-educated women in particular have exhibited a dramatic shift to a later age of childbearing over the past 35 years.

Fertility rates are correlated with a a variety of demographic variables and are influenced by racial and ethnic mix, marital status, income, education and labor force participation among other demographic attributes.

Of particular interest to demographers is the marital status of women who give birth. Two generations ago virtually all births in the U.S. occurred to married women. Since then the proportion of out-of-wedlock births has increased steadily to the point today that barely half of births occur to married women. In 1960 only 5% of births occurred to unmarried women compared to 40% in 2015. The likelihood of being an unmarried mother decreases markedly as the age of the mother increases.

For example, while nearly 75% of all births to 15-year-old women are to those classified as unmarried, only 15% of the births to 30- to 34-year-old women are so classified. The increased level of nonmarital fertility reflects the rise in nonmarital sex over time.

The implications of a high rate of births to unmarried women are significant, with this trend contributing to a radical modification of household structures in the U.S. and making single female heads-of-household the fastest growing household type. In addition, there are important social and economic implications of a high rate of births to unmarried women. The potential consequences for the mental and physical health of both the mother and the baby are significant, especially since unmarried mothers typically have limited access to health services.

Fertility levels vary widely by labor force status and income level as well. The overall birth rate for those in the labor force 2015 was 7.9/1000 versus 9.2 for those not in the labor force. The highest fertility rate is for the unemployed whose rate of 16.7 compares to 7.3 for the employed.

In regard to income, those living at or below the poverty level report a GRR of 81.7. The rate declines sharply with increases in income with the GFR for those with incomes 200% or more of poverty reporting a rate of 44.8 (Martin et al., 2017). Exhibit 6.11 describes the variation in fertility levels of various demographic subgroups in U.S. society.

Exhibit 6.11: Who's Having Babies?
Global fertility rates mask the significant variation that exists among various groups within the U.S. population when it comes to reproductive patterns. Fertility rates vary widely along a number of demographic dimensions. Some of the more important distinctions are illustrated below (with most figures based on 2015 data):

Age of Mother/Father	Rate/1000	
	Mother	Father
10–19	24.2	9.0
20–24	76.8	51.6
25–29	**104.3**	87.4
30–34	101.5	**103.8**
35–39	51.8	69.1
40–44	11.0	28.6

Race and Ethnicity	Rate/1000
White	12.0
Black	14.3
American Indian	9.7
Asian/Pacific Islander	14.0
Hispanic	**16.3**

Educational Level	Rate/1000
Less than high school	**17.4**
High school only	10.1
Some college	8.8
Associate degree	7.0
Bachelor's degree	3.6
Graduate/professional degree	4.0

Marital Status	Rate/1000 women
Currently married	**88.7**
Not married	51.8

Labor Force Status	Rate/1000
In labor force	7.9
Employed	7.3
Unemployed	**16.7**
Not in labor force	9.2

Poverty Status	Rate/1000 women
At or below poverty level	**81.7**
100–199% of poverty level	62.8
200% or more above poverty level	44.8

Source Martin et al. (2017)

The above discussion does not present an exhaustive list of the factors having potential impact on fertility with the factors worthy of concern varying from community to community. Compositional change (e.g., changing age or racial/ethnic composition) over time is equally important given the population redistribution patterns underway in the United States.

6.5 Data Sources for Fertility Analyses

Fertility data are drawn from a variety of sources, although official vital statistics registries represent the most reliable source. Relatively high-quality birth registration systems exist in each state, and the standard birth certificate includes a variety of data on the characteristics of the child, mother, and father. Data from these state systems are compiled at the national level by the National Center for Health Statistics. Exhibit 6.12 provides a list of items on the standard birth certificate.

Exhibit 6.12: Items Included on the Standard Certificate of Live Birth

Child	Mother	Father	Pregnancy
Name	Name	Name	Pregnancy history
Sex	Age	Age	Date of last normal menses
Date of birth	State of birth	State of birth	Month prenatal care began
Hospital/facility name	Place of residence	Race/ethnicity	Prenatal visits
County of birth	Race/ethnicity	Education	Pregnancy complications
Birth weight	Marital status	Relation to child	Concurrent illnesses
Apgar score	Education		Congenital anomalies
			Method of delivery
			Medical risk factors
			Obstetric procedures

Source National Center for Health Statistics

In addition to the birth registration system, sample surveys are a source of data on fertility-related behavior. Surveys provide information on such issues as contraceptive use, infertility, and breast-feeding practices. Surveys like the National Survey of Family Growth conducted by the National Center for Health Statistics make it possible to track trends in fertility-related behavior.

The U.S. Census Bureau collects data on a limited number of fertility issues through both the American Community Survey (ACS) and the Current Population Survey (CPS). In the ACS, women are asked whether or not they had given birth within the previous year. The CPS has a more extensive list of fertility inquiries, including questions with regard to actual and expected fertility whose answers are cross-tabulated by other demographic factors.

For statistical purposes, births are assigned to both the mother's *place of residence* and the *place of occurrence*. For most purposes, place of residence is the most important consideration. Fertility rates and associated statistics are relevant for the community in which the mother resides and not for the place where the birth occurred, especially if the delivery takes place outside the community of residence. This has become a more frequent occurrence as an increasing number of rural areas lack obstetrical facilitates, and expectant mothers are required to travel outside their home communities for care. There are also the rare occasions where an expectant mother is traveling away from home when an unexpected delivery occurs. From an applied perspective, information on births by place of occurrence may be useful especially to health demographers involved in the planning of obstetrical services. Case Study 6.1 describes efforts to reduce infant mortality within a disadvantaged community.

Case Study 6.1: Reducing Infant Mortality Among a Disadvantaged Population

Infant mortality remains a problem in the U.S. particularly among low-income minority populations. Many disadvantaged communities exhibit infant mortality rates comparable to "third-world" countries. The problem of low birth weight has emerged as the single most important cause of infant death and subsequent health problems in infancy and childhood. Although low birth weight babies represent a small percentage of all babies born, well over half of all infant deaths occur among this group. The relationship between infant mortality/morbidity and low birth weight has been known for many years and, despite dramatic overall changes and medical advances, the incidence of low birth weight among high-risk populations continues to be a perennial problem.

The existence of high infant mortality rates reflects the convergence of multiple demographic attributes. Low-birth weight (and hence infant mortality) is not randomly distributed among the population, but is endemic within certain demographic subgroups. The demographic attributes associated with low-birth weight are age (i.e., under 16 years/over 35 years), race (i.e. African-American), income (i.e., at or below poverty level), marital status (i.e., unmarried), and education (i.e., low educational attainment). Any one of these factors could contribute to the likelihood of low birth weight and a combination of these almost assures an at-risk pregnancy.

One solution offered to address the issue of low-birth weight was a program that identified at-risk mothers early in the process. Working through various social service agencies and health facilities, at-risk mothers were identified and targeted for the risk-reduction program. Educational materials were developed customized to resonate with women in these risk categories. More important, a home visitation program was developed to provide on-going attention to the at-risk mothers. Importantly, peer mentors were utilized who were matched with the at-risk mothers on the basis of their demographic characteristics.

After two years of program operation, there is evidence that the infant mortality rate is actually being affected. There has also been a reduction in the number of low-birth weight babies in the community. Although it is difficult to isolate the effects of this particular infant mortality reduction program (given that there were other programs operating as well), there is evidence that leveraging information on the demographic attributes of the at-risk population allowed for the development of an informed risk-reduction program.

Exercise 6.1: Calculating Age-Specific Fertility Rates

For this exercise students will calculate age-specific fertility rates using the cohorts of child-bearing age women in North County. Column 1 lists the age interval for child-bearing age women, Column 2 the number of women in each cohort, and Column 3 the number of births generated by that age cohort. Students must perform the calculations to generate the entries for the empty columns.

Age interval	No. of women	No. of births	No. of births/No. of women	Multiplier	ASFR
10–14	6600	6	______	1000	______
15–19	5745	300	______	1000	______
20–24	4331	478	______	1000	______
25–29	5454	621	______	1000	______
30–34	6162	526	______	1000	______
35–39	6754	244	______	1000	______
40–44	6217	44	______	1000	______
Total	41,163	2219	______	1000	______

Exercise 6.2: Calculating Changes in Racial/Ethnic Mix
Using the data supplied below, calculate the births and new population for these racial/ethnic groups:

Racial/ethnic group	Annual birth rate	Original population (%)	Annual births	10-year change	New population
Non-hisp. whites	10/1000	10,000 (48%)	____	______	______ (___%)
Hispanics	25/1000	5000 (24%)	____	______	______ (___%)
African Americans	20/1000	5000 (24%)	____	______	______ (___%)
Asian-Americans	15/1000	1000 (5%)	____	______	______ (___%)
Total		21,000	____	______	______ (100%)

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Chapter 7
Demographic Processes: Mortality

Abstract The study of mortality is a major endeavor among demographers with the analysis of mortality patterns being central to applied demography. An examination of deaths and death rates allows the demographer to understand patterns of mortality within a population. This chapter considers the factors that contribute to mortality and the variation that exists in mortality risk among various groups in society.

7.1 Introduction

Mortality refers to the level of death characterizing a population, and the study of it involves research on the who, how, why, and when issues related to dying. Demographers have contributed greatly to our understanding of mortality both in terms of the development of mortality measures and the identification of patterns within the population. Applied mortality analyses can inform efforts to reduce overall mortality within the population as well as mortality attributed to specific causes.

The study of mortality has historically been important to population scientists for several reasons. As one of the three primary demographic processes its analysis is considered critical to an understanding of population growth and change. Mortality serves as a limiting factor vis-à-vis population growth, and a society's pattern of mortality is reflected in its population composition. A preponderance of seniors (and, conversely, the relative dearth of youth) reflects the decreased mortality and increased longevity characterizing the U.S. population. Similarly, the "Arab spring" that occurred around 2010 in several Middle Eastern countries was a manifestation of a precipitous decline in infant mortality. For the first time in history a preponderance of infants survived to young adulthood in certain Middle Eastern countries, resulting in a demographic "bulge" in the young adult age cohort.

The impact of mortality on contemporary U.S. society is not as significant as it has been in the past. The mortality rate has dropped to the point that death is a relatively rare event (even though the number of annual deaths continues to edge

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up). As a component of population change, mortality has become less important than fertility and both have become less important than migration in the U.S. today. Further, the correspondence between mortality and morbidity has become less clear. Because of the preponderance of chronic disease within the U.S. population, determining the "true" cause of death has become increasingly challenging. This is not to say that mortality analysis cannot provide insights into a society's health status and morbidity patterns, but that the situation is more complicated today and requires a better understanding of disease processes and the vagaries of death certificates than in the past.

7.2 Concepts and Measures

7.2.1 Concepts

Mortality refers to the level of death within a population as measured by the number of deaths and the death rates characterizing that population during a particular time period. *Death* is defined as the complete cessation of life after a live birth has taken place. Deaths that occur prior to a live birth–fetal deaths—are allocated to a separate category of mortality study. Though the words "cessation of life" may seem to comprise a simple, straightforward definition, medical advances are making the interpretation of death more complex. The definition of death is constantly being rewritten in the light of medical and technological advances, although that issue is beyond the scope of this book.

Although deaths are counted and rates calculated for the general populations as a first step in mortality analysis, infant deaths represent a special category. *Infant mortality* refers to the level of death characterizing babies under one year of age. The infant mortality rate (IMR) is considered a useful indicator for comparing the health and well-being of groups across and within populations. The rate of infant mortality is considered a measure of not only health status but of the social, economic and environmental conditions characterizing a population, thereby providing insights that extend beyond a simple recounting of infant deaths.

The IMR can be divided into *neonatal* and *postneonatal* components, with the former referring to deaths during the first 28 days of life and the latter reflecting deaths occurring from 29 days to one year. Deaths occurring prior to delivery are considered *fetal* deaths. Deaths during the first month of life are most often a result of congenital abnormalities, low birth weight and birth complications, respiratory distress syndrome, and maternal complications of pregnancy. Deaths during the remainder of the first year are primarily due to environmental factors. Sudden infant death (SIDS) is a major factor in post-neonatal deaths, accounting for some 30% of deaths during this period.

The *causes of death* affecting a population are a major factor in determining the level of mortality characterizing a population. Populations in different times and places are subject to different threats to health which, in turn, determine the conditions from which most people die. These causes of death are subject to change over time, and the United States population has undergone significant transformation of its primary causes of death since the early part of the 20th century. From an applied perspective, this aspect requires particular attention, since there are major correlations between demographic attributes and mortality rates resulting in significant disparities in mortality among different population groups within contemporary U.S. society.

7.2.2 Measures

The most basic way to measure mortality is simply to count the number of deaths that occur within a population during a specific period of time. Such counts are usually based on a one-year period and may be reported for the nation as a whole, states, metropolitan areas or smaller geographic areas. Virtually every death in the U.S. is recorded, and as a result our death data are of very high quality. Compiling death counts over a period of years allows demographers to identify trends with regard to increases or decreases in mortality. Insights into mortality can be gained by cross-classifying deaths by the medical, social, and economic characteristics of the deceased (e.g., cause of death and age at death).

Using a simple count of deaths in the analysis of mortality has several shortcomings. As in the case of fertility analysis, a comparison of deaths among geographic areas or over time is generally not very useful, given the various sizes of the populations reporting these deaths. It would not be meaningful, for example, to compare the number of deaths in Community X (population 10,000) with the number of deaths in Community Y (population 100,000). Because of the need to compare mortality levels for different populations and over time, demographers have developed a number of rates for this purpose. Exhibit 7.1 presents the calculations used to generate commonly used measures of mortality. (Note that the method for calculating age-adjusted death rates is not included here but is dealt with in Exhibit 7.2.)

> *The crude death rate is frequently used due to its ease of calculation. However, being "crude" it may not provide the most accurate measure of mortality, and demographers frequently adjust this rate to take age structure and other factors into consideration when measuring mortality.*

The simplest measure used is the *crude death rate* (CDR). Like the crude birth rate discussed in Chap. 6, this rate expresses mortality as the number of deaths per 1000 population during a particular year (e.g., 6.5 deaths per 1000 people in 2010). The number of deaths, particularly for small populations, may fluctuate widely from year to year, and researchers may calculate a 3-year average to account for this. Crude death rates are frequently cited due to their ease of calculation. However, just as it is not very useful to compare numbers of deaths for various communities, comparisons based on crude death rates can be misleading.

Exhibit 7.1: Calculation of Mortality Rates

The calculation of mortality rates is relatively straightforward and the requisite data are usually readily available. Death data (numerators) are available from vital statistics registries, and population figures (denominators) can be drawn from Census Bureau data, state demographic centers or commercial data vendors.

$$\text{Crude death rate (CDR)} = \frac{\text{Number of deaths in year } X}{\text{Midyear population in year } X} \times 1000$$

$$\text{Age-specific death rate (ASDR)} = \frac{\text{Deaths to persons age } X \text{ to age } X+5 \text{ in year } Y}{\text{Number of persons age } X \text{ to age } X+5 \text{ in year } Y} \times 1000$$

$$\text{Infant mortality rate (IMR)} = \frac{\text{Number of deaths to persons under 1 year of age in year } X}{\text{Live births in year } X} \times 1000$$

$$\text{Neonatal mortality rate (NMR)} = \frac{\text{Number of deaths to persons 1 to 28 days of age in year } X}{\text{Live births in year } X} \times 1000$$

$$\text{Post-neonatal mortality rate (PNMR)} = \frac{\text{Number of deaths to persons 29 days to 1 year of age in year } X}{\text{Live births in year } X} \times 1000$$

$$\text{Cause-specific death rate (CSDR)} = \frac{\text{Number of deaths from a specific cause in year } X}{\text{Midyear population in year } X} \times 1000$$

$$\text{Maternal mortality rate (MMR)} = \frac{\text{Number of women dying during childbirth in year } X}{\text{Live births in year } X} \times 1000$$

The section below provides examples of the calculation of the most important indicators described above:

$$\text{Crude death rate (CDR)} = \frac{100\text{ deaths in 2010}}{10{,}000\text{ residents in 2010}} \times 1000 = 10/1000$$

$$\begin{aligned}\text{Age-specific death rate (ASDR)} &= \frac{10\text{ deaths of }45-49\text{ year-olds in 2010}}{500\ 45-49\text{ year-old residents in 2010}}\\ &\quad \times 1000\\ &= 20/1000\end{aligned}$$

$$\begin{aligned}\text{Infant mortality rate (IMR)} &= \frac{3\text{ infant deaths in 2010}}{200\text{ births in 2010}} \times 1000\\ &= 15/1000\text{ live births}\end{aligned}$$

$$\begin{aligned}\text{Cause-specific death rate (CSDR)} &= \frac{20\text{ heart disease deaths in 2010}}{10,000\text{ residents in 2010}} \times 1000\\ &= 2/1000\end{aligned}$$

$$\begin{aligned}\text{Maternal mortality rate (MMR)} &= \frac{2\text{ maternal deaths in 2010}}{200\text{ births in 2010}} \times 1000\\ &= 10/1000*\end{aligned}$$

*Maternal mortality rates are typically presented per 10,000 live births

Just as everyone in a population is not at risk of pregnancy, not everyone in a population is at equal risk of death at a particular point in time. Death rates are driven to a certain extent by the biological characteristics of the population but, like birth rates, exhibit some level of elasticity. Death rates may rise or fall as a result of economic developments, social trends, wars and natural disasters, and other non-biological factors. Death rates are also influenced by developments in medicine and technology. Death rates exhibit a correlation with demographic attributes such as age, sex, race, income, education and other factors (as described below).

The age structure is a major determinant of death rates in contemporary U.S. society. Because of the effect of age distribution on death rates, demographers refine the crude death rate by adjusting it for the age distribution of the population under study. This involves using a "standard" population to convert the crude death rate to a more meaningful measure by removing the influence of age structure. The age-adjusted death rate thereby provides a basis for cross-population comparisons.

Another way in which to refine the crude death rate is through the calculation of *age-specific death* rates (ASDRs). By calculating the death rate for each age cohort, it becomes possible to determine which portions of the age distribution account for the mortality observed. ASDRs are usually calculated for 5-year age intervals, though 3- or even 1-year intervals may be used for more detailed analyses.

In contemporary U.S. society each age cohort has its unique death rate, and demographers typically generate age-specific rates in order to better understand patterns of mortality.

The infant mortality rate (IMR) represents a special case of age-specific death rates. The IMR is expressed as a 1-year rate and is examined separately because of the relatively high probability of dying during the first year of life. Persons under age 1, for example, are 20 times more likely to die in a given year than those in the 1–4 year-old cohort.

The fetal death rate is calculated to determine the extent to which babies are "stillborn." This includes miscarriages that occur after 28 weeks of gestation. The perinatal mortality rate combines late fetal and early infant mortality into one rate. This figure is used to assess the quality of antenatal and perinatal medical care. It is calculated by adding the later fetal deaths (usually after 28 weeks of gestation) to early infant deaths (usually during the first 7 days after birth but sometimes the first 28 days—i.e., neonatal period—after birth) for a given year and then dividing by the denominator (i.e., live births for that year).

One note of caution with regard to the use of rates should be offered. Rates can be considered "averages" in that they summarize the characteristics for a particular population. The use of rates assumes that the rate reasonably accurately describes the population under study. However, depending on the level of geography for which data are obtained, a rate may be misleading. In fact, there are many situations in which no one in the population is "average". A case in point might be a county that recorded an infant mortality rate of 10/1000 live births. Further examination, however, determines that half of the population exhibits a rate of 5/1000 while the other have exhibits a rate of 15/1000. Without decomposing the population into subgroups this information would be lost and a misleading perception of the population's status with regard to infant mortality would be presented. Unfortunately, public health data are seldom available to analysts below the county level. This represents a challenge for those performing epidemiological analyses. Wherever possible the study population should be decomposed in order to generate rates that reflect the actual conditions characterizing that population.

Our understanding of mortality patterns can be significantly advanced by examining the cause of death. The cause-specific death rate (CSDR) reflect the health status of the population, social factors that contribute to mortality and the effectiveness of the healthcare delivery system. The method for calculating cause-specific death rates is similar to other death rates, with the numerator being the number of deaths from a particular cause. The at-risk population (the denominator) is typically the total population unless it is a condition restricted to a particular sex.

There are, however, a number of issues related to the specification of cause of death. Given today's morbidity patterns, it is increasingly difficult to specify the ultimate cause of death. With a preponderance of chronic diseases, it is often the case that death can and should be attributed to a factor other than the underlying cause of death. For example, patients with AIDS do not typically die as a direct result of AIDS but due to system failure as a result of AIDS. Similarly, individuals affected by diabetes are often said to die from "complications of diabetes".

While the death certificate provides space for the recording of contributing conditions, the complexity of chronic disease often makes it difficult to determine the exact cause of death. Today, obesity, while not an immediate cause of death, is increasingly being listed as a contributing factor. We have in fact developed a better appreciation of the role of obesity in a variety of health problems through the analysis of death certificates.

Life expectancy is a measure that represents the "average" number of years that members of a population live. For still-living populations, the calculation of life expectancy involves assumptions with regard to future age-specific death rates (ASDRs). Life expectancy projections may be adjusted to reflect anticipated age-specific death rates.

A population's mortality patterns are the primary determinant of life expectancy. The fact that life expectancy for the U.S. population has continued to increase over the past century is a function of a reduction in overall mortality rates and particularly a reduction in infant mortality, child mortality and maternal mortality. Life expectancy, like mortality rates, is somewhat elastic in that this metric does not simply reflect biological health but the range of social, economic and political factors that influence mortality rates. Recently observed declines in life expectancy within the U.S. population reflect these types of non-biological influences.

> *A population's mortality patterns are a primary determinant of life expectancy. The increase in life expectancy for the U.S. population experienced during the 20th century was a function of declining rates of infant mortality, child mortality and maternal mortality.*

For many measures of mortality, the rates generated may be misleading if the population under study is not a "standard" population. When comparing two communities in terms of their mortality profiles, the various rates discussed above are useful if their population composition is similar. However, in many cases, distinctly different populations may affect the rates and result in misleading comparisons. For example, the crude death rate for Florida in 2009 was 9.2 per 1000 population, a figure much higher than the CDR of 7.2 for Nevada in that same year. This would suggest (counter-intuitively) that Nevada is a healthier state than Florida. However, when the death rate is standardized to take into account differences in age structure, the age-adjusted death rate is 6.7 for Florida and 7.9 for Nevada. In addition to age standardization, it is possible to adjust mortality rates by other demographic characteristics such as sex and race. Exhibit 7.2 describes the process of data standardization used by demographers.

Exhibit 7.2: Standardization of Data

Standardization is a method for adjusting mortality rates or other measures of vital processes for compositional factors that have an effect on those rates. For example, the number of deaths occurring in any year is a function of three components: health status, population size and demographic attributes (e.g., age). Since mortality rates are frequently used as indicators of health conditions, it is important to hold population size and age structure (and perhaps other attributes) constant when mortality rates are being constructed.

The calculation of rates addresses concerns over differences in population size and allows the analyst to compare the health status of two populations that are different demographically. The crude death rate (CDR) may be used to compare the mortality experience of two populations. However, the CDR may be misleading since it is influenced by differences in the age structures. That is, areas with relatively young populations (and hence less risk of dying) are likely to report low death rates, while areas with relatively old populations (and greater risk of dying) are likely to report high death rates independent of the size of the respective populations.

It is possible to adjust or standardize rates in order to control for age structure and, often, other factors (e.g., race). One method for accomplishing this is to select a "standard" age structure (e.g., the age structure for the United States), apply the ASDRs from two different populations to the standard age distribution, and then compare the number of deaths and age-adjusted death rates that result. This process generates the number of deaths for the respective populations *as if* their age structures were the same. The revised number of deaths (the numerator) can then be divided by the population size and an age-adjusted death rate generated.

The same principles of standardization can be used to adjust rates for other factors, such as education, race, and ethnicity. For example, the death rates for a predominantly white population and a predominantly African-American population might be recalculated using a standardized method that assumes that the populations have comparable racial characteristics.

The following calculations illustrate the process of data standardization. If the crude death rates for the populations of Mexico and the United States are compared, we find that the death rate for the U.S. (8.5/1000) is considerably higher than that for Mexico (4.7/1000). Knowing what we do about the two countries a higher death rate for the U.S. does not appear realistic. In order to develop more accurate figures for comparison purposes the rates can be adjusted using a standard age distribution (in this case that for the U.S.).

Age	Standard population	Age-specific mortality rate per 100,000 population		Expected number of deaths	
		Mexico	United States	Mexico	United States
<1	2400	1693.2	737.8	41	18
1–4	9600	112.5	38.5	11	4
5–14	19,000	36.2	21.7	7	4
15–24	17,000	102.9	90.3	17	15
25–44	26,000	209.6	176.4	55	46
45–64	19,000	841.1	702.3	160	133
65+	7000	4967.4	5062.6	348	354
Total	100,000			639	574

When a standard age structure is employed and death rates recalculated as above, we find that the age-adjusted mortality rate for Mexico is 6.4/1000 (compared to the crude rate of 4.7/1000) and the age-adjusted mortality rate for the United States is 5.7/1000 (compared to the crude rate of 8.5/1000). Thus, age-adjusted death rates for these two countries indicate that the health status of the U.S. population (at least as measured by the mortality rate) is more favorable than that of Mexico.

7.2.3 *Life Tables*

Life tables describe the probability of death over the life cycle for a population and thus represent a valuable tool for mortality analysis. Life tables provide health planners, demographers, insurance companies, and risk managers with a great deal of useful information. Age-specific mortality rates are calculated and combined in such a way as to generate a measure of life expectancy. Life tables are a mechanism for combining death data and rates into a summary measure of mortality.

The construction of a life table begins with a hypothetical population of 100,000 and commences to "age" that population over the life cycle. For each age cohort the probability of dying is presented for the year(s) in question. The surviving population in each age cohort can then be calculated. The table also presents the number of person-years lived to date for each cohort along with the expected remaining person-years for the surviving population. Finally, life expectancy for each age cohort is calculated.

The life table is an invaluable resource for analyzing the mortality experience of a defined population and projecting future longevity levels for that population.

Life tables reflect the social, economic, and political conditions characterizing a population. Comparative life table analysis can yield information on life expectancy differentials by sex and race for any age. Comparing life tables for blacks and whites reveals that two very different populations exist vis-à-vis mortality risk. For example, out of 100,000 white females born in a specific year over 85,000 will be alive at age 65. For black males, only 57,000 will be alive at that same age, or only about two-thirds of the white female population.

Cause-specific life tables allow the measurement of the effect of the hypothetical removal of certain causes of death on overall life expectancy. It is not unusual to find life table calculations assuming that heart disease or cancer is eliminated as a cause of death. Clinical researchers and healthcare administrators rely on information on the survival ratios of patients on whom various procedures are performed. Exhibit 7.3 presents an example of a life table for the U.S. population.

Exhibit 7.3: Abridged Life Table: United States 2003

Age	Probability of dying between ages x and x + 1	Number surviving to age x	Number dying between ages x and x + 1	Person-years lived between ages x to age x + 1	Total number person-years lived above age x	Expectancy of life at age x
0–1	0.006879	100,000	688	99,398	7,784,998	77.8
1–5	0.001174	99,312	117	396,970	7,685,600	77.4
5–10	0.000727	99,196	72	495,784	7,288,630	73.5
10–15	0.000898	99,124	89	495,452	6,792,846	68.5
15–20	0.003251	99,035	322	494,460	6,297,395	63.6
20–25	0.004869	98,713	481	492,387	5,802,935	58.8
25–30	0.004865	98,232	478	489,966	5,310,547	54.1
30–35	0.005551	97,754	543	487,457	4,820,581	49.3
35–40	0.007433	97,211	723	484,370	4,333,124	44.6
40–45	0.011588	96,489	1118	479,837	3,848,755	39.9
45–50	0.017540	95,371	1673	472,927	3,368,918	35.3
50–55	0.025802	93,698	2418	462,770	2,895,990	30.9
55–60	0.036299	91,280	3313	448,575	2433,221	26.7
60–65	0.055819	87,967	4910	428,282	1,984,646	22.6
65–70	0.082066	83,057	6816	399,173	1,556,364	18.7
70–75	0.125036	76,241	9533	358,595	1,157,191	15.2
75–80	0.188740	66,708	12,590	303,365	798,596	12.0
80–85	0.288884	54,117	15,634	232,350	495,231	9.2

(continued)

(continued)

Age	Probability of dying between ages x and x + 1	Number surviving to age x	Number dying between ages x and x + 1	Person-years lived between ages x to age x + 1	Total number person-years lived above age x	Expectancy of life at age x
85–90	0.420212	38,484	16,171	151,473	262,881	6.8
90–95	0.575974	22,312	12,851	77,357	111,408	5.0
95–100	0.733375	9461	6938	27,543	34,051	3.6
100 and over	1.000000	2523	2523	6508	6508	2.6

Source National Center for Health Statistics (2006)

7.3 Demographic Correlates of Mortality

The relationship between various demographic variables and mortality rates has become a major consideration for health demographers. Two or three generations ago, the U.S. population did not exhibit the morbidity and mortality patterns that are observed today. The ascendancy of chronic disease has been the primary contributor to this development.

Overall, there is a direct and positive relationship between age and mortality in contemporary U.S. society, with the probability of dying being different for each age cohort. The risk of death is particularly high during the first year of life but drops dramatically for children and teenagers. The likelihood of death increases slowly for each subsequent age cohort with death rates beginning to accelerate when the population reaches “middle age”. Not surprisingly, the greatest risk of death is exhibited by the oldest age cohorts.

It should be noted that the observed pattern of mortality by age is relevant for the U.S. population at a particular point in time. In fact, significant differences in mortality by age is a relatively modern phenomenon. Traditional societies and U.S. society for much of its history exhibited a much different age-specific configuration, one that reflected a predominance of acute conditions rather than the chronic conditions accounting for most deaths today. If the major killers are health threats such as epidemics, infectious and parasitic diseases, and injuries, then virtually everyone is at the same risk of death.

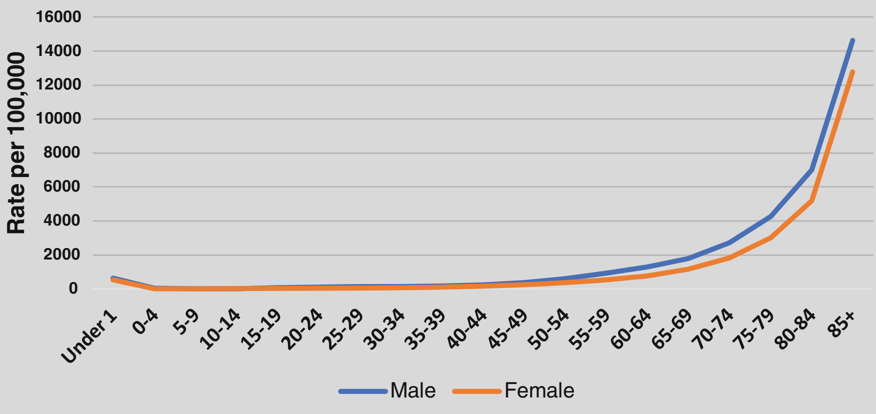
The 2014 age-specific mortality rate of 11.5/1000 for those aged 5–9, the cohort with the lowest death rate, increases gradually up through age 50. From the mid-fifties on the increase in the mortality rate is dramatic (Kochanek, Murphey, Xu, et al., 2016). This mortality configuration reflects conditions in contemporary U.S. society and has been maintained for the past two or three decades.

Historically, there was little difference in mortality rates for various age cohorts (the very young and very old excepted) for the U.S. population but, with the emergence of chronic disease as the major cause of death, each cohort exhibits an age-specific mortality rate.

For example, the leading causes of death for infants (under 1 year) are birth defects, respiratory conditions, and infectious diseases. The leading causes for young adults are accidents and suicide; for young adult African-Americans homicide is added to the list. The elderly are more likely to fall victim to the major killers: heart disease, cancer and stroke. Ultimately, each age cohort has its own peculiar cause-of-death configuration, and to a certain extent these differences in mortality patterns reflect differences in morbidity patterns. However, the emergence of chronic diseases has complicated the relationship between morbidity and mortality in that chronic diseases are not necessarily the direct cause of death.

The differences in mortality between males and females is particularly noteworthy (Kochanek et al., 2016). Overall, males exhibit a higher mortality rate than females. In 2014 the crude death rate was 8.5/1000 for males and 8.0/1000 for females. As illustrated by Exhibit 7.4, males record a higher mortality rate for every age cohort. The differences in sex-specific mortality rates are small up until age 14, but widen with increasing speed thereafter. For all conditions except those restricted to females, males exhibit a higher mortality rate.

Exhibit 7.4: Age-Specific Mortality Rates by Sex: United States 2014



Source National Center for Health Statistics

Significant differences in mortality are found between various racial and ethnic groups with current trends representing a substantial departure from past experience (Kochanek et al., 2016). As recently as 15 years ago the non-Hispanic white population held a distinctive mortality advantage over other racial and ethnic minorities. Today that advantage has essentially evaporated. Based on the crude death rate it appears that whites bear the greatest risk of mortality of any observed racial or ethnic group. The white mortality advantage still appears to have dissipated, with only African-Americans exhibiting a higher age-adjusted mortality rate.

Until recent years, the non-Hispanic white population in the U.S. maintained a clear mortality advantage. However, today all major racial and ethnic groups other than African-Americans exhibit lower death rates than the white population.

Whites in the United States are more likely to die from chronic conditions, especially those associated with aging. Blacks and members of certain ethnic groups are relatively more likely to die from acute conditions. Further, nonwhites are more likely to be affected by environmentally caused health problems and life-threatening problems associated with lifestyles (such as homicide, HIV/AIDS, and accidents). Consequently, the dominant causes of death among the white population are heart disease, cancer, and stroke. African-Americans, on the other hand, are more likely to die as a result of infectious conditions, respiratory and digestive systems conditions, and the lifestyle-associated problems noted above.

Much of the mortality advantage characterizing Asian-Americans and Hispanics has been attributed to the foreign-born among these populations. While first generation immigrants are on average healthier than native-born Americans, subsequent generations of Asian-Americans and Hispanics, it seems, do not fare as well in comparative mortality analyses. Interestingly, Native Americans have made the greatest gains of any group in reducing mortality in recent years (National Center for Health Statistics, 2010).

A number of demographic attributes exhibit an association with mortality, and the demographic composition of a defined population can serve as a predictor of its mortality rate.

A particularly important cause of death for the African-American population is infant mortality. Although infant mortality was dramatically reduced as a cause of death in the United States during the last century, it continues to be a serious health threat for nonwhites. The infant mortality rate for African-Americans in 2014 was more than twice that for whites, 11.3 per 1000 live births versus 4.8 (Kochanek et al., 2016). The African-American population has not benefited from improvement in mortality to the extent that other racial and ethnic groups have.

Mortality outcomes for married persons are better than for unmarried persons. These findings suggest that marriage provides a buffer with regard to adverse health outcomes (Robards, Evandrou, Falkingham, et al., 2012). It has also been suggested that a committed non-marital relationship may serve the same function of mitigating mortality for those in such relationships.

Cross-national analyses have found that the mortality advantage of married persons continues up to the oldest age groups (85–89) and that, the largest absolute differentials in mortality levels between marital statuses are at higher ages. This same research found that over the 1990s the advantage of married people increased for almost all the countries studied. An increasing body of work has used long-term marital history to account for current mortality (Robards et al., 2012). There is a long history of findings of adverse mortality outcomes for single men relative to women.

The U.S. population exhibits noteworthy disparities in mortality related to income. The mortality rate for the lowest income group is considerably higher than that of the most affluent, even after adjusting for age (National Center for Health Statistics, 2016). The CDR for the segment of the U.S. population with the lowest income is more than twice that for the highest income category. Virtually all infant mortality in the United States today is accounted for by the lowest income groups, and maternal mortality (which has been virtually eliminated society-wide), is disturbingly common among the poor and appears to be increasing.

The pattern with regard to mortality and education resembles that exhibited for mortality and education. The death rate for the poorly educated is much higher than for those with higher educational achievement (National Center for Health Statistics, 2010). Infant mortality, once a leading cause of death, has been virtually eliminated from the groups with the highest educational levels. The poorly educated as it turns out account for the bulk of infant deaths. The correlation between educational level and infant mortality rates is reflected in differences in low birth weight babies and premature births.

The unexpected and unprecedented uptick in mortality rates for certain segments of the U.S. population is being attributed to the "diseases of despair"—addictions, suicide depression and other conditions–that plague the poorly educated white population.

Mortality rates and longevity vary directly with occupational status. Mortality rates for professionals are significantly lower than those for unskilled laborers, for example. A study in Sweden and Germany found a link between mortality and occupational status, with the risk of death for the lowest occupational group (unskilled laborers) being nearly twice that of the highest (professionals). The authors note that income and education are confounding factors (Geyer, Hemstrom, Peter, et al., 2006). The causes of death for those lower in terms of occupational status are similar to those for the poor and uneducated.

It is found that certain occupations tend to be characterized by inordinately high levels of both. It is also found that certain industries tend to be characterized by inordinately high levels of both morbidity and mortality. Among the standard industrial categories utilized by the U.S. Department of Labor the industry recording the highest death rates in 2008 was farming/fishing/forestry with 30.4 deaths per 100,000 employed workers. This compares to finance and insurance with 0.3 deaths per 100,000 workers (National Center for Health Statistics, 2010).

Hummer, Rogers, Nam, et al. (1999) found a clear relationship between church attendance and mortality rates. People who never attend church services exhibit a risk of death 1.87 times that for those who attend services two or more times per week. This calculates out to a 7-year difference in life expectancy (at age 20) between non-attenders and frequent attenders. Koenig, McCullough, Larsen's (2001) review of previous studies found that those who were deemed to be religious experienced fewer suicides than the non-religious (Koenig et al., 2001).

7.4 Mortality Trends in the U.S.

Like fertility, mortality is a dynamic process, influenced by a number of demographic factors and subject to significant fluctuations. The total number of annual deaths in the United States, as indicated in Exhibit 7.5, increased steadily during the twentieth century. However, by 2005 this trend had moderated and the number of annual deaths stabilized at around 2.4 million per year, or around one million more deaths annually compared with 1935. By 2014, however, the number of deaths had increased to over 2.6 million, no doubt reflecting the long-awaited impact of aging baby boomers.

More significant than the number of deaths, however, is the mortality rate since it is adjusted for population size. The crude death rate in 1900 was 17.2 per 1000. This figure declined dramatically during the first one-half of the twentieth century, with a rate of 10.8 recorded in 1940. The death rate continued to decline during the century, recording a modern-day low of 8.0 in 2010. The most recent NCHS data, however, indicate an unexpected increase to 8.5 in 2015. This figure represents an uptick in mortality unprecedented in recent years (Kochanek et al., 2016). Exhibit 7.5 presents combined data for deaths and crude death rates.

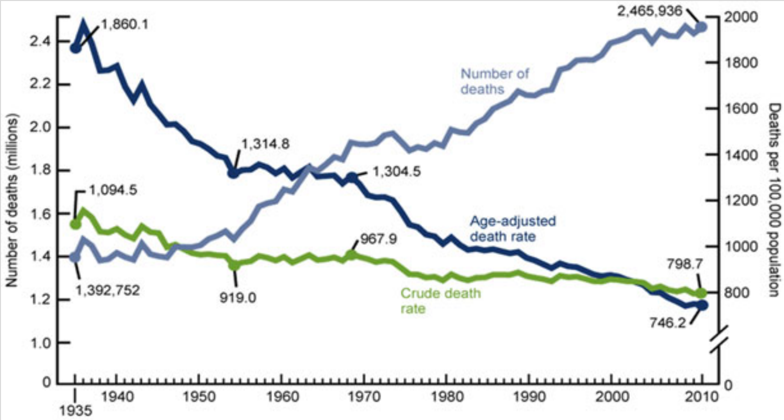
Exhibit 7.5: Deaths and Death Rates: United States 1935–2015

Year	Deaths[a]	Crude Death Rate
2015	2713	8.5
2010	2468	8.0
2005	2448	8.3
2000	2403	8.5
1995	2312	8.7
1990	2146	8.6
1985	2084	8.8
1980	1990	8.8
1975	1893	8.8
1970	1921	9.5
1965	1828	9.3
1960	1712	9.0
1955	1529	9.4
1950	1452	9.5
1945	1402	10.1
1940	1417	10.8
1935	1393	11.0

Source National Center for Health Statistics
[a]Deaths in thousands

At the beginning of the twentieth century life expectancy was about 49 years, with women outliving men by around three years. Significant improvement was seen in life expectancy during the first half of the 20th century, and since WWII life expectancy has continue to increase but at a steadily declining rate. Viewed over time, life expectancy increased dramatically to over 59 years in 1930, 68 years in 1970 and over 75 years in 1990. By 2015 life expectancy in the U.S. had increased to 79 years. Between 1930 and 1970 the male/female differential in life expectancy widened, reaching seven years by 1970. The seven-year margin continued until 1990, followed by a gradual narrowing of the difference. Today, U.S. women outlive men by five years on the average. Exhibit 7.6 graphically displays trends in deaths, crude death rates and age-adjusted death rates.

Exhibit 7.6: Deaths, Crude Death Rates, and Age-Adjusted Death Rates: United States: 1935–2010



Notes 2010 data are preliminary. Crude death rates on an annual basis are per 100,000 population; age-adjusted rates are per 100,000 U.S. standard population. Rates for 2001–2009 are revised and may differ from rates previously published. *Source* CDC/NCHS, National Vital Statistics System, Mortality.

An interesting twist has arisen with regard to life expectancy in some geographic areas of the United States. For certain subsets of the U.S. population, life expectancy is currently decreasing (Kindig & Cheng, 2013), with the trend toward greater longevity being reversed for the populations in a number of U.S. counties (i.e., 4% of U.S. men and 16% of U.S. women experiencing *declining* life expectancy) (Ezzati, Freedman, Kulkarni, et al., 2008). While the most adverse trends in longevity have been limited to a small segment of the population, the decline was found to be relatively widespread among females. The fact that any segment of the U.S. population is demonstrating a decline is life expectancy is worthy of note.

Exhibit 7.7: Life Expectancy at Birth by Sex in the United States 1900–2015

Year	Total	Males	Females
2015	78.8	76.5	81.3
2010	78.7	76.2	81.0
2005	77.4	74.9	79.9
2000	76.8	74.1	79.3

(continued)

(continued)

Year	Total	Males	Females
1990	75.4	71.8	78.8
1980	73.7	70.0	77.5
1970	70.8	67.1	74.8
1960	69.7	66.6	73.1
1950	68.2	65.6	71.1
1940	62.9	60.8	65.2
1930	59.7	58.1	61.6
1920	54.1	53.6	54.6
1910	50.0	48.4	51.8
1900	47.3	46.3	48.3

Source National Center for Health Statistics

One of the significant developments during the twentieth century in the U.S. was the dramatic reduction in infant mortality. As can be seen in Exhibit 7.8, early in that century infant mortality was a leading cause of death and contributed to a relatively short average life expectancy. Between 1920 and 1940 the IMR was cut essentially in half and by 1970 it was halved again. Overall, a rate of 85 infant deaths per 1000 live births in 1920 was cut to 7 per 1000 by 2000. A similar but even more dramatic trend was recorded for maternal deaths, a leading cause of death for females at the beginning of the twentieth century. The maternal death rate of around 80 per 10,000 births was reduced to only 1 per 10,000 by the end of the 20th century. The improvements in infant and maternal mortality rates can be attributed to a number of factors in addition to better medical care, including improved public health conditions and changes in demographic characteristics such as education and income. Moreover, the sharp reduction in the maternal mortality rate was directly responsible for the rapid increase in female life expectancy that took place in the middle part of the 20th century.

Current trends in maternal mortality in the U.S. display a pattern that suggests a reversal of historic trends. The century-long decline in the maternal mortality rate began to reverse itself after 1980 with maternal mortality rates actually increasing moving into the 21st century.

Current trends in maternal mortality in the U.S. display a pattern that suggests a reversal of historic trends. The century-long decline in the maternal mortality rate began to reverse itself after 1980, stagnating during the 80s and 90s and actually increased moving into the 21st century. The rate of less than 1.2 maternal deaths per 10,000 live births in the 1980s increased to a modern high of 2.5 deaths per 10,000 live births in 2014, making the U.S. the only developed country for which the maternal mortality rate is increasing (Kassenbaum, 2014).

The disappointing progress the U.S. has made in reducing infant mortality is to a great extent a function of disparities in access to healthcare that exist between various groups within the population. The relatively large infant mortality disparity between African-Americans and whites, for example, reflects differences in life chances between the two groups. The racial difference in infant mortality can be partially attributed to dissimilarities in the cause of death. African-American infants exhibit a greater likelihood of dying from complications associated with low birth weight, pneumonia, and respiratory distress syndrome. Exhibit 7.8 presents trends in infant and maternal mortality for the U.S.

Exhibit 7.8: Infant and Maternal Mortality Rates in the United States 1920–2014

Year	Infant mortality[a]	Maternal mortality[b]
2014	5.8	2.5
2010	6.1	1.3
2005	6.9	1.0
2000	6.9	1.0
1990	9.2	0.8
1980	12.6	0.9
1970	20.0	2.2
1960	26.0	3.7
1950	29.2	8.3
1940	47.0	37.3
1930	64.6	67.3
1920	85.8	79.9

Source National Center for Health Statistics
[a]Deaths per 1000 live births
[b]Deaths per 10,000 live births

Significant changes have occurred with regard to the major causes of death affecting U.S. society. The dominant causes of death early in the 20th century have waned in importance due to improvements in disease prevention and treatment. In 1900 acute conditions—particularly infectious and communicable diseases—were the leading causes of death. "Diseases of civilization", while not unknown, accounted for only a small fraction of the deaths and by 2009 heart-related conditions and cancer, although minor threats a century ago, accounted for about 48% of all mortality. Other conditions related to environmental threats and lifestyles had also become prominent. In 1900 it could be argued that death was a result of what disease did to the population, but by 2009 it had become clear that deaths were due to what the population was doing to itself. Exhibit 7.9 presents the leading causes of death in 1900 and 2009. Case Study 7.1 describes the extent to which a disease can affect different demographic groups disproportionately.

Exhibit 7.9: Proportion of Deaths Attributed to Leading Causes 1900 and 2009

	1900	2009
Heart disease	8.0%	25.0%
Cancer	3.7%	22.9%
Tuberculosis	11.3%	*
Diarrhea	8.1%	*
Chronic lower respiratory diseases	*	5.7%
Stroke	4.5%	5.4%
Liver disease	5.2%	*
Accidents	5.1%	4.9%
Alzheimer's disease	*	3.3%
Diabetes	*	2.9%
Pneumonia/influenza	10.2%	2.3%
Nephritis and related	*	2.0%
Suicide	*	1.5%

Source National Center for Health Statistics
*Negligible proportion

Case Study 7.1: Understanding the Epidemiology of HIV/AIDS

Many diseases currently affecting the U.S. population exhibit a clear distribution pattern based on demographics. One of the conditions that was linked to demographic subsets of the population almost since its identification is acquired immunodeficiency syndrome (AIDS). In fact, the history of the HIV/AIDS epidemic is really a history of shifting demographic correlates.

AIDS was first recognized as a new disease in the United States when clinicians in New York, Los Angeles, and San Francisco began to see young, white homosexual men with a certain type of pneumonia (PCP) and Kaposi's sarcoma (KS), both unusual diseases for young adults. A similar syndrome was reported for injecting drug users. Then, in mid-1982, the Centers for Disease Control and Prevention (CDC) published a report of 34 cases of KS and opportunistic infections in Haitians living in several different states in the United States, none of whom reported homosexual behavior. Shortly thereafter, the CDC reported cases of PCP among persons with hemophilia.

Before HIV was identified as the virus that causes AIDS, tracking the course of the epidemic depended on the reporting of AIDS diagnoses to public health departments. However, throughout the 1980s most of the states with the largest numbers of AIDS cases did not report HIV test results. This began to change in the 1990s when attempts to monitor the course of the epidemic were augmented. The observed incidence of HIV cases continued to increase into the 1990s, with the peak incidence of deaths (50,877) reached in 1995. A rapid decline of deaths in 1996 and thereafter was a result of both the peak in AIDS incidence and the effectiveness of multidrug therapy which became widely available in 1996.

The characteristics of the first 50,352 cases, reported between 1981 and 1987 to CDC, differ significantly from the characteristics of the 69,151 cases reported a decade later in 1996 and then even later in 2015. During the 1990s and into the 21st century, the epidemic became increasingly an epidemic of non-white populations, women, heterosexuals and injecting drug users. While only 8% of the earlier cases were female that proportion rose to 21% of the 1996 cases, 23% in 1999 and 26% in 2001. Since then the proportion of cases attributed to females has dropped to 21% in 2015.

The distribution of new cases by race/ethnicity also changed greatly during the first twenty years of the epidemic. The proportion of new cases in non-Hispanic whites dropped from 60% in 1981 to 43% in 1996 and to 28% in 2001. The proportion of new cases in African-Americans rose from 25% in 1981 to 50% in 2001, and the proportion of Hispanics rose from 14% to 20%. Today African-Americans are represented among AIDS cases at 4 times their proportion in the U.S. population, and Hispanics at nearly twice their population percentage. In 2015 the proportion of new cases attributed to whites was 26%, blacks 44% and Hispanics 24%.

Although the proportion of cases who were "men who have sex with men" (MSM) declined from 71% in 1983 to 44% in 1996 (of whom 4% also reported injecting drug use) that proportion has held steady for several years and, contrary to some predictions in the early 1990s of a precipitous decline, increased to 67% in 2015. (Users of CDC data on reported cases should note, however, that the risk groups in which cases are initially reported are skewed toward a high proportion in the "risk not reported/identified" category, the majority of which are eventually reclassified as MSM cases.)

By 1993, AIDS had become the leading cause of death among persons 25–44 years old and eighth overall among all causes of death, accounting for 2% of the total. Over 40,000 U.S. residents died of AIDS in 1994 and 50,000 in 1995. The number of AIDS deaths had dropped to 6721 by 2014. In 1994, AIDS accounted for 23% of all deaths among men and 32% of all deaths among African-American men. It was third overall among causes of death for women 25–44 years of age (11% of deaths), but first among African American women (22% of deaths). (These data probably underestimate of the impact of AIDS on mortality in young adults, because studies have found that using HIV as the underlying cause of death on the death certificate captures only two-thirds to three-fourths of deaths attributable to HIV infection.)

Since the mid-1990s when AIDS was a leading cause of death for those 25–44 it has dropped in significance to the point that it accounts for only a fraction of one percent of deaths. The majority of this decline is probably attributable to the effectiveness of the multidrug treatment regimens that became widespread beginning in 1996, although it is also due in part to the peaking of infection incidence rates in the mid-1980s. The reported increase in transmission by MSMs is thought to be linked to a new generation that did not experience the tragedy of the 1990s.

Perhaps more than any other disease HIV/AIDS is a product of social behavior, with the behavior patterns and lifestyles characterizing various demographic segments of U.S. society being primary factors in the distribution of HIV infections and AIDS deaths. An understanding of the distribution of the disease within the population and the changing demographic correlates of its incidence provide invaluable information to those seeking to reduce the burden of HIV/AIDS on U.S. society.

7.5 Sources of Mortality Data

The primary source of mortality data in the United States is the government death registry maintained by the National Center for Health Statistics. This registry is compiled from death certificates filed at the local level (i.e., county health department) which are processed at the state level and forwarded to NCHS for compilation and analysis. In the U.S. highly accurate data are available for mortality and relatively timely information on deaths and death rates. Death rates are generally provided for the total population although it is not uncommon to present death rates for subsets of the population or to adjust death rates for standardization purposes. Mortality data are generally reported based on the place of residence of the deceased, although data are also collected on the place of occurrence of this vital event.

The data collected on the standard death certificate include primary cause of death, contributing causes, and individual demographic and socioeconomic characteristics such as sex, race, ethnicity, last occupation, place of residence, and place of death. Using these data, demographers can study the relationship between the cause of death and a variety of demographic variables. Exhibit 7.10 describes the data available through the standard death certificate.

Exhibit 7.10: Relevant Items: Standard Certificate of Death

Sex	Location of death
Age at death	Date of death
Location of residence	Hospital/facility name
Marital status	
Education	
Race	
Cause of death (3)	
Manner of death	
Contribution of tobacco	
Occupation	
Industry	

There are several potential problems related to data compiled from death certificates. While identifying the cause of death may seem relatively easy to a layperson, in practice it is often difficult to determine the precise cause of death, potentially resulting in the incorrect assignment of cause. Some deaths are complicated in that more than one condition is present (e.g., cancer and pneumonia) with several bodily systems affected (e.g., heart and lungs). Further, it is often difficult to distinguish between and among the primary and contributing causes, especially since the proximate cause of death may not represent the ultimate factor in the death. For example, few people die as a direct result of diabetes or AIDS since some derivative condition (e.g., pneumonia) or associated system failure (e.g., kidney failure) is likely to be the proximate cause of death. This situation is further complicated by the fact that the cause of death in many jurisdictions may not be assigned by a physician but a medically untrained coroner.

Exercise 7.1: Data Standardization

Using the data supplied below, calculate the age-adjusted death rate for this community in Florida:

Age category	Original population	Crude		Adjusted	
		Death rate	Deaths	Population	Deaths
0–15	1000	2/1000	_____	1500	_____
15–29	1000	1/1000	_____	1500	_____
30–44	1000	3/1000	_____	1500	_____
45–59	2000	5/1000	_____	1500	_____
60–74	2000	15/1000	_____	1000	_____
75+	1000	30/1000	_____	500	_____
Total	8000		_____	8000	_____

Crude death rate: deaths per 1000 persons = _____

Age-adjusted death rate: deaths per 1000 persons = _____

Exercise 7.2: Life Table Calculations

The partial life table presented below has some blank spaces left in the columns. For this exercise students will fill in the missing data.

Age	Probability of dying between ages x to x + 1	Number surviving to age x	Number dying between ages x to x + 1	Person-years lived between ages x to x + 1	Total number of person-years lived above age x	Expectation of life at age x
	q(x)	l(x)	d(x)	L(x)	T(x)	e(x)
0–1	0.006123	100,000	612	99,465	7,866,027	78.7
1–2	0.000428	99,388	43	99,366	7,766,561	78.1
2–3	0.000275	99,345	27	99,331	7,667,195	77.2
3–4	0.000211	99,318	21	99,307	7,567,864	76.2
4–5	0.000158	99,287	16	83,283	7,468,556	75.2
5–6	0.000145	99,281	14	99,274	7,369,267	74.2
6–7	0.000128	99,267	13	99,260	7,269,993	73.2
7–8	0.000114	99,254	11	99,249	7,170,733	72.2
8–9	0.000100	99,243	10	99,238	7,071,484	71.3
9–10	0.000087	99,233	9	99,229	6,972,246	70.3
10–11	0.000079	99,224	8	99,220	6,873,017	69.3
11–12	0.000086	99,216	9	99,212	6,773,797	68.3
12–13	0.000116	99,208	12	99,202	6,674,585	67.3
13–14	0.000175	99,196	17	99,188	6,575,383	66.3
14–15	0.000252	99,179	25	99,167	6,476,195	65.3
15–16	0.000333	99,154	33	99,138	6,377,028	64.3
16–17	0.000412	99,121	41	99,101	6,277,891	63.3
17–18	0.000492	99,080	49	99,056	6,178,790	62.4
18–19	0.000573	99,032	57	99,003	6,079,734	61.4
19–20	0.000655	98,975	65	98,942	5,980,731	60.4

(continued)

(continued)

Age	Probability of dying between ages x to x + 1	Number surviving to age x	Number dying between ages x to x + 1	Person-years lived between ages x to x + 1	Total number of person-years lived above age x	Expectation of life at age x
	q(x)	l(x)	d(x)	L(x)	T(x)	e(x)
20–21	0.000744	98,910	74	98,873	5,881,789	59.5
21–22	0.000829	98,836	82	98,795	5,782,916	58.5
22–23	0.000892	98,754	88	98,710	5,684,120	57.6
23–24	0.000925	98,666	91	98,621	5,585,410	56.6
24–25	0.000934	98,575	92	98,529	5,486,789	55.7
25–26	0.000936	98,483	92	98,437	5,388,260	54.7
26–27	0.000943	98,391	93	98,344	5,289,824	53.8
27–28	0.000953	98,298	94	98,251	5,191,479	52.8
28–29	0.000971	98,204	95	98,157	5,093,228	51.9
29–30		98,109	98	98,060	4,995,071	50.9
30–31	0.001029	98,011	101	97,961	4,897,011	50.0
31–32	0.001063	97,910	104	97,858	4,799,051	49.0
32–33	0.001099	97,806	108	97,752	4,701,193	48.1
33–34	0.001137	97,699	111	97,643	4,603,440	47.1
34–35	0.001180	97,587	115	97,530	4,505,797	46.2
35–36	0.001235	97,472	120	97,412	4,408,267	45.2
36–37	0.001302	97,352	127	97,289	4,310,855	44.3
37–38	0.001377	97,225	134	97,158	4,213,567	43.3
38–39	0.001461		142	97,020	4,116,408	42.4
39–40	0.001557	96,949	151	96,874	4,019,388	41.5
40–41	0.001663	96,798	161	96,718	3,922,514	40.5
41–42	0.001793	96,637	173	96,551	3,825,796	39.6

(continued)

(continued)

Age	Probability of dying between ages x to x + 1	Number surviving to age x	Number dying between ages x to x + 1	Person-years lived between ages x to x + 1	Total number of person-years lived above age x	Expectation of life at age x
	q(x)	l(x)	d(x)	L(x)	T(x)	e(x)
42–43	0.001962	96,464	189	96,370	3,729,245	38.7
43–44	0.002177	96,275	210	96,170	3,632,875	37.7
44–45	0.002423	96,065	233	95,949	3,536,705	36.8
45–46	0.002676	95,833	256	95,704	3,440,756	35.9
46–47	0.002931	95,576	280	95,436	3,345,052	35.0
47–48	0.003205	95,296		95,143	3,249,616	34.1
48–49	0.003505	94,990	333	94,824	3,154,473	33.2
49–50	0.003830	94,658	363	94,476	3,059,649	32.3
50–51	0.004177	94,295	394	94,098	2,965,173	31.4
51–52	0.004535	93,901	426	93,688	2,871,075	30.6
52–53	0.004903	93,475	458	93,246	2,777,386	29.7
53–54	0.005284	93,017	491	92,771	2,684,140	28.9
54–55	0.005684	92,526	526	92,263	2,591,369	28.0
55–56	0.006117	92,000	563	91,718	2,499,106	27.2
56–57	0.006589	91,437	603	91,136	2,407,388	26.3
57–58	0.007095	90,834	644	90,512	2,316,253	25.5
58–59	0.007626	90,190	688	89,846	2,225,741	24.7
59–60	0.008180	89,502	732	89,136	2,135,895	23.9
60–61	0.008767	88,770	778	88,381	2,046,759	23.1
61–62	0.009397	87,992	827	87,578	1,958,378	22.3

Spreadsheet version available from: ftp://ftp.cdc.gov/pub/Heaith_Statistics/NCHS/Publications/NVSR/63_07/Table01.xlsx

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Chapter 8
Demographic Processes: Migration

Abstract Migration is the third component of population change and over time has become of increasing interest to demographers due to its growing influence on society. Internal migration is a primary factor in the changing distribution and composition of the U.S. population, while international migration is at record-setting levels. The techniques utilized to measure migration are discussed in this chapter and the ways in which migration affects U.S. society are explored.

8.1 Introduction

Migration, or geographic mobility, is the third component of population change (along with fertility and mortality). Migration is the most dynamic and complex of the three population processes, as well as the most difficult to measure. While death occurs once to each individual and the average number of births per woman in the United States is about two, migration is a much more frequent event for most Americans. Recent estimates indicate that the typical American moves 20 times between birth and death, although there is now evidence that the level of residential mobility is actually declining (U.S. Census Bureau, 2000; Winthrop, 2012). About 17% of the population changes residence each year (down from 20% in the 1940s), and over a five-year period more than 45% of the population moves.

In the United States immigration has become the major contributor to population growth with the volume of international migration at record levels. For most U.S. communities, internal migration has become the most important factor in population change. Fertility and mortality have become less important factors in population growth and change as the U.S. fertility rate has declined below replacement levels and the mortality rate continues to fall.

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8.2 Migration Concepts

Migration refers to a physical move involving an intended permanent change in residence. Permanent change in residence implies that the person or household in question intends to stay in the new residence for an indefiinite period of time. A residence is defined as the place where a person usually sleeps and eats. Having any residence at all implies some type of permanency in what is recognized as appropriate housing, though certain categories of individuals do not have recognized residences (e.g., the homeless). Daily or seasonal movement to and from jobs or for climatic reasons does not qualify as migration, though such short-term changes in location have implications for both the community of origin and the community of destination. Communities such as Daytona Beach, Florida, and Sturgis, South Dakota, encounter short-term population increases due to tourism, for example.

Geographic mobility has been a defining characteristic of U.S. society, with Americans displaying a greater propensity for residential change than any comparable population.

Demographers classify migration into two major categories—international and internal. Persons involved in migration either move between countries or they move within the boundaries of a single country. *International migration* refers to the intended permanent movement between one country and another. Persons migrating to a country are referred to as *immigrants*, while individuals moving out of a country are labeled *emigrants*. Every country has laws and policies that govern international migration, especially immigration. In the United States, international migration is regulated by immigration laws that establish the conditions for entry into the country. These laws specify conditions and country-specific limits on the number of persons who may legally move to the United States in any given year. Immigration law in the U.S. has limited effect on emigration from this country; most U.S. citizens are free to leave as long as some country will allow entry.

Internal migration refers to change of residence within a particular country. Internal migration is generally less regulated (and measured) than is international migration. Within the United States, internal migration is basically unimpeded, though laws designed to limit the growth of certain communities have a relatively long history. Demographers refer to internal migrants coming into an area as *in-migrants*, while those leaving an area are termed *out-migrants*.

Internal migration can be categorized as either short-distance or long-distance, and a hierarchy of definitions has been created to reflect the distance of the move. Anyone who permanently changes residences (regardless of distance) is classified as a *mover*, but in order for a mover to be technically a *migrant* in the U.S., the mover has to change his or her county of residence. The county was chosen for the mover/migrant distinction because it was felt that, in general, movement across such a boundary involves substantial change in social and economic milieux. Thus, a migrant is a mover, but a mover is not necessarily a migrant. Other useful distinctions also reflect the distance and nature of the movement. *Intrastate* migration refers to movement within a state while *interstate* migration refers to movement between two states.

> *Although internal migration is a major factor in population growth and change in the U.S., the measurement of internal migration is problematic since there is no migration registry or other mechanism for systematically tracking the movement of the population.*

The measurement of internal migration in the U.S. is problematic because there is no migration registry or other mechanism to track the movement of the population. Migration data are most often derived by comparing addresses at two points in time based on a survey or some type of systematic record keeping. This approach, however, does not consider the number or nature of the moves that may have occurred between the two dates specified.

The migration concept is difficult to apply to certain categories of people in transit (e.g., migrant workers, "snowbirds"), for whom the move is not expected to be permanent. Moreover, the growing complexity of living arrangements reflected in nontraditional households and blended families makes the measurement of migration even more difficult.

In recent decades, migration has become the most important component of the population change equation in the U.S. At the subnational level, the impact of migration is felt more immediately than the effect of fertility or mortality on a community. As birth rates and death rates have fallen, migration has come to play an even more important role in population change. The effects of migration can be significant in the short run for population size and composition at both the point of origin and the point of destination. Persistent long-term migration flows affect subsequent population change in the areas receiving migrants through the births and deaths of "new" residents. Areas losing residents through out-migration do not realize the births and deaths of their former residents and therefore do not benefit from the "lost" births with respect to population growth.

Migration streams, or the flow of relatively large numbers of persons from one area to another, are a common phenomenon. These streams involve large numbers of migrants moving from one location to another for the same ostensible reason. For example, the flow of African-Americans from the South to the Northeast and Midwest during the 1930s and 1940s constituted a migration stream. More recently, African-American migration streams from the Midwest and Northeast back to the South have been identified. Thus, some African Americans were born in the South, resided in the North for some period of time, and they (or their descendants) returned to the South at a later point in time (i.e., *return migration*). *Rural to urban migration*, which began in some areas of the nation as early as 1850, was an inevitable consequence of industrial development. The east-to-west and city-to-suburb movement of the population has forever changed the social, economic and political structure of the United States. In more recent years the migration of persons from the Snowbelt to the Sunbelt has markedly affected both the place of origin and the place of destination.

A number of major migration streams have defined U.S. history including the historic movement from east to west, the exodus of rural Southerners with the advent of agricultural mechanization, the movement from rural areas to urbans, the concentration of population in the South, and, more recently, the shift urban areas to suburbs. In recent years the surge in immigration has constituted a major migration stream.

Migration can also be classified as voluntary or involuntary. Voluntary migration occurs at the migrant's volition and usually involves moves for economic needs, retirement, family reasons or simply for a change of scene. Involuntary migration is typically a result of political or religious persecution, wars or civil unrest, or famines and other natural disasters. Involuntary migration is not a major concern in the U.S. although there have been historical situations such as Indian "removal", the Civil War and the "dustbowl" of the 1920s where significant involuntary migration occurred.

Involuntary migration within an international context represents a major challenge of the 21st century. War, famine, persecution and other factors in many regions of the world have contributed to a crisis with regard to displaced persons. There are a reported 65 million people currently in refugee camps worldwide, with the number steadily growing in response to current societal disruptions. This represents by far the most significant reordering of the world's population in history, especially since few displaced persons will be able to return to their home countries.

One other distinction should be made between legal and illegal immigration. Legal immigration refers to those entering a country with the formal permission of that country. This typically involves the acquisition of a visa for a temporary visit to the U.S. or a "green card" that allows for the permanent or fixed-period residence of the immigrant in this country. All immigrants, of course, must possess current, legitimate passports before entry. Other countries have similar legal requirements. Illegal immigrants are those who enter a country without proper legal authorization. Many of these are temporary movers seeking short-term employment or visits with family members. Others enter the country illegally with the intent of staying permanently. While accurate records are maintained by federal immigration authorities (Immigration and Customs Enforcement) on legal immigration, limited data are available on illegal immigrants. The estimated 11 million "illegal" immigrants currently residing in the United States are considered problematic by many.

8.3 Migration Measures

Demographers have developed a number of migration measures. In measuring migration, difficulties arise related to the concepts employed and the data sources available. Accurate records are maintained in the U.S. for international migration (i.e., for immigrants and emigrants). However, these records pertain primarily to legal immigrants; statistics on the growing number of illegal immigrants are based on estimates and are understandably less accurate. Since no formal records are maintained on internal migration in the U.S., we are left with a significant gap in our understanding of the year-to-year mobility of the U.S. population.

The most common measure of migration is simply a count of the number of individuals moving from one geographic area to another. Thus, the number of people moving into a county during a given year and the number of people moving out of that county constitute crude indicators of migration. Those moving into a geographic (*in-migrants*) add to the population total while those moving out of a geographic area (*out-migrants*) subtract from the total. These populations can be depicted in terms of raw numbers or rates. Exhibit 8.1 describes the different measures of migration that demographers have developed.

Two summary measures of migration have been developed to refine these raw numbers. *Net migration* is a measure of the absolute difference between in-migration and out-migration for an area over a given time period. For example, if county X in state Y gained 10,000 in-migrants and lost 5000 out-migrants between 2005 and 2010, the figure for net migration would be 5000. (Had the figures been reversed, net migration would have equaled -5000.) *Gross migration* is used to measure the total amount of migration by adding in-migrants to out-migrants. Thus, gross migration for county X for this time period would be 15,000. Gross migration is used to assess the total amount of population turnover, while net migration is a better indicator of the outcome of the migration process.

Exhibit 8.1: The Calculation of Migration Rates

Migration rates are relatively easy to calculate if the required data are available. Data (numerators) on international migration are available from Immigration and Customs Enforcement and internal data are available from IRS records and sample surveys. Population figures (denominators) can be drawn from Census Bureau counts or from estimates generated by other sources. These basic rates can be adjusted to reflect other factors such as age and marital status as desired.

$$\text{In-migration rate} = \frac{\text{Persons moving into area in } Y_1}{\text{Midpoint population estimate in area for } Y_1} \times 1000$$

$$\text{Out-migration rate} = \frac{\text{Persons moving out of area in } Y_1}{\text{Midpoint population estimate in area for } Y_1} \times 1000$$

$$\text{Net-migration rate} = \frac{\text{Persons moving in in } Y_1 - \text{Persons moving out in } Y_1}{\text{Midpoint population estimate in area for } Y_1} \times 1000$$

$$\text{Gross migration rate} = \frac{\text{Persons moving in } Y_1 + \text{Persons moving out in } Y_1}{\text{Midpoint population estimate in area for } Y_1} \times 1000$$

$$\text{Migration efficiency} = \frac{\text{Net migrants (in-migrants} - \text{out-migrants)}}{\text{Gross migrants (in-migrants} + \text{out-migrants)}}$$

For a hypothetical population of 10,000 that experienced during Y_1 2000 in-migrants and 1000 out-migrants the following rates would be generated:

In-migration rate:	200 per 1000 population
Out-migration rate:	100 per 1000 population
Net migration rate:	100 (a net gain) per 1000 population
Gross migration rate:	300 (moves in or out) per 1000 population
Migration efficiency:	0.333

While the comparison of the absolute numbers of movers, non-movers, and migrants is important, rates need to be calculated when there are size differences between the areas being compared. Rates for in-migration, out-migration, net migration and gross migration can be generated. The numerator for these rates is the total for each migration category (e.g., in-migrants); the denominator depends on what is considered to be the population at risk for migration. The identification of the population at risk, that is, persons with at least some probability of moving over a given timeframe, is complicated because each rate has a different risk group.

Consider, for example, the out-migration rate for a specific city in a one-year period. The numerator of the rate is the number of out-migrants, while the denominator is the population at the beginning or in the middle of the one-year period. However, identifying the population at risk for the in-migration rate is problematic since virtually the entire population of the United States could be considered at some risk of moving into the geographic area in question. For this reason, the denominator for the in-migration rate is typically the same one used for calculating the out-migration rate. This means that the rate generated is technically the percentage of population increase due to in-migration.

Patterns of in- and out-migration have an impact on the population size and composition of both the sending and receiving geographic areas, often resulting in significant changes in the characteristics of either or both areas.

The rate of migration has a substantial impact on the population size and characteristics of the affected communities. An examination of migration trends for Florida illustrates this point. The population of Florida grew substantially (17.6%) between 2000 and 2010, although that growth rate was considerably below the ones seen in previous decades. Net migration—not natural increase, the difference between births and deaths—has historically accounted for over 85% of the state's growth. The growth due to net migration was not uniform across all age cohorts, however, with the largest absolute increases for young adults (25–34), mature adults (50–64), and the oldest old (85 and over). Each of these age cohorts experienced increases in excess of 200,000 in-migrants for the 2000–2010 period.

8.4 Migration Patterns in the U.S.

8.4.1 International Migration

The U.S. has always considered itself a nation of immigrants, and that is truer today than at about any time in the past. The volume and nature of immigration to the United States have varied greatly over the history of the country. A comparison of the data by decade shows a low of 528,000 immigrants for the period 1931–1940 and a record high of 14 million immigrants during the first decade of the 21st century. The contribution of immigration to population growth historically was greatest during the first two decades of the twentieth century. This contribution declined markedly in the 1930s, and it was only in the 1980s that immigration's contribution began to increase.

Despite accusations by some politicians that the U.S. has an "open door" policy with regard to immigrants, there is a limited number of ways in which foreigners can legally enter the United States. Visa types are divided into two categories: non-immigrant visas and immigrant visas. The former type is available to those temporarily visiting the country and covers a wide range of visitors from tourists to students to athletes to scientists to even medical patients. Mexican border crossing cards are also included in this category. The terms of residence vary depending on the type of visa issued. Some who enter under a non-immigrant visa may eventually request a change of status to an immigrant visa, and a significant number overstay their visa limits in order to remain in the U.S.

The most common type of immigrant visa is issued to family members of current U.S. citizens (with fiancés included in this category). The major other category involves employment-related visas that allow for longer term residence (or even permanent non-citizen) residence. Refugees and asylum seekers represent a special category of immigrants. This last category represents by far the smallest number of immigrants. In 2016 over 600,000 immigrant visas were issued with the majority of these involving family reunification. Over 10 million non-immigrant visas were issued along with another million-plus border crossing cards. Approximately 85,000 refugees were admitted during 2016 (Krogstad & Radford, 2017).

The U.S. has once again become a nation of immigrants with record numbers of legal immigrants added to the population over the past two decades accompanied by an estimated 11 million undocumented immigrants.

This trend has led to an increase in the number of legal immigrants living in the U.S., from 24 million in 1995 to 40 million in 2010, more than tripling the figure for 1970. These estimates of the number of foreign-born living in the U.S. include both legal immigrants and an estimated 11 million undocumented aliens. The proportion of the population that is foreign-born was 13.1% in 2010, representing a modern-day high.

It should be noted that without post-World War II international migration, the population of the nation and many sub-areas would have declined in number and exhibit a much older age structure. Immigration has, in fact, accounted for 29% of U.S. population growth since 2000. Exhibit 8.2 provides the decade-by-decade record of immigrant flows, along with the percentage of total decade population growth accounted for by immigrants. Exhibit 8.2 provides information on U.S. immigration trends decade by decade over the past 180 years.

Exhibit 8.2: Legal Immigrants and the Proportion of Population Growth Due to Immigration by Decade for the United States, 1831–2010

Decade	Immigrants (in thousands)	Population growth for decade (in thousands)	Percent of population growth due to immigration
2001–2010	10,000*	19,980*	42.0*
1991–2000	9080	32,712	27.8
1981–1990	7413	22,164	32.7
1971–1980	4493	23,244	19.3
1961–1970	3322	23,979	13.9
1951–1960	2515	27,767	9.1
1941–1950	1035	19,028	5.4
1931–1940	528	8894	5.9
1921–1930	4107	17,064	24.1
1911–1920	5736	13,738	41.8
1901–1910	8795	15,978	55.0
1891–1900	3688	13,047	28.3
1881–1890	5247	12,792	41.0
1871–1880	2812	10,337	27.2

(continued)

(continued)

Decade	Immigrants (in thousands)	Population growth for decade (in thousands)	Percent of population growth due to immigration
1861–1870	2315	8375	27.6
1851–1860	2598	8251	31.5
1841–1850	1713	6122	28.0
1831–1840	599	4203	14.3

*Estimate

Sources U.S. Census Bureau (2010). *Statistical Abstract of the United States, 2010*, Tables 2, 7 and 50. Source data came from the U.S. Immigration and Naturalization Service, *Statistical Yearbook*, Camarota (2010)

The country of origin is an important consideration in the analysis of immigration trends. Up until 1920, the vast majority of immigrants were from Europe. Since 1920 most of the share lost by Europe has been gained by Asia, and in the decade of the 1980s nearly half of all immigrants originated in Asia. Altogether, 85% of all immigrants came from Asia or countries in North and South America in the 1990s. In 2010, the major sources of legal immigrants by country were Mexico (139,120), China (70,863), India (69,162), the Philippines (58,173), and the Dominican Republic (53,870). These same countries (except for the Dominican Republic) account for the largest numbers of foreign-born currently living in the U. S. As a result of this shift in county-of-origin, the immigrant population is quite different in culture and language from the majority European-origin population historically populating the United States. Exhibit 8.3 presents data on trends in immigration based on world region of origin.

Exhibit 8.3: Number of Immigrants and Percent to the United States by Selected Continent of Origin, 1831–2010

Decade	Total immigrants[a]	Europe	Asia	Other America	Africa
2001–2010	10,000*	1400 (14)*	2600 (26)*	5200 (52)*	800 (8)*
1991–2000	9080	1309 (14)	2890 (32)	4449 (49)	382 (4)
1981–1990	7413	706 (10)	2814 (39)	3581 (49)	192 (3)
1971–1980	4493	801 (18)	1634 (36)	1929 (43)	92 (2)
1961–1970	3322	1239 (37)	445 (13)	1579 (48)	39 (1)
1951–1960	2516	1492 (53)	157 (6)	841 (33)	17 (1)
1941–1950	1035	622 (60)	59 (3)	355 (34)	7 (0)
1931–1940	528	348 (66)	15 (3)	160 (30)	2 (0)
1921–1930	4107	2478 (60)	97 (2)	1517 (37)	6 (0)

(continued)

(continued)

Decade	Total immigrants[a]	Europe	Asia	Other America	Africa
1911–1920	5736	4377 (76)	193 (3)	1144 (20)	8 (0)
1901–1910	8795	8136 (93)	244 (3)	362 (4)	7 (0)
1891–1900	3688	3559 (97)	71 (2)	39 (1)	1 (0)
1881–1890	5247	4722 (90)	68 (1)	426 (8)	– (0)
1871–1880	2821	2262 (80)	124 (4)	404 (14)	– (0)
1861–1870	2315	2064 (89)	65 (3)	167 (7)	– (0)
1851–1860	2598	2453 (94)	41 (2)	75 (3)	– (0)
1841–1850	1713	1598 (93)	– (0)	62 (4)	– (0)
1831–1840	599	496 (83)	– (0)	33 (6)	– (0)

[a]Numbers in thousand, percentages in parentheses
*Estimate
– Less than 1000
Sources U.S. Bureau of the Census (1922), (1932), (1953), (1985), U.S. Census Bureau (2010). Source data came from the U.S. Immigration and Naturalization Service, *Statistical Yearbook*; Pew Research Center (2015)

Information regarding the characteristics of immigrants is important for an understanding of their impact on U.S. social institutions. Females now account for over half of the immigrant population to the U.S. The predominance of females represents a recent shift in sex ratio, since up until the 1980s the majority of immigrants were males. Over half of all immigrants are under age 30 and few are over 65. The median age for recent immigrants is only 29 years, compared to 40 years for native-born Americans. Immigrants overall are less educated than the native born. However, the young age structure of today's immigrants accounts for the fact that virtually all of the national increase in public school enrollment over the last two decades can be attributed to the children of immigrants. In 2000, there were 8.6 million school-age children from immigrant families in the United States and this number continues to increase. The leading occupations for immigrants in 2007 were farm workers, building maintenance workers, and construction workers (U.S. Census Bureau, 2008). The poverty rate for immigrants is 50% higher than that for natives, with immigrants and their U.S.-born children (under age 21) accounting for 22% of all persons living in poverty.

The continued high rate of immigration has been accompanied by increases in the number of immigrants residing in every state and the redistribution of immigrants around the nation. Between 2007 and 2015 the proportion of the population that was foreign-born increased in every state except one (Colorado). In many cases, these increases were dramatic, with many states without a history as immigrant destinations showing significant increases in the proportion foreign-born. Although the absolute numbers remain small, states as diverse as South Carolina, Arkansas, and North Dakota doubled or tripled the proportion of foreign-born. Exhibit 8.4 presents data on the distribution of the foreign born by state.

The surge in immigration over the past two decades has meant that every U.S. state has increased its number of immigrant residents, with many of the states doubling or tripling their proportion foreign-born.

The figures for 2015 also indicate a redistribution of immigrants among the various states. California and New York maintained their advantage as the states with the highest proportion foreign-born, but New Jersey moved past Florida to take third place and Nevada, Texas and Massachusetts moved up in significance as homes for the foreign-born. Some states with already significant immigrant populations essentially doubled the size of their foreign-born population (Connecticut, Rhode Island, Virginia and Washington). The proportion of the foreign born accounted for by the seven most immigrant-centric states accounted for over 70% of the foreign-born in 2000, that figure had fallen to 67% by 2015 (2011–2015 average) indicating a greater dispersal of immigrants across the nation.

Despite the fact that immigrants have become distributed far and wide within the U.S. the proportion of immigrants accounted for by the largest metropolitan areas actually increased over the past fifteen years. In 2000 the top 10 metropolitan areas (MSAs) accounted for over 44% of all immigrants with this proportion increasing to 51% by 2015.

Exhibit 8.4: Percent Immigrants by State and 2015 (Ranked by Order in 2015)

State	2007	2015	State	2007	2015
California	25.9	27.3	Michigan	5.1	6.6
New York	19.6	22.9	Pennsylvania	2.9	6.5
New Jersey	14.9	22.1	New Hampshire	3.9	6.0
Florida	18.4	20.2	Nebraska	3.9	6.0
Nevada	15.2	19.3	Oklahoma	3.2	6.0
Hawaii	16.1	17.7	Idaho	5.3	5.7
Texas	12.2	17.0	Tennessee	1.8	5.0
Massachusetts	12.4	16.1	Indiana	2.4	4.9
Maryland	9.0	15.2	Wisconsin	3.6	4.8
Connecticut	8.8	14.6	South Carolina	1.6	4.8
Illinois	9.5	14.5	Iowa	3.9	4.8

(continued)

(continued)

State	2007	2015	State	2007	2015
District of Columbia	10.6	14.1	Arkansas	1.8	4.8
Washington	7.4	13.7	Vermont	3.5	4.5
Rhode Island	7.8	13.5	Ohio	2.5	4.3
Arizona	12.9	13.4	Missouri	3.0	4.0
Virginia	7.7	12.1	Louisiana	2.8	4.0
Oregon	7.8	9.9	North Dakota	1.5	3.8
Colorado	9.8	9.8	Wyoming	1.0	3.8
New Mexico	5.8	9.4	Kentucky	2.5	3.6
Delaware	4.7	9.3	Alabama	1.5	3.5
Minnesota	5.1	8.3	South Dakota	1.4	3.2
Utah	5.5	8.2	Mississippi	0.9	2.4
North Carolina	4.4	7.9	Montana	0.8	2.1
Alaska	4.2	7.4	West Virginia	0.9	1.6
Kansas	5.7	7.1			

Source U.S. Census Bureau

Given the diversity of the immigration pool it is not surprising that different nationalities exhibit different settlement patterns. Some of these patterns have been long established and their impact is still felt today. Others are of more recent origin and reflect the changes in the origins and characteristics of contemporary immigrants. Immigrants from Europe best represented by the surge of immigration around the beginning of the 20th century primarily settled on the East Coast particularly in its larger cities. The descendants of these Irish, Italian, German and Polish immigrants are still concentrated in these areas today. Other European immigrants (e.g., Scandinavians) were more likely to settle in the "heartland" with their descendants still found in the upper Midwest. Other historical patterns included the settlement of immigrants of Asia on the West Coast with their influence clearly noticeable in San Francisco today, for example, and the traditional patterns of Hispanic settlement of Cuban immigrants in Florida, Puerto Rican "immigrants" in New York and other Northeast cities, and Mexicans in the southwestern states.

Today's immigrant settlement patterns are dominated by Mexican immigrants who constitute the largest group. While the concentration of Mexican immigrants remains noticeable in the southwest, members of this group have expanded to virtually every county in the U.S., and major concentrations of Mexican immigrants are found in every major city. Settlement patterns for other immigrant groups from Central and South America do not necessarily follow the same pattern with "serial migration" resulting in concentrations of different national groups in various parts of the nation (but invariably in large cities). While immigrants from Asia still concentrate on the West Coast they have become much more dispersed over time but still settling primarily in larger cities across the nation. Some cities such as Atlanta, Georgia, have become magnets for these "new" immigrants.

8.4.2 *Internal Migration*

In the United States, internal (or domestic) migration is a dynamic process that is a significant contributor to population change. About 17% of the population changes residence each year (down from 20% in the 1940s), and over a five-year period more than 45% of the population moves. This translates into about 135 million persons moving during the first five years of the twenty-first century alone. Of the 135 million, 60% were classified as movers (within county) and 38% were classified migrants (crossed a county boundary) (U.S. Census Bureau, 2011). Among the migrants 56% stayed within their original state of residence while 44% moved across a state boundary.

The history of the United States is, to a great extent, a chronicle of migration. While space doesn't allow the details of historical internal migration to be presented, some key trends should be noted. The general flow of population in the U.S. since the colonization of the New World by Europeans has been from east to west. The country's population center at the time of the first census in 1790 was on the east coast; today, the population center is in Missouri. As the country became more fully settled, the general trend toward east-to-west movement continued but a more complicated picture emerged. During the first half of the twentieth century a large number of people left the South, destined primarily for the Midwest and the Northeast but also contributing to the influx of new residents into the West region. This flow primarily involved African Americans who had been displaced from farm work with the mechanization of agriculture. Since the 1950s the outflow from the South has been reversed, and today the South has more population than any of the other three regions.

Region-to-region migration flows have reshaped the U.S. population landscape, resulting in significant depopulation of the Northeast and Midwest regions and surging population growth in the South and West.

Since World War II there has been a steady pattern of out-migration from the Northeast and the Midwest and in-migration to the South and West. Between 2005 and 2010 the highest levels of both in- and outmigration of all four census regions occurred in the South, further solidifying the South's rank as the most populous region. Some 3.5 million people moved into the South from the Northeast, the Midwest, and the West while 2.4 million people moved out of the region. The

South had a net gain of 1.1 million residents during this five-year period. In contrast, the West showed a net gain of 71,000 while the Northeast lost 832,000 residents and the Midwest lost 350,000 residents. As of 2015, the proportion of the nation's population accounted for by the respective regions was: South-37.7%; West-23.6%; Midwest-21.1% and Northeast-17.9% (Ihrke & Faber, 2012). Exhibit 8.5 presents data on migration trends for a recent time period.

Exhibit 8.5: Regional Migration Patterns United States 2010–2011[a]

	Northeast	Midwest	South	West
In-migration	247	537	1056	616
Out-migration	524	493	831	608
Net migration	−277	43	225	9
Movers from abroad	189	172	379	319
Net migration (including abroad)	−88	215	604	328

[a]Figures stated in thousands
Source U.S. Census Bureau (2011)

Migration flows of the type described above can have a significant impact on population composition for both the sending and receiving geographic areas. It cannot be assumed that in-migrants and out-migrants are going to have the same demographic characteristics and, in fact, today it is more likely that they will be dissimilar. Thus, we have examples of cities that are trading one type of population for another (e.g., losing affluent households to surrounding suburbs while attracting less affluent households to replace them) or native-born populations giving way to foreign-born residents. Some states have seen their composition radically affected by migration flows with northern Virginia, for example, being transformed from a primarily non-Hispanic white area to a highly diverse area in terms of race and ethnicity (due to its proximity to the District of Columbia). Some states like Texas continue to attract significant in-migrants yet these newcomers are quite dissimilar from existing Texas residents. Case Study 8.1 describes how one city came to represent the face of racial and ethnic diversity.

Case Study 8.1: The Evolution of America's Most Diverse City

The population of Houston, Texas, grew by over 1.2 million residents between 2000 and 2010, making it the nation's fastest growing metropolitan area (MSA). Perhaps more important, the impact of this growth on the racial and ethnic composition of the metro area has made it the nation's most diverse urban population. Based on an analysis of census data for 1990, 2000 and 2010, researchers at Rice University found that the Houston region has become dramatically more racially and ethnically diverse over the past

20 years. The diversity is such that every racial/ethnic group is now a demographic minority, allowing Houston to surpass New York City as the nation's most diverse major metropolitan area.

From 1990 to 2010 the balance between the four major racial/ethnic groups has increased across the multiple-county metropolitan region. The Anglo (non-Hispanic white) population represents a declining share of the metro area population. Its majority status (58%) in 1990 had declined to 40% by 2010. Meanwhile the percentage of Latinos had increased from one-fifth of metropolitan residents to more than one-third. Assuming this rate of growth continues, Latinos are projected to become the region's largest racial/ethnic group in the near future.

Other racial/ethnic groups in the metropolitan region have either increased, though to a lesser degree than Latinos, or held their own. The percentage of Asians in the Houston metropolitan region increased from 3.4% in 1990 to 4.8% in 2000 and 6.5% in 2010. African-Americans have remained relatively stable over this time period, accounting for 17.5% of the population in 1990 and 16.8% in 2010. The proportion defining themselves as multi-racial remained approximately the same between 2000 and 2010. Figure 8.1 illustrates the racial and ethnic makeup of the Houston metropolitan area for the three time periods under study.

The growth of racial/ethnic diversity has occurred throughout the region. The City of Houston was more diverse in 2010 than 1990 and so is every

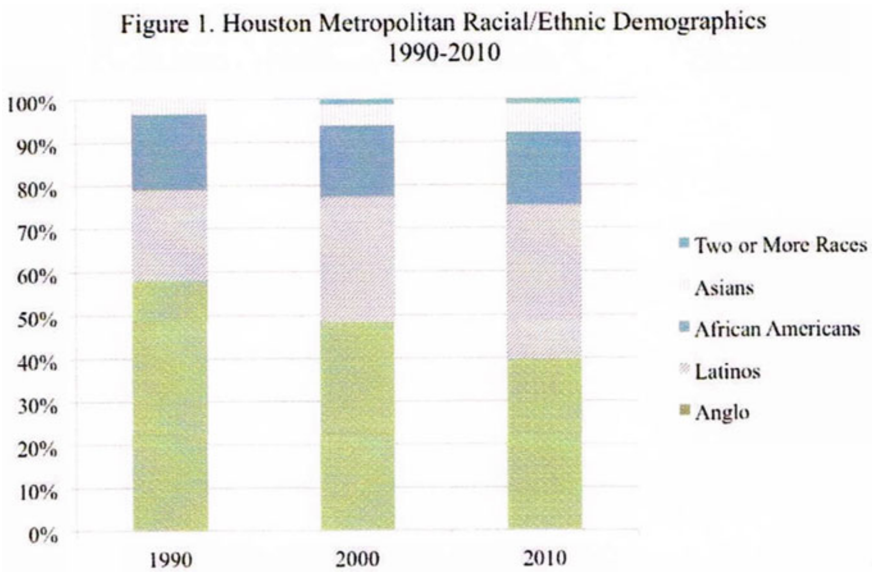

Fig. 8.1 Houston metropolitan racial/ethnic demographics 1990–2010. *Source* Emerson et al. (2016)

other city and county within MSA. In 2010 the City of Houston lost its title as the most diverse city in the region, with Missouri City and Pearland surpassing Houston in terms of racial/ethnic diversity.

Houston finds itself in the unique position of becoming perhaps the nation's first fully diverse metropolitan area, and harnessing the region's burgeoning racial/ethnic diversity is a growing challenge for community leaders. An opportunity exists to demonstrate how to lead the nation in the transition to a fully inclusive, unified multi-racial/multi-cultural region.

The other major trend since World War II has been the shift in residence based on type of community. At the time of the first census in 1790, 95% of the population lived in what today are classified as "rural" areas. With the advent of industrialization in the U.S., a mass movement from rural areas to urban areas occurred, to the point that today only 5% of U.S. citizens live in rural communities. The rural-to-urban migration trend peaked in the 1970s and a new flow emerged—from urban areas to suburban areas. Since that period the major flow has been out of the nation's central cities and into surrounding suburbs. Today, more Americans live in communities classified as suburbs than in any other type of community.

In recent years two additional migration streams have been identified. One involves the flow from the suburbs to the exurbs. Exurbs refer to communities beyond the boundaries of a metropolitan area but in an adjacent county. As suburban areas have become more crowded, their characteristics have changed, and jobs have become more decentralized, some citizens are opting for residence at ever greater distances from the central city. The second trend involves the "reurbanization" movement, with a number of factors driving a shift of population back into the central city in many places. A new generation that is not comfortable with the homogenous nature of the suburbs, rising transportation costs, and home ownership has spurred some movement back into urban areas. Some of this reflects the "gentrification" of the inner city, as affluent individuals and families move into areas in decline, causing the cost of housing to increase and often displacing the original residents. "Millennials" are thought to be driving much of the reurbanization trend as they shun traditional American propensities for automobile and home ownership.

By 1990 the U.S. had become a "suburban" society as people fled the central cities for surrounding suburbs. This trend, however, has been reversed in the 21st century as re-urbanization is occurring across the nation.

Additional insight into internal migration can be gained by examining the respective characteristics of movers and non-movers. Movers are considerably younger than non-movers, recording a median age nine years less. The youth of movers is reflected in the concentration of persons under 35. Because of the preponderance of youthful movers, areas receiving migrants gain a younger population, in general, while areas losing migrants "age" more rapidly because of the loss of younger persons. Continued gain or loss can have a significant impact on both the size and age structure of the populations sending and receiving migrants. One notable exception to the youth selectivity of migration is the movement of older persons to certain retirement areas of the United States. Even so, the overall proportion of persons above the age of 55 who move is low. Domestic movers are slightly more likely to be male and considerably more likely to be never married and better educated. The incomes of movers, however, tend to be somewhat lower on the average and the poverty rate somewhat higher. Case Study 8.2 describes the impact of migration flows on Congressional redistricting.

Case Study 8.2: Internal Migration and Congressional Redistricting

The U.S. Constitution requires that the number of members each state sends to the House of Representatives be based on its share of the nation's population. The basis for this apportionment is the census conducted every ten years, and since 1790 a census has been conducted for this purpose. Over time, the decennial census became increasingly used as a mechanism for collecting additional information on the U.S. population above and beyond that required for apportionment.

The House of Representatives is composed of Congressmen representing 435 congressional districts. The districts are allocated to the various states based on their population size. Each state, of course, must have at least one Congressional representative. Since the populations of each state do not grow at the same rate some states' shares of the nation's population decline over time while others' shares will have increased. Those states losing population typically lose House members while states that have seen their populations grow relatively faster gain seats.

The population count generated by each census is made available by December 31 of the census year. This process is not without controversy since there is inevitably an undercount of the population when the census is conducted. While a simple across-the-board undercount might be adjusted for, the undercount is not across the board but affects some populations—and some states—more than others. Historically, there have been undercounts of poor Americans, those in certain minority groups, and hard-to-reach populations like migrant workers and the homeless. More recently, undercounts of immigrants—particularly undocumented immigrants—have heightened the concern over the undercount. After every census the question therefore arises as to the appropriateness of adjusting the census figures for the undercount. Invariably, it is decided to go with the actual count rather than an adjustment. (Ironically, some politicians who objected to including undocumented aliens in the 2010 census count changed their mind when they realized that their states stood to lose Congressional representation.)

Once the census numbers are collected and certified, they are passed to the legislatures of each state for the purpose of drawing new congressional districts. In most states, redistricting is taken up by the state legislature and governor. Redistricting is understandably an often highly politicized process, an issue beyond the scope of this case study. However, it should be noted that the redistricting process represents an example of applied demography since population size and composition are the primary inputs into the apportionment process. Some applied demographers, in fact, specialize in redistricting consultation.

The impact of the census count and the subsequent apportionment process can be seen when shifts in Congressional representation are examined. Since 1940 there have major shifts in representation by the various states as a result of shifting migration patterns. Between 1940 and 2010 California gained 30 representatives, Florida gained 21 and Texas gained 15. For this same period, New York lost 18 seats and Pennsylvania lost 15. After the 2010 census, Western states gained eight of the 12 new Congressional seats, with the remaining four awarded to the Southeast. Texas gained another four representatives, Florida two and six states one each (Arizona, Georgia, Nevada, South Carolina, Utah and Washington). One the other hand, two states (New York and Ohio) lost two representatives each while eight states each lost one seat (Illinois, Iowa, Louisiana, Massachusetts, Michigan, Missouri, Nebraska, and Pennsylvania). While many of the states benefitting from migration shifts are considered “red” states due to their Republican-leaning populations, the bulk of the population increases were recorded for minorities—particularly in states like Arizona, Florida and Texas.

8.5 Sources of Migration Data

Data on migration within the United States are derived from censuses, surveys, and administrative records. On Census Bureau surveys respondents are typically asked if they lived in the same house either one year ago or five years ago depending on the survey. The American Community Survey is the most useful and current source of this information, and data on county-to-county population flows based on the latest ACS survey are available on the Census Bureau website. On other federal surveys, respondents are asked how long they have lived at their current location and/or how many times they have moved in the last three years. The Current Population Survey elicits data on one-year migration status and the reason for the move.

The other source of internal migration data, administrative registries from the Internal Revenue Service, use a two-points-in-time comparison of addresses to generate data on the volume and nature of residential moves. Data available from the IRS provides the number of household members (and their incomes) moving from one county to another from one year to another. Thus, this database would indicate how many people (along with their associated household incomes) moved from County A to County B between, for example, 2010 and 2011. The IRS data come closest to complete coverage of the population but none of these data sources captures the complexity of contemporary migration patterns.

More accurate and detailed information available on international migration than for internal migration since actual data rather than survey estimates are available on immigrants. As with internal migration, the American Community Survey elicits information on international migration (presumably both legal and illegal). However, the best data on legal migration are provided by the agencies charged with monitoring ingress and egress into and out of the country. The Immigration and Customs Enforcement agency (ICE), now under the Department of Homeland Security, maintains records on immigration and emigration and regularly publishes this information in its *Yearbook of Immigration Statistics.* This agency also generates annual estimates of the volume of illegal immigration into the U.S. The U.S. Department of State is charged with tracking immigrant and non-immigrant visas issued and reports that information annually. Data on illegal immigrants is limited and, in the absence of actual data, estimates must be generated.

Exercise 8.1: Contribution of Migration to Population Change

You have been asked to calculate population change for Podunk County in order to develop plans for school expansion. Calculate population change first by looking only at natural increase and, then, by including migration in the equation.

Population change for Podunk County based on natural increase:

2000 Population	Births 2000–2009	Deaths 2000–2009	2010 Population
50,000	500	200	________

Population change for Podunk County based on natural increase AND migration:

2000 Population	Births 2000–2009	Deaths 2000–2009	In-migration	Out-migration	2010 Population
50,000	500	200	1000	200	________

Exercise 8.2: U.S. Metropolitan Areas and Racial/Ethnic Diversity
The graphic below presents data on the racial and ethnic diversity of the ten largest U.S. metropolitan areas. Students should examine the graphic to determine the patterns of diversity associated with each of the metro areas and answer the following questions:

1. Which of the metro areas is the most diverse in terms of racial and ethnic mix?
2. Which of the metro areas is the least diverse in terms of racial and ethnic mix?
3. In what ways do historic patterns of immigrant settlement affect the observed patterns?
4. In what ways do these patterns reflect the regionals distribution of various racial and ethnic groups?

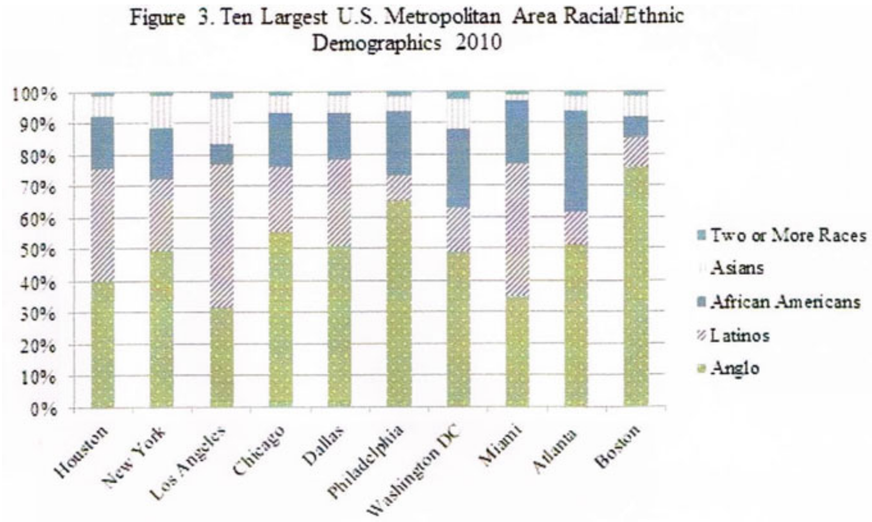

Fig. 8.2 Ten largest U.S. metropolitan area racial/ethnic demographics 2010. *Source* Emerson et al. (2016)

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Chapter 9
Population Change and Its Measurement

Abstract Population change is a major area of interest in applied demography, and this chapter considers the key techniques used in the production of estimates, projections and forecasts. The various approaches to generating "synthetic data" are considered along with the pros and cons of the available techniques. In addition to basic statistical techniques more complex methods of producing estimates and projections are considered.

9.1 Introduction

Demographers pay considerable attention to population change since this phenomenon has implications for population size, distribution and composition. A population's characteristics at any point in time represent a static "snapshot" of that population, and it is the changes that occur in a population over time that represent the dynamic aspects. Population change is an inevitable aspect of social existence. Even the most stable traditional society will undergo change as a result of demographic processes, albeit sometimes at an imperceptible rate. Even in the absence of migration, differential birth rates or deaths rates for subgroups in society will result in compositional change. This is occurring in the United States today, for example, as the white population displays lower birth rates than various minority populations, leading to a restructuring of the racial and ethnic composition of the country's population.

While the measurement of population change is a critical activity of demographers, there are often situations in which adequate information is not available for this purpose. There are situations when a current population count is needed but not available due to the fact that no actual or estimated data can be obtained for the geography in question. There are other occasions in which information on population size and characteristics is desired for a past time period for which data are not available or for a future time period for which data are obviously not available. In these situations, demographers rely on population estimates, projections and, to a lesser extent, forecasts. Using well-established techniques, data on population size

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and in some instances population characteristics (that is, synthetic data) are generated for past, present and future time periods. (Note that the range of techniques available for generating estimates, projections and forecasts cannot be fully covered in one chapter. The additional resources cited at the end of this chapter should be helpful in providing guidance to the wide range of techniques available for generating these statistics.)

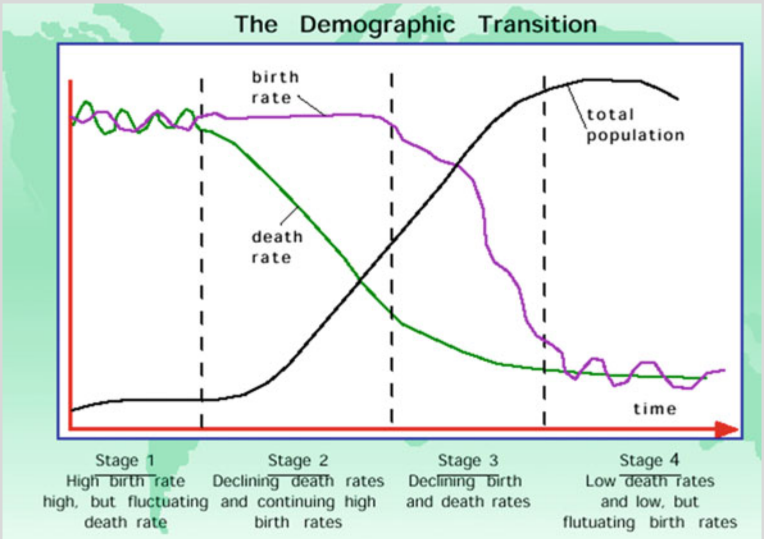
There are often situations in which the desired data are not available and demographers must generate "synthetic data" in the form of estimates, projections and forecasts.

Demographers often rely on government sources of population data (see section on data sources below). The federal government (by virtue of the Census Bureau) is the major source of demographic data. However, the now limited data generated through the decennial census are not available for a year or often longer after collection and are quickly dated. Data from the American Community Survey are also not available for a year or more after collection. While the Census Bureau and state data agencies may calculate projections for future years they seldom provide data below the county level. For data at the sub-county level non-governmental sources may have to be accessed. For these reasons, applied demographers must acquire the skills necessary to produce estimates and projections.

Since the focus of this book is applied demography limited attention is paid to demographic theory. However, much of the research on population change has been informed by the work carried out by demographers related to the demographic transition. Exhibit 9.1 describes the key contribution demographers have made to theories of population change.

Exhibit 9.1: The Demographic Transition

Demographers describe the "demographic transition" (DT) as a process involving a population's transition from high birth and death rates to low birth and death rates as a society evolves from a pre-industrial society into an industrialized soceity. Demographic transition theory is based on an interpretation of demographic history developed by the American demographer Warren Thompson (1929) based on his examination of changes in birth and death rates in industrializing societies over the previous 200 years. This process is typically represented by the demographic transition model (DTM) illustrate below.



In Stage 1, for countries in the pre-industrial phase of development death rates and birth rates are high and roughly in balance. All human populations are believed to have exhibited this balance of births and deaths until shifts began occurring in Western Europe in the late 18th century. Because the two rates are approximately in balance, population growth is typically very slow in Stage 1. In Stage 2 death rates drop rapidly as improvements in food supply and sanitation increase life expectancy and reduce the impact of disease. Without a corresponding fall in birth rates this produces an imbalance in vital events, and the countries in this stage experience a large and unprecedented increase in population.

In Stage 3, birth rates fall due to access to contraception, increases in wages, urbanization, a reduction in subsistence agriculture, and other social changes. Population growth begins to level off as a result. The decline in birth rates in developed countries started in the late 19th century in northern Europe. During Stage 4 both birth rates and death rates fall to unprecedented low levels. Birth rates, in fact, may drop to well below replacement level as has happened in countries like Germany, Italy, and Japan. Death rates may remain consistently low or increase slightly due to increases in lifestyle diseases and an aging population in developed countries.

By the late 20th century, birth rates and death rates in developed countries had leveled off at rates that resulted in little or no population growth. Most developed countries today are in Stage 3 or 4 of the model; the majority of developing countries have reached Stage 2 or Stage 3. Major exceptions to this process are some poor countries in sub-Saharan Africa and the Middle East which remain in Stage 1.

As with all models, this is an idealized picture of population change. The model is a generalization that applies to groups of countries and may not accurately describe each individual case. The extent to which it applies to less-developed societies today remains to be seen. Many countries such China, Brazil and Thailand have passed through the Demographic Transition Model very quickly due to rapid social and economic change. Some countries, particularly African countries, appear to be stalled in the second stage due to stagnant development and the effect of AIDS.

Source Thompson (1929).

Whether the demographer is interested in generating estimates, projections or forecasts, certain procedures should be followed. Assumptions should be made about the best approach to follow, and this may be dictated by a number of factors. Further, assumptions must be made concerning observed trends. If, for example, the population has been changing at a certain rate for several years assumptions should be made relative to the likelihood that it will continue to grow or decline at the same rate in the future. Finally, assumptions must be made concerning the quality of the data to which the analyst has access. If using census data the demographer can be fairly confident of the quality of the data (or at least know that it is recognized as the "gold standard"). If using data from some other source care must be taken to assure that the quality of the data is adequate.

9.2 Estimation Techniques

Population estimates are typically calculated when there is no actual data available. Most often demographers speak of current estimates (i.e., for the current time period or one near the current time period). However, estimates may be made for future or past years when existing data points are available for past time periods or future time periods if projections are already available.

"Interpolation" and "extrapolation" are commonly used methods by demographers to generate estimates and projections.

Population estimates can be either simple or complex. The simplest approach to estimating or projecting change is to use known data points to extrapolate or interpolate data. Obviously, the more data points one has access to, the more reliable the estimate or projection. Exhibit 9.2 discusses the interpolation and extrapolation processes that are employed in the generation of estimates and projections.

Exhibit 9.2: Using Interpolation and Extrapolation Techniques
Demographers use interpolation and extrapolation as methods for generating estimates and projections. Most estimates employ an interpolation approach when existing data points can be accessed. This method assumes that a population figure for an intermediate year will fall somewhere between the populations identified for the beginning and ending periods. For example, if one were interested in a mid-decade population estimate (e.g., 2005), the estimate could be interpolated from the figures for 2000 and 2010. Theoretically, the mid-decade estimate would represent the mid-way point between the two figures (or, in this case, the average of the two). Although the mid-year population could fall outside the range of the two data points, this is assumed to be very unlikely.

When interpolation is used assumptions must be made, of course, concerning the rate of change for that decade, with the most straightforward approach assuming that the rate of change is constant over the time period in question. However, if there is evidence that the rate of change is faster or slower for some period within the ten-year time interval, the assumptions must be modifired. An assumption of this type must be made whether the rate of change is calculated in terms of numerical change or percentage change.

When calculating projections (and forecasts) the extrapolation method is typically used when past and/or current data are available. The rationale behind extrapolation is that, once a trend has been established, it can be expected to continue into the future on a similar trajectory. This is a “leap of faith” of course in that many factors can serve to divert a trend that has been underway for some time. Yet, the assumption of a continued trajectory is often made and, for the most part, can be empirically demonstrated. Thus, if an analysis wanted to project the population for 2020 for a defined population, it would be possible to extrapolate from existing data points into the future. The analyst could determine the numerical change between 2000 and 2010 based on census figures and assume the same absolute or percentage change for 2020. With the technique the 2000–2010 trend is extrapolated into the future. Interpolation could also be used for generating a projection if projections of populations for future years have been generated. For example, if the 2010 population count for the U.S. is available and the Census Bureau has generated a projection for the U.S. population in 2030, interpolation could be used to yield a projection for 2020.

A number of techniques are available for this purpose some of which are considered "reality-based" estimates. These types of techniques tend to rely on "proxy" or "symptomatic" measures of population size and distribution. This approach utilizes data that is thought to be a representation of the population based on some logical correlate. For example, some fairly direct measures of the number of households within a defined area might be determined by the number of utility hookups, on the assumption that all occupied dwellings require electricity, gas and/or water. Of course, assumptions have to be made with regard to household size since the only information available is the number of occupied units that are hooked up to the utility system. A less direct method might involve the use of school enrolment data as a means of estimating population size. This method requires assumptions about the ratio of students to adults in a population and has to take into consideration private schools and home schooling. Data for proxy or symptomatic measures such as utility hookups and school enrolment are generally publicly available, providing an easily accessible source of proxy data.

Reality-based estimates may use proxy or symptomatic data as a basis for generating population estimates in the absence of actual data.

A reality-based method that is particularly useful in developing population estimates—assuming the requisite data are available—is the *housing-unit method*. This method has some similarities to the utility hookup estimates but is thought to provide a greater depth of understanding of the phenomenon under investigation. This approach involves starting with a known population—e.g., the "official" count from the most recent census—and employs an approach similar to the component method. Here, however, the "components" are housing units added to the community over a set period of time and housing units that are removed from the community over the same period. Thus, to the known number of housing units for Time 1 the analyst adds new home construction, new apartment construction, and newly established mobile homes between Time 1 and Time 2.

From the housing stock extant during Time 1 the analyst must subtract housing units (i.e., homes or apartments) that are demolished or otherwise taken out of stock and mobile homes that are eliminated. The required information on these activities is generally available from public records, although the availability, completeness and currency have to be considered on a case-by-case basis.

The other factor that must be addressed, of course, is the average number of occupants for each type of housing unit. This information is generally available from American Community Survey data for the target area and can be applied to each type of unit. Finally, adjustments have to be made for occupancy rates for the various types of housing units since unoccupied housing will not contribute individuals to the population total. The figures generated for each type of housing unit are then summed to yield a population estimate for Time 2. While this approach is not able to take the homeless and migrant workers into consideration, for a "normal" population its specificity in terms of housing type makes it a useful technique.

Another approach that is commonly used by demographers to generate population estimates and—less commonly—projections is the *ratio method*. This approach assumes that the share of the population for a geographical subunit represents a specified proportion of the total population, and that a constant ratio exists between the total population and the population for the sub-unit under study. Hence, past relationships between population growth in an area or community and that of its economic region or State are valuable guides for projecting the population of geographical sub-units.

For example, for the United States, it is assumed that the population of a particular state represents a certain proportion of the total population and, further, that this ratio remains constant over time. Thus, assuming that one has an accurate count for the highest level of geography (e.g., the United States), it is possible to estimate the population for each of the states based on its population's ratio to the whole. If New York state historically accounts for 10% of the nation's population, it can be assumed, then, that it will account for 10% of the newly determined national population. The same procedure could be followed for any sub-unit, with county populations being derived from the state population, census tract populations being derived from the county population and so forth.

9.3 Projection Techniques

Projections are utilized to generate population statistics for future years. The most parsimonious methods used for population projections are considered *constant change* methods of population extrapolation. These approaches assume that population growth follows natural laws and, therefore, can be expressed in mathematical or graphical form. Basically, the future population is forecast by examining past trends and projecting these trends into the future. The assumption is that the pattern observed for the past (e.g., increase, decrease) can be expected to continue into the future. This is typically a wholly mathematical exercise and does not consider the components that contribute to the observed change.

The data used for generating projections utilize historic data from decennial census reports and/or available local or State reports. Two data points (Time 1 and Time 2) are sufficient for generating a trend line and extrapolating into the future. If more data points are available all the better, although the construction of the trend line may become more complicated. In using the plotted information for projection purposes, the analyst assumes that the condition implied by the straight line will continue into the future.

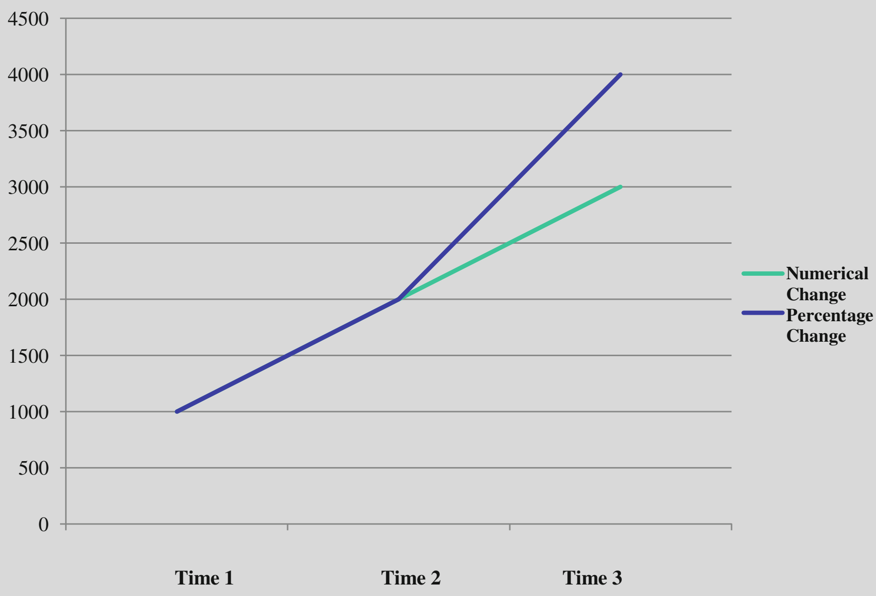
In generating population projections demographers make assumptions about the extent to which observed historic trends can be expected to hold in the future.

It is not necessary to be familiar with semi-log or other mathematical frameworks to generate straight-line projections, and analysts may opt to use a method based on a constant arithmetic population change or a constant proportional population change. For the former, historic data which plot as a straight line on arithmetic graph paper imply constant arithmetic change in population each year. This growth pattern implies that the population has changed by the same number of people each year. The data would appear as a straight line when plotted on arithmetic paper. If it has been found, for example, that over a ten-year period the average annual increase was 1000 residents for a defined geographical area, then this figure (1000 per year) would be extrapolated into the future.

Not only does the approach assume that there is a constant average year-to-year increase but that the increase observed over the historical period was also constant year to year. For a defined geography it is found, for example, that the population increased by 10,000 over a ten-year period—or an average of 1000 per year. It is possible, however, that most of the increase occurred during the first years of the decade but slowed during the later years. Or, it could have been that the population was relatively stagnant during the first few years of the decade, with rapid growth occurring within the last few years. While the constant change method does not require that such factors be taken into consideration, if there is evidence of inconsistent change over the study period, the projection generated may be misleading.

An alternative to the numerical approach is the constant percentage change method. If one analyzed the numerical change results it would be found that, since the base population each year has increased (or decreased) by a constant amount, the rate of change is different for each year resulting in a different pattern of growth —that is, curvilinear). When the same data are plotted on semi-log paper (with population on the log scale and time on the arithmetic scale), a straight-line plot results. In this situation, the numerical increase each year is greater than the year before, although the rate of increase is constant. Exhibit 9.3 illustrates the results generated by using the two different models (numerical and percentage).

Exhibit 9.3: Two Projection Models



The ratio method described above for use in generating estimates can also be used for projecting populations for sub-units. The population growth of a study area can be projected into the future by relating its growth to a larger area of which it is a part, such as a state, a region, or the nation. The basic procedure is to compute the ratio between the population of the study area and some larger area at the time of past censuses. This ratio may simply be between the study area and a larger area, or a series of interrelated ratios may be calculated between pairs of successively smaller geographical areas. Such a series, known as step-down ratios, might be between the study area and the State economic area, the State economic area and the whole State, the State and the region and, finally, the region and the Nation. This method requires the availability of a reliable projection for the larger area and comparable historic data for the subareas to be used should be examined before.

The component method of calculating population change considers the three primary factors that influence population growth and decline—fertility, mortality and migration.

One commonly used method for projections is the *component method*. There are three components to population change to consider: fertility, mortality and migration. Individuals are added to the population through the fertility process (births) and subtracted through mortality process (deaths). Individuals are added to a population through in-migration and subtracted through out-migration. Thus, the population at Time 2 is a result of adding births and in-migrants and subtracting deaths and out-migrants from the population at Time 1. Population change resulting from the addition of births and the subtraction of deaths is referred to as "natural increase" (or decrease as the case may be). In a closed society, these are the only factors that influence population change. Since there are virtually no closed societies, the role of migration must be factored into the equation. Exhibit 9.4 describes the calculation of projections using the component method. Exhibit 9.3 provides formulas for the calculation of population change using the component method.

Exhibit 9.3: Calculating Population Change, Component Method
The component method for calculating population change uses births, deaths and migration flows as the basis for generating synthetic data. The first formula illustrates the calculation of natural increase/decrease while the second formula introduces migration into the equation.

Natural Increase/Decrease

$$\mathrm{Pop}_2 = \mathrm{Pop}_1 + \mathrm{Births} - \mathrm{Deaths}$$

Example:

$$\mathrm{Pop}_{2000} = \mathrm{Pop}_{1990} + \mathrm{Births\ and\ \text{-}\ Deaths}_{1990-2000}$$
$$\mathrm{Pop}_{2000} = 10,000 + 6000 - 1000$$
$$\mathrm{Pop}_{2000} = 15,000$$

Natural increase = 5000

Natural Increase/Decrease and Migration

$$\mathrm{Pop}_2 = \mathrm{Pop}_1 + \mathrm{Births} - \mathrm{Deaths} + \mathrm{Migration}$$

Example:

$$\mathrm{Pop}_{2000} = \mathrm{Pop}_{1990} + \mathrm{Births\ and} - \mathrm{Deaths}_{1990-2000} + \text{In-migration and} - \text{Out-Migration}$$

$$\mathrm{Pop}_2 = \mathrm{Pop}_1 + \mathrm{Births} - \mathrm{Deaths} \pm \mathrm{Migration}$$
$$\mathrm{Pop}_{2000} = 10,000 + 6000 - 1000 + 3000 - 1000 = 17,000$$

Population Change = +7000

Another available projection technique involves the use of *cohort-change ratios* (CCRs). This technique (also referred to as the Hamilton-Perry Model) can be used to develop projections not only by age, but by age and sex, age and race, sex and race, and so on (Swanson & Tedrow, 2017). The major advantage of this method is that it has much smaller data requirements than the traditional cohort-component method. Instead of mortality, fertility, migration, and total population data, the Hamilton–Perry method simply requires data from the two most recent censuses. This method can be used to project population by age and sex using cohort-change ratios computed from census data or other data sets involving successive time periods. In its simplest form this approach involves cohort-to-cohort advances over time. For example, the number of persons in the 20–24 age cohort in Time 2 should be similar to the number in the 10–14 age cohort tens year previous (if one is using decennial census data). The same is true for any other age cohort except, as noted below, the very youngest and very oldest cohorts. Assumptions must be made, of course, related to the impact of immigration and mortality on the population under study.

Given the nature of the CCRs, 10–14 is the youngest age group for which projections can be made (if there are 10 years between censuses). To project the population aged 0–4 and 5–9 one can calculate the Child Woman Ratio (CWR) and incorporate it into the model. This does not require any data beyond what is available in the decennial census. Projections of the oldest open-ended age group differ slightly from the CCR projections and require that the three oldest cohorts be grouped for calculating the population in the oldest cohort.

The cohort-change ratio from time period to period should equal 1.00 or less in the absence of any disruptive event. A cohort-change ratio greater than 1.00 indicates that more increments (e.g., in-migrants) then decrements (e.g., deaths and out-migrants) occurred during the interval. Thus, for example, a fast-growing suburb would yield a higher ratio due to the fact that the numbers added to the population between censuses exceeded the numbers lost to death or out-migration.

One disadvantage of the cohort-change ratio method is that it can lead to unreasonably high projections in rapidly growing places and unreasonably low projections in places experiencing population losses. Geographic boundary changes are an issue as well. Since extrapolation methods of this type are based on population changes within a given area, it is essential to develop geographic boundaries that remain constant over time. For some sub-county areas, this presents a major challenge, however. Case Study 9.1 describes a demography-based technique for predicting the demand for health services.

9.4 Generating Forecasts

Forecasts represent a special—and an infrequently used—form of synthetic data. Given the variety of factors that could contribute to population change, forecasts may make sense in some cases. Econometric approaches to forecasting use equations that project utilization as a function of the interplay of independent variables based on multiple factors make more sense than forecasts based on a single factor. Theoretically, the more factors used in predicting future conditions, the more accurate the prediction will be.

Case Study 9.1: Using Population Projections to Anticipate Health Services Demand

Demographers involved in the planning of health services require access to data on disease incidence and prevalence, as well as data on the volume of health services consumed. However, there is no central repository of data on either the amount of morbidity within a population or the level of health services required to meet the needs of that population. Yet, this information is essential for the development of an informed health plan.

Health demographers do have some options in that the distribution of diseases in contemporary America exhibits a strong association with certain demographic characteristics. Unlike past acute conditions, today's chronic conditions are highly correlated with the demographic attributes of a population. Thus, if the demographer has access to key demographic data for a defined population—e.g., the age and sex distribution—and utilization rates for various types of services it is possible to estimate and project health services demand for that population.

A case in point might be the need to estimate the demand for various physician specialties. A hospital, for example, may be initiating a physician recruitment effort or a chain of primary care clinics might be considering establishing a site in a newly developed community. Assuming that the analyst has access to the age-sex breakdown for the target population it becomes possible to generate estimates and projections of the demand for various medical specialties among other factors.

Data are available from the National Center for Health Statistics that indicate physician utilization rates for each five-year cohort for males and females separately. It then becomes a simple matter of applying the age/sex-specific rates to each cohort to generate the anticipated number of cases. The estimates based of age and sex are typically adjusted for region of the country and, to the extent that additional attributes are available, they could be adjusted for race, income, insurance status or some other factor. Admittedly, these are modeled data but, in the absence of actual data, they represent the best possible estimate. Estimates and projections can be generated for any time period as long as the requisite inputs are available. The table below presents the anticipated number of visits for selected specialties for a specific metropolitan area in 2017.

Estimated Physician Visits for Selected Specialties, Metro Service Area, 2017

Family Practice	56,683
Internal medicine	28,450
Pediatrics	5157
General surgery	4257
Obstetrics/gynecology	12,347
Orthopedic surgery	8447
Cardiovascular disease	7687
Dermatology	7408
Urology	6043
Psychiatry	3322
Neurology	2917
Ophthalmology	19,583
Otolaryngology	3624
All other specialties	28,750

Not surprisingly, the calculations based on the available data suggest that primary care physicians (e.g., family practitioners, internists, OB/GYNs) are more in demand by this population than many of the specialists (e.g., psychiatry, neurology, otolaryngology). These estimates, in fact, reflect an older population that includes a lower than average proportion of children (hence fewer pediatric visits) and a higher than average proportion of seniors (hence, relatively more orthopedic, cardiovascular, and ophthalmological visits). Generating estimates in this manner allows the health demographer to use modeled data to fill a void in the existing knowledge.

Econometric forecasting addresses these factors in a series of mathematical expressions. The equation ultimately used is the one that best "fits the curve" exhibited by the historic trends. As a simple example, the historic ratios described above can be plotted as a time series and projected forward to generate a forecast. Local conditions must be examined, however, and the factors that might influence the future ratios fully understood. Former relationships between population growth in the area under consideration may suddenly change. Moreover, economic and social forces exert differing effects at different times on particular areas. Simply because a ratio has had a particular trend in the past is no assurance that it will continue to have that relationship in the future. For example, during the early decades of this century, coal mining towns in the Appalachian area grew at a faster rate than their State as a whole. However, during the past few decades, this trend has been reversed.

Forecasts represent the most complex form of projections since they attempt to consider all possible factors that might influence population growth and change.

An example of a technique that could be used for demographic forecasting is structural equation modeling (SEM). The two central components of SEM are the path model and the measurement model. The path model or path analysis quantifies specific cause-and-effect relationships between observed variables. The measurement model quantifies linkages between (1) hypothetical constructs that might be known but unobservable components of the phenomenon under study and (2) observed variables that represent a specific hypothetical construct in the form of a linear combination. Cause-and-effect relationships between observed variables are usually based on theoretical considerations or evidence from prior studies. However, certain conditions must be met for a variable to be designated as cause versus effect.

Once the model is fitted to data, the path coefficient (direct effect) for each path is estimated and interpreted similarly to a regression coefficient. An indirect effect of any causal variable is estimated as the product of the chain of direct effects, and a total effect is the sum of all direct and indirect effects. As with multiple regression, an effect is interpreted as the change induced by fixing other variables in a model and changing only the subject variable. A direct effect would occur if all other variables in a model remained constant. In estimating an indirect effect, all other variables in the model are controlled except for the mediating variables in the path representing the indirect effect of interest. Observed variables should be both valid and reliable with respect to measurement of the latent variables.

The relationships in structural equation modeling are usually formulated by linear regression equations, and can be graphically expressed by path diagrams. The distinct advantages of this technique compared to other statistical methods are the ability to test construct-level hypotheses and provide interpretation based on the analysis. As an example, this method could be used to explain the factors that determine a health index for an individual or, more appropriately, a population. A health index is often used as an indicator of the level of health of a community or a country. These indexes are influenced by the health status of individuals within the community. Besides being often used as an indicator of the state of welfare of a country, the health index may also indicate its level of productivity and economic growth. If the relationship of the indicator variables with their respective latent variables can be determined the contributors to the health index can be identified.

This appears to be a particularly useful technique for forecasting demographic-related phenomena. The health of a population is influenced by factors that are related to the economy and the environment, as well as social and biological factors. Some of these factors are observable and some are not. The factors that are not directly observed, such as lifestyle, socio-demographic attributes, and mental health condition can be measured through indicator variables.

Studies using this approach (e.g., Ferra, Kamarulzaman, & Abdul Aziz, 2013) have found that structural equation modeling is a useful technique for generating demographic-based forecasts of health phenomena.

9.5 The Impact of Population Change

Changes in population size almost invariably result in changes in population distribution and population composition. Differential birth and death rates may cause changes in both the distribution and composition while the distribution of in-migrants may exhibit different patterns from the population in the receiving community. Migrants, in fact, affect the population composition of both the communities from which they originate and those to which they migrate.

In the United States historical migration patterns have contributed significantly to the redistribution of the U.S. population. Migration from the eastern portions of the nation to the western portions has been a constant phenomenon since the continent's first settlers. More recently, migration from the Northeast and Midwest to the South and West regions has dramatically reshuffled the distribution of the nation's population and reshaped its social tapestry. Other examples of the impact of migration on the U.S. population include the migration streams of primarily African-Americans from the South to the Midwest and Northeast during the period of agricultural mechanization during the first half of the 20th century and the dispersion of the Hispanic population throughout the U.S. since the 1990s. While Hispanics (particularly Mexican-Americans) remain concentrated in the West and southwestern states, migration over the past two decades has resulted in the spread of this population across the nation to the point that virtually every U.S. county counts Mexican immigrants among its residents.

A change in population size often involves changes in population distribution and population composition.

Change in population size typically involves changes in the composition of the population affected by the change. There are a few situations in which the population composition remains constant over time even as residential turnover occurs. Examples include a single-family neighborhood with facilities geared toward young families in which the residents' characteristics remain constant over time as new young families replace older families whose housing needs have changed. Or the retirement community that has age restrictions and perhaps other requirements of its residents to assure a consistent demographic mix for the community.

In most cases, however, it is expected that population turnover will be accompanied by changes in population composition. This has been demonstrated time after time in our urban centers as wave after wave of successive immigrant groups have one after another replaced each other, thereby significantly changing the character of the community or as "urban pioneers" replace long-time residents in inner-cities through the gentrification process causing old-time residents to bemoan the fact that the neighborhood is "not like it used to be." An important role for applied demographers involves the ability to anticipate the implications of population change, and Case Study 9.2 describes the impact on residential turnover on population composition.

Case Study 9.2: Population Turnover and Compositional Change

When population change occurs it not only affects the size of the population but also has implications for population distribution and composition. Whether the change is engendered by persons added to the population through birth or in-migration or persons subtracted from the population through death or out-migration, population size, distribution and composition are inevitably affected.

A case in point is an older suburban area on the fringe of the inner city in a medium-sized Southern city. The Taylor community had been established during World War II as an industrial community of middle- and working-class families. It maintained this status until the 1970s when the last plants closed and jobs disappeared from the community. The decline of industry coincided with the beginning of the movement of inner-city residents into near suburbs and the subsequent flight of white residents to more distant residential areas.

The residential turnover that occurred between 1980 and 2010 had a major impact on the composition of the residents of the Taylor community. This analysis focuses on the two decades between 1990 and 2010 in an effort to understand the compositional changes occasioned by the turnover the community experienced. In terms of population size, there was little change over the two decades with the number of people residing in the community in 2010 little different from that in 1990. The distribution of the population geographically within the community changed little over these two decades as well, since the area was essentially "built out," and there was little space for additional residential development.

A major shift, however, was noted in the composition of the population. By the time the influx of inner-city residents was underway, the original Taylor population had aged considerably, with many of the original "settlers" from the 1950s and 60s aging in place. Older residents made of the bulk of community members with older working-age residents and seniors being more common in 1990 among long-time residents while the younger age cohorts (e.g., ages 5–34) were overrepresented among the newcomers. Interestingly, the sex ratio exhibited little change over this two-decade period.

The most important change was recorded for the racial mix. In 1990 the white population still maintained a slight edge (55%–45%), but by 2010 the population was 89% black and 11% white. No other racial or ethnic group was represented to any extent. This racial turnover was accompanied by a number of other changes. The proportion of the population that was married dropped from 55% to 32% (with one-fourth of the latter being separated). The proportion never married increased from 28% to 51%. The proportion of family households declined from 79% to 71% and the proportion of female-headed households with children increased from 17% to 26%.

Similar dramatic changes were recorded over the two decades for a number of other attributes. The median household income actually declined between 1990 and 2010 (from $23,270 to $21,367) as did the median family income (from $27,942 to $24,750). At the same time, the poverty population increased dramatically, with the proportion of persons living at or below poverty increasing from 20% to 61%, the proportion of poverty-level families from 17% to 36% and the proportion of impoverished children under 18 from 21% to 63%.

These changes in socioeconomic status reflected a decline in labor force participation overall (from 67% to 62%) but an increase in female labor force participation (from 24% to 44%). The already high unemployment rate increased dramatically (from 15% to 40%). The educational level did not increase over this time period and actually declined slightly.

Clearly, as a result of population change, the population of Taylor looked a lot different in 2010 than it did in 1990. It was transformed from an older, predominantly white moderately educated middle and working-class population of stable families into a predominantly younger African-American lower- to working-class population with limited education and high rates of unemployment. While the overall size of the population and its distribution felt limited effect from the population turnover that occurred, the community's population composition was significantly altered.

9.6 Data Sources for Population Change

Demographers have long used population estimates and projections in the absence of actual data, and a variety of techniques are utilized for these purposes. Population estimates for states, MSAs, and counties are prepared each year as a joint effort of the Census Bureau and the state agency designated by each state governor under the Federal-State Program for Local Population Estimates (FSCPE). The purpose of the program is to standardize data and procedures so that the highest quality estimates can be derived. Most states also generate population estimates and projections that are available through state agencies. However, these figures are often produced at irregular intervals, and thus may be quite dated.

Population estimates and projections generated by government agencies have historically been the only ones available. Today, however, a number of data vendors provide these figures. These vendor-generated data are often made available down to small units of geography (e.g., the census tract) and in greater detail (e.g., sex and age breakdowns) than government-produced figures. They offer the flexibility to generate estimates and projections for "custom" geographies (e.g., a market area) not available for government-generated statistics. The drawback, of course, is that some precision is lost as one develops calculations for lower levels of geography and for population components. However, the ease of accessibility and timeliness of these vendor-generated figures have made them a mainstay of health planners and researchers.

Issues have been raised concerning the quality of the synthetic data produced by both government agencies and commercial data vendors. Data users typically need the latest information possible, and in an effort to be expedient the question of quality sometimes has become a secondary concern. Any evaluation of the quality of synthetic data requires knowledge of the date and quality of the historical data being used as a basis for the estimates and projections. Furthermore, attention must be paid to the methods and assumptions utilized to generate the figures. If, for example, one assumes that population growth in an area is gradual and can be described by a simple mathematical function, population estimates and projections will be reasonably accurate as long as the assumptions hold. However, to the extent that an assumption is wrong, the (incorrect) mathematical function will yield inaccurate estimates and projections. While it is not possible to be aware of all the nuances of data quality and method, users are urged to evaluate underlying assumptions critically and to ascertain the accuracy of the synthetic data that are available.

Exercise 9.1: Constant Change Projections

There are two ways in which a constant change technique can be used to generate population projections: numerical change and percentage change. For the community featured below examine the data provided and compute projections using these two different techniques. Discuss how the outcome differs depending on the technique used.

Model 1: Numerical change

$$\text{Population } T_{1990} = 10,000 \quad \text{Population } T_{2000} = 20,000$$
$$\text{Population } T_{2010} = \_\_\_\_\_\_\_\_\_\_\_$$

Calculate the average annual numerical change between 1990 and 2000. Apply this figure to the period between 2000 and 2010 and calculate the 2010 population.

Model 2: Percentage change

$$\text{Population } T_{1990} = 10,000 \quad \text{Population } T_{2000} = 20,000$$
$$\text{Population } T_{2010} = \_\_\_\_\_\_\_\_\_\_\_$$

Calculate the average annual percentage change between 1990 and 2000. Apply this figure to the period between 2000 and 2010 and calculate the 2010 population.

Examine the two outputs and determine how they differ. Plot the trends using an Excel spreadsheet or other tool and compare the slopes generated by the two techniques.

Exercise 9.2: Calculating Population Change

You have been asked to calculate population change for Podunk County in order to develop plans for school expansion. Calculate population change first by looking only at natural increase and, then, by including migration in the equation.

Calculate the missing values for Podunk County based on natural increase for a future year and for a past year:

2005 Population	Births 2005–2014	Deaths 2005–2014	2015 Population
50,000	500	200	_________

2005 Population	Births 2005–2014	Deaths 2005–2014	2015 Population
_________	500	200	30,000

Calculate the missing values for Podunk County based on natural increase AND migration:

2005 Population	Births 2005–2014	Deaths 2005–2014	In-Migration	Out-Migration	2015 Population
50,000	500	200	1000	200	_________

2005 Population	Births 2005–2014	Deaths 2005–2014	In-Migration	Out-Migration	2015 Population
50,000	500	200	200	800	_________

2005 Population	Births 2005–2014	Deaths 2005–2014	NetMigration*	2015Population
50,000	500	200	_________	60,000

*Net migration = Difference between in-migration and out-migration

Exercise 9.3: Housing Unit-Based Estimates

Students are tasked with the job of estimating the population for Smith County for 2015 using a reality-based approach. Information is available on the number of housing units of various types in the county in 2010 based on the decennial census. Information is available from local sources on the new housing units that have been added since 2010. Estimates of the average household size can be obtained from the American Community Survey (ACS). Using the information provided, generate an estimate of the 2015 population of Smith County.

Housing Type	Number	Average Household Size	Added Population
Single-family home	1000	3.00	_______
Apartments	500	2.00	_______
Mobile homes	50	2.50	_______
Total population added between 2010 and 2015			_______

Smith County 2015 Population = 20,000 + [added population] = ____________

Note This exercise does not take into consideration housing stock that has been removed from the total between 2010 and 2015

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Chapter 10
Business Demography

Abstract The earliest major application of demography to real world problems occurred in the business arena. Business professionals realized early on that demographics had implications for virtually every commercial endeavor—from market research to product development to consumer decision-making. Business professionals readily adopted demographic methods and data for their own use, and many of the early applied demographers made their contribution within the world of commerce.

10.1 Introduction

Business demography is defined as the application of the concepts, methods and data of demography to business challenges and opportunities. Business demography in grounded in the application of the demographic perspective to business issues. Applied to the world of commerce, the demographic perspective involves an understanding of how demographic factors affect business conditions. Business planners use demography to help decision makers make better choices with respect to commerce-related strategies and the implementation of those strategies.

The use of demographic data and methods in business planning has a relatively long history, and the early acceptance of demographic input on the part of business professionals contributed to the development of applied demography as a distinct discipline. In fact, the application of demographic resources in the business arena predates its application in most other contexts. As business strategy in general, and marketing in particular, began to move away from a mass market approach to a more targeted strategy focusing on market segments during the 1960s, demographic data become increasingly important.

The growth of business demography was given impetus through: (1) an appreciation on the part of the business community of the role that demographics could play; (2) the increasing interest in business demography on the part of professional demographers; and (3) the increasing ease of access to demographic data useful to businesses. Given the emphasis on advancing the society's economic development

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and the interest of individual businesses, it is not surprising that this was the realm in which demographics was first intensively applied. Although demographic analysis began in business as a technical function that supported other operational activities, demographics eventually came to be a driver for most business decision making. Once relegated to the backroom, demographic input was eventually promoted to the boardroom with few corporate decisions made today without considering "the demographics."

The earliest application of demographics to the solution of real-world problems occurred within the business arena as corporations realized they needed to understand the characteristics of the emerging consumer market.

Demographers were quick to recognize the potential applications of demography to business challenges. Many of the demographers who entered the private sector were attracted by the potential contribution of demography to business decision-making. Corporations large and small recognized the potential contribution of demography, and many demographers have contributed to the success of corporations as they have strived to adapt to a changing environment.

Perhaps the essence of business demography has best been captured by Smith and Morrison (2003). As they note, business demography encompasses the application of demographic concepts, data, and techniques to the practical concerns of business decision makers. This loosely organized field includes—but is not limited to—site selection, sales forecasting, financial planning, market assessment, consumer profiles, target marketing, litigation support, and labor force analysis. Specific applications have evolved over time, reflecting changes in data sources, computer technology, statistical techniques, and the business environment itself. Exhibit 10.1 describes the emergence of the consumer as a driving factor in the development of business demography.

Businesses have based decisions on demographic data and techniques since as far back as the late nineteenth century (Pol & Thomas, 1997), although the emergence of business demography as a distinct field is quite recent. As the field matured, it became routine for businesses to base decisions on the advice of consultants and employees skilled in collecting, analyzing, and interpreting demographic data (Smith & Morrison, 2003). Responding to these developments, the Population Association of America formed a Committee on Business Demography in 1982, which together with the Committee on State and Local Demography launched the *Applied Demography* newsletter in 1985.

Business demographers fall into three distinct groups: those employed by private companies, whose work pertains specifically to those companies and their business activities (e.g., market analyses, customer profiles, site selection); those employed by firms that create demographic databases (e.g., population estimates, consumer spending, lifestyle clusters); and individual consultants who undertake specific projects for particular clients.

Not all practicing "demographers" have formal training in demography. Indeed, the diversity in training, educational background, and current occupation reflects the eclectic nature of business demography as a field. They may have backgrounds in economics, geography, marketing, statistics, survey research, or other disciplines. Many people with business backgrounds have acquired skills in demographic analysis out of professional necessity. Even those with formal demographic training have acquired many job skills principally through work experience rather than academic training. Few academic programs extend their demographic focus to business fields, and few business schools offer training in demographic applications.

Exhibit 10.1: The Emergence of a Consumer Economy and the Ascendency of the Consumer

Up until World War II the U.S. economy was considered to be a "production economy" driven by manufacturing and other sectors that emphasized the production of (mostly) industrial goods. This production orientation assumed that producers already knew what consumers needed. Products were made to the manufacturer's specification, and then customers were sought. Prior to the war it was a sellers' market with producers offering standardized products in an environment that reflected a here-is-our-product-take-it-or-leave-it attitude. After WWII the situation changed radically as post-war prosperity resulted in unprecedented discretionary income in the hands of Americans who had been hardened by the austerity created by the Depression and World War II.

Post-war prosperity led to the emergence of the "consumer" and the ascendency of a "consumption economy". For the first time consumers began to make demands on producers, and the sellers' market turned into a buyers' market. The term "marketing" which had been around since 1910 took on new meaning as producers now had to compete for the burgeoning consumer market. The postwar period was marked by a growing emphasis on consumption and acquisition, and the frugality of the Depression era gave way to a degree of materialism that shocked older generations. The availability of consumer credit and a mind-set that emphasized "keeping up with the Joneses" generated demand for a growing range of goods and services. This period witnessed the birth of the first generation of citizens with a consumer mentality. The new consumer had added "wants" to the shopping list along with traditional "needs."

A wide variety of new products and services emerged during the postwar period, particularly in consumer goods industries. Newly empowered consumers demanded a growing array of consumer goods and services. This development contributed to the emergence of marketing for three primary reasons. First, consumers had to be introduced to and educated about these new goods and services. Second, the entry of new producers into the market gave rise to a level of competition unknown in the prewar period. Mechanisms had to be developed to make the public aware of a new product and to distinguish that product (in the eyes of potential customers) from that offered by competitors. Consumers had to be made aware of purchase opportunities and then persuaded to buy a certain brand. Third, the standardization of existing products during this period further contributed to the need to convince newly empowered consumers to choose one good or service over another. Where few differences existed between the products in a market, the role of marketing became crucial. Marketers were enlisted to highlight and, if necessary, create differences between similar products.

The original response of business in the face of the emerging consumer market was mass marketing. This one-size-fits-all model represented a holdover from the production economy when producers "knew" what their customers needed. It was eventually realized that the market for consumer goods was highly differentiated and that marketing all things to all people was not effective in the new economic environment. This realization led to the abandonment of the mass marketing model for a target marketing approach. The differentiation that led to this new model was primarily along demographic dimensions. Not only did demographic differentiation determine who bought what products but even influenced what brands of a particular product consumers in different segments preferred. Even a "standardized" product—e.g., Campbell's soup—was offered in different version (often unknown to the customer) in response to regional preferences. It came to be the conventional wisdom that, if one could determine the demographic profile of a target population, the consumer behavior of this population could be predicted.

This model was even extended by some business demographers from target marketing to micro-marketing. With micro-marketing very narrow segments of the consumer population and even individual households could be identified based on their demographic characteristics. This model allowed for the emergence of customized marketing focusing on specifically defined sets of consumers. The direct mail and telemarketing industries emerged as a result of this capability. Thus, a marketer seeking to target households with senior residents with a certain household income likely to be living alone for a home health service could access data on households that met these criteria and more efficiently focus the marketing effort.

The demographic perspective highlights the connection between demographic characteristics and processes and business-related behavior. Unlike in some other areas of demographic endeavor, the end-point in business demography is typically a decision. Whether the project involves consumer research, new product development, site selection or any number of other business-related activities, the end point is—a decision that usually answers some question related to a concrete problem. For example, what segment of the consumer market should be targeted? What products are needed by the senior market? Where should the next retail outlet be located?

Business decisions frequently have a locational component. Business research often involves the identification and profiling of a defined geographic area. This could be a county, ZIP code, census tract or some grouping of these units. The targeted area could represent the population covered within a radius of a point or a population defined in terms of drive time from a specific site. In every case, no one is better prepared than demographers to provide the analysis necessary to support locational decisions.

Business demography represents the intersection of demographic variables, demographic processes and business activities. The demographic attributes of a population have important implications for the business environment and ultimately the overall economy. In the contemporary U.S. economy much of the economic activity is driven by consumer spending. This assumes that consumers have discretionary income that can be circulated to drive economic activity. Prior to WWII consumers had little discretion in their spending with virtually all resources devoted to basic needs—thus, a limited consumer market. With post-WWII prosperity consumers had unprecedented disposable income at their command.

The relationship between demography and business is a two-way street, with a population's characteristics influencing the nature of the economic system and the operation of the economic system affecting the population's demographic processes.

At the same time, the economic conditions that exist at a point in time have significant implications for the demographic attributes of society. In times of austerity the fertility rate is typically suppressed as in the case of the Great Depression and WWII when births dropped dramatically. With the prosperity and optimism following the end of the war, fertility soared resulting in the baby boom and unprecedented demand for a diverse range of products—from home furnishings for first-time home buyers to obstetrical and pediatric services to baby clothes and toys. In times of prosperity the U.S. is attractive to immigrants who are seeking economic activity. Thus, during the positive economic environment of the 1990s and early 2000s millions of immigrants (legal and illegal) entered the U.S. seeking employment. Then, with the recession that occurred around 2008 the flow of immigration was reversed as economic opportunities in the U.S. diminished.

Numerous other examples of this intersection can be identified. The changing nature of the U.S. economy over the past 100 years has transformed the U.S. from an agrarian society to an urban society and dramatically affected the nature of the American household. The nature of the economy determines the types of occupations that individuals choose and the type of educational skills they seek. As we learned during the 2016 presidential election the economy can play an important role in voter decisions.

The changing demographics of the U.S. population have had a major impact on business activity. The fastest growing group of consumers today is seniors, a segment often ignored by marketers in the past since it was assumed they had completed their purchasing activities. (Indeed, the historical "hump" in household expenditures in the U.S. was around age 50 [Martins, Yusuf & Swanson, 2012]). Now seniors are perceived as a desirable market. A generation ago unless a business was strictly geared to a specific racial or ethnic group (e.g., African-American hair products), the minority market was essentially ignored. Today, with various racial and ethnic groups experiencing substantial growth and the relative size of the traditional native-born white market diminishing, most businesses must address the needs of growing racial and ethnic populations. Exhibit 10.2 describes life-cycle analysis as a technique that can be used to segment the population for business purposes.

Exhibit 10.2: Life-Cycle Analysis

For decades marketers have viewed the consumer life-cycle as a framework for guiding the development of marketing plans. The life-cycle is a demographically based model that depicts the path that individuals follow as consumers transition from birth to death. This model contends that individuals experience fairly standardized stages of life as they age, with each stage predictably transitioning to the next stage. Thus, babies are born and spend a certain amount of time in infanthood. Infants become toddlers and then preschoolers. Children experience a period of schooling and in the process become teenagers. Teenagers grow into young adults who then become college students or enter the workforce.

In this model, young adults get married and establish families at a certain point, setting off a series of stages that include families with young children, families with older children and eventually empty-nest families. Simultaneously, the bread-winner(s) is going through a professional life-cycle that involves a progression of employment situations culminating in retirement at the end of working life. This is followed by a period of old-age and, presumably, declining activity and health status. These phases are defined for all practical purposes in terms of demographics and, it could be argued, that the observed patterns are a product of demographic forces.

The traditional model assumes that each phase in the life-cycle is characterized by certain consumer behaviors and the demand for certain goods and services. Thus, babies and infants have certain needs, and these needs change as they mature into school-children. Teenagers develop distinct consumer preferences and these extend into young adulthood often influenced by popular culture. In this model, virtually everyone goes through a period of family formation that includes establishing a household, perhaps buying a home and certainly acquiring the home furnishings required by new householders. As consumers age—and presumably generate more income—their needs and wants change. As their children age their purchase practices change until the last children leave the home. At this point, these aging consumers look to vacation homes, leisure activities and other forms of consumer expenditure to occupy their "golden years." Savvy marketers will be able to determine the consumer needs at each step of the way and promote the goods and service demanded at that point in the life-cycle.

This approach served marketers well through much of the post-war period but, because of demographic developments, has become increasingly difficult to justify today. The model assumes a fairly standard set of phases that virtually everyone goes through in a predictable fashion. However, there is very little that is predictable about the demographic forces affecting contemporary U.S. society. Beginning with infanthood there today's situation is quite different from any past conditions faced by society. For starters, nearly half of babies are born to unwed mothers. This means that a large portion of the population is not involved in family formation in the traditional sense. These young families often do not establish their own homes and may remain with their parents or move in with other family members. Even children born in wedlock may end up in a blended family or be raised by a family member other than a parent. The model assumes that people will get married and stay married yet it is clear that is less and less the typical pattern. In fact, people may experience a series of marriages resulting in various combinations of blended, mixed and extended families. Add to this the fact that a large portion of Millennials are neither working nor in school, and significant numbers of adult children continue to live with their parents. And then there is the growing number of same-sex marriages. All this, of course, has implications for household formation and the purchase of consumer goods.

A similar pattern is seen with regard to career paths. It was not unusual in the past for a worker (typically the male breadwinner) to take a job as a youth and continue to work for that company until retirement. This is a rare event today, and there are many different career paths that individuals (both male and female) may pursue. Many workers follow unconventional paths with regard to employment, particularly in an economy that encourages entrepreneurship and self-employment. Even among those who follow a more traditional path, many may change occupations and employment statuses many times during their working years. It is not unusual for workers to experience two, three or more different careers.

These changing demographic patterns have wreaked havoc with the life-cycle model of consumer behavior. Very little is predictable in today's environment, complicating the challenge for marketers seeking to identify target markets. When all young families were very similar the job of the marketer was relatively easy. Most members of young families had the same wants and needs. But if the totality of young families includes traditional twenty-something parents and two children, 15-year-old unwed mothers, stepchildren adopted by their new "parents" and same-sex couples adopting Chinese orphans, the marketing process is much more complicated. Just as demographic forces served to create the original life-cycle, they now serve to complicate the process to the point that life-cycle analysis has become of limited use to today's marketers.

Because of the developments that have occurred in the economy and the emergence of a consumer market, the American business environment has changed dramatically. Businesses have become increasingly market oriented and attuned to the changing demographic attributes of their target markets and the overall consumer market. As businesses have become more consumer driven the demand for demographic data and demographer input has grown. Few business decisions are made today without considering "the demographics," and demographers or their surrogates are increasingly found around the boardroom conference table.

The tools of business demography parallel those that demographers use generally (Smith & Morrison, 2003). Data are drawn from a variety of sources and standard demographic concepts, measures, and techniques are applied. What sets business demographics apart is the purposes for which the data are used. Business demography aims to clarify and inform business decisions rather than to advance knowledge. For example, geodemographic segmentation systems can classify neighborhoods with similar demographic characteristics and consumer preferences into lifestyle clusters (Weiss, 1988). Given business demography's emphasis on decision making, techniques that update recent census data and project future values play a particularly important role. Demographers introduce fresh perspectives to the business world because they can envision business problems differently than business people ordinarily do (for example, distinguishing among age, period, and cohort effects that reshape a market). They inform and advise, broaden perspectives, and even serve as catalysts for organizational change. By exposing business minds to new perspectives, demographers can elevate management thinking from an operational to a strategic level (Siegel, 2002).

10.2 Spheres of Activity

Demographic analysis is applied to a wide range of social problems and every sector of society exhibits issues that can benefit from the application of demographic concepts, techniques and data. This is particularly the case for business demography, and there are few commercial activities that are not in some way tied to demographics. The sections below highlight some of the more common applications of demographics in the business world.

10.2.1 Consumer Research

Most business activity today begins with consumer research. There is no longer an assumption that the producer knows best; there have been too many product failures. Consumer research may involve an overall approach to the market and identify growth trends, population distribution patterns, consumer spending activities and a variety of other factors that characterize the economy. As the research becomes more targeted the questions that are asked include: Who buys what products? Where to they buy the products? What are the brand preferences of different groups? What are they willing to pay for them? What attracts them to that product?

The examples of divergent consumer buying patterns are unlimited. Who buys discount clothes versus designer fashions? Who buys Ford pick-up trucks versus BMWs versus Priuses? Who buys Kentucky Fried Chicken versus Church's Fried Chicken? Who buys lottery tickets versus savings bonds, Budweiser versus chardonnay, mobile homes versus condos?

Most business activity begins with consumer research since demographic attributes are a major determinant of consumer decision-making.

The relevant point here is that these differences reflect the demographic attributes of the population. Like most behavior discussed in this book consumer decisions are driven to a great extent by the demographics of the consumers in question. Teenagers buy different products than seniors, women buy different products than men, African-Americans buy different products than whites or Hispanics. Consumer decision making is driven by income levels, educational attainment, household structure, employment status and a number of other demographic factors. Today, the consumer market is being affected by the radically different perspective of Millennials when it comes to consumption. Exhibit 10.3 describes key demographic correlates to consumer behavior.

Extensive databases have been established to track the consumer behavior of various demographic segments. Virtually every time a purchase is made at a grocery store or other major retailer or a credit or debit card is used for a purchase, data are transmitted to some database. This information can then be used by marketers (as described below) to efficiently target specific consumer segments. Further, various consumer research companies conduct on-going surveys of consumer behavior and this information—typically segmented in terms of demographic subgroups—is incorporated into the consumer database.

Exhibit 10.3: Demographic Correlates of Consumer Behavior

Much of the research that takes place on consumers focuses on their behavior—in particular their consumption patterns. This research reveals clear-cut differences in the purchasing patterns of different demographic segments in U.S. society. The section below summarizes the key differences and provides examples of some of the behaviors associated with specific demographic categories.

Age. One of the most well-established maxims in consumer research is that members of different age groups exhibit different patterns of consumer behavior. Not surprisingly, infants and young children have different consumer needs than teenagers and young adults. Teenagers are highly influenced by popular culture, and young adults are investing in goods and services associated with adulthood. Seniors, on the other hand, have long completed most of their major purchases and are now "investing" primarily in services. Even within the same product lines, however, differences exist in terms of preferences. With automobiles, for example, young adults are likely to favor sporty vehicles while young families are looking for practicality and seniors are looking for comfort when considering automobile purchases.

Sex. Males and females clearly display different consumption patterns. Not only are there products that are engineered for use by males or females, but there are clear gender-based preferences exhibited in purchase patterns. Some obvious differences include a female focus on the purchase of clothes compared to a male emphasis on the purchase of sporting goods (although demographers must be careful not to overgeneralize). Females have different attitudes toward "shopping" than males (e.g., "shop to you drop") and respond to different marketing appeals.

Race and Ethnicity. There are clear differences in consumer behavior among members of different racial and ethnic groups in the U.S. Beyond the basic goods that all people require the manner in which purchases occur differs widely among whites, African-Americans and Asian-Americans and among ethnic groups such as Hispanics and subgroups of Southeast Asians and Middle Easterners. Lifestyle differences between various racial and ethnic groups account for much of the difference in consumer patterns with cultural preferences playing a strong role. Just comparing the consumer preferences of whites and African-Americans we find clear-cut brand preferences (e.g., for cleaners 409 vs. Awesome, for fried chicken Kentucky Fried Chicken vs Churches Fried Chicken). Major markets have developed today around various racial and ethnic groups who were likely to be ignored by marketers in the past.

Marital Status and Household Structure. Marketers of consumer products have long recognized the differences in consumer patterns that characterize those in different family and household situations. Obviously, married people

—especially those with children—have different consumption priorities than the unmarried. Families in the early stages of formation have extensive requirements for the various goods required to establish a household. As children come along, a whole range of other goods and services are required. People living in non-family households typically have fewer household-related consumption requirements especially if they are young and mobile. The married are likely to apply their disposable income to practical household needs, while the single are able to devote more of their disposable income to popular culture products and goods and services that support their lifestyles.

Income. Not surprisingly consumer behavior varies dramatically between various income groups in U.S. society. Obviously, the higher the income the more disposable income is available, and more of disposable income is devoted to discretionary spending. Variations in disposable income aside, different income groups exhibit clear preferences for different products. Much of this is related to lifestyle and to modes of living that each income group is accustomed to. Even for routine consumer items such as food there are clear differences with downscale populations more likely to patronize fast-food restaurants and discount retailers. "Designer" clothes are more likely to be purchased by the more affluent while "knock-off" replicas are popular with more style-conscious down-scale consumers. At the lower end of the economic scale there is a higher rate of consumption of beer while wine consumption is more common at the upper end. (Consumption patterns associated with educational levels exhibit similar differences as those based on income although there are some important differences.)

These examples do not exhaust the range of demographic factors that influence consumer behavior, with differences found in consumption patterns among residents of different regions of the country, different types of communities (e.g., rural, suburban, urban), different occupations and even different religions. Much of consumer marketing today is driven by the fact that consumer behavior differs substantially based on demographic attributes, and business demographers will play an important role in business decision-making for the foreseeable future.

10.2.2 Product Development

In a consumer market such as that characterizing the U.S. new products are always being developed and offered to the consuming public. Further, existing products are constantly re-assessed to determine the extent they resonant with a changing market. Indeed, one of the most common phrased used by marketers is "new and improved." Whether a new product is being developed or an existing product is being modified, the demographics of the consuming public are a major consideration. In either case product developers must understand the needs and preferences of consumers, with these needs and preferences invariably falling along demographics dimensions.

In considering new product development there are a couple of different approaches that characterize industry today. On the one hand, a producer may have a product ready to introduce to the public and needs to determine what groups within the market should be targeted. Marketers must determine who to target with their promotional efforts, and the consumer research described above comes into play here. On the other hand, a producer may focus on a particular segment of the market and be interested in what new products that market may support. Thus, if the segment that a producer focuses on is babies or teenagers or seniors, the emphasis will be on the type of product that appeals to that segment of the market.

10.2.3 Product Sales/Marketing

Demographic information and analysis have become essential to identifying, locating, and understanding the diverse consumer groups that form markets for goods and services. In many ways the application of demographics to sales and marketing represents the most intensive application of demographics in the business arena. Long ago, it became a maxim among advertisers that half of their advertising dollars were being wasted, they just didn't know which half. Partly in response to the inefficiency of mass marketing a distinct industry has developed devoted to understanding the demographic segmentation of the consumer market.

As an extension of the consumer research described above, marketers have identified market segments along various demographic dimensions. This has allowed for the development of a target marketing approach to product promotion and, in some cases, to even a micro-marketing approach. This information can be utilized in a variety of ways, the first one typically determining who (and who not) to market to. Enter target marketing and the ability to segment a market into groupings that can be assessed in terms of their business potential. Target marketing has become a precise science, and this approach depends heavily upon an understanding of market demographics.

The recognition of the relationship between demographic attributes and consumer behavior was a major factor in the development of the target marketing approach to product promotion.

In addition to identifying targets for a marketing campaign, information on market demographics is used to determine the approach to marketing to be utilized, the type of message likely to resonate with the target market, the form of media best suited for the target audience, and even the time of day or week at which various groups should be contacted. An obvious example would be the promotion of products geared to both men and women. Men and women respond to different "pitches," and this has to be considered in developing marketing plans. For example, it was realized at some point that females buy more automobiles than males, yet marketing was heavily weighted toward males. Similarly, it was realized that females not only consume more health services than males but also make most of the decisions with regard to the consumption of health services. The healthcare industry underwent a major conversion as it adjusted to accommodate the needs of its primary customer.

Until recently, almost all marketing was geared to younger consumers, and the models used in advertisements were all younger than the average consumer (even if the product was geared toward seniors). It was finally realized that the bulk of the consumer market had shifted toward older age groups, and older models began to appear in the advertisements.

Different demographic segments respond to different media. There was a time when newspapers were the go-to medium for reaching much of the market. Today, a minority of Americans actually read newspapers, and those who do are limited to certain demographic categories. However, if your market is senior citizens, newspapers may be an effective route to follow, since this segment is the last holdout when it comes to newspaper readership. Other common venues for reaching target audiences such as radio, network television and magazines have diminished in importance as the demographics of the market have changed. Younger consumers focus on social media and are much more likely to be reached via the Internet than through the traditional media channels. If the target audience is Millennials, the marketing strategy will be much different than if the target audience is aging baby boomers.

Case Study 10.1: Developing a Marketing Campaign

A business demographer has been tasked with helping to develop a marketing campaign for a new fitness center. Thanks to consumer research carried out during the feasibility study, there is a significant amount of information available on the demographics of the population within the area served by the center. The job of the demographer is to refine the profile of the target population and assist marketers in developing a marketing campaign.

The first step is to identify and profile the population within the service area that is most likely to patronize a state-of-the-art fitness center. While a wide range of people are likely to use such a center there is a core group of customers that needs to be cultivated to make the fitness center successful. Based on previous consumer research and information from other sites it is anticipated that the core customers for this facility will be in the 25-34 age range, predominantly female, relatively well educated and moderately affluent. Many of those in the target audience are single or married without children. Thus, families with children will not be intensively targeted nor will seniors.

In developing the marketing campaign consideration must be given to the message that is conveyed, and this message should be one that resonates with the target audience. Thus, the content of any marketing materials should emphasize the types of features that appeal to educated, financially comfortable young adults without children. These features include: reasonable cost, flexible hours, "cool" exercise classes, trendy exercise equipment, and a comfortable social environment. Marketing content should avoid information that conveys images of traditional gyms that are likely to be unappealing to the target audience.

With the content decided upon, the next step is to determine the channels to be used in distributing the promotional material. Previous research has indicated that the population targeted by this facility is well "plugged in" when it comes to social media. Information about the new facility should be disseminated through various social media channels with the hope that some "noise" might be generated within the social networks in which members of the target audience participate. Beyond this, the target population might be reached through contemporary music radio stations. Advertisements (and, better yet, articles) in local alternative newspapers and "throwaway" publications that focus on health or lifestyles may be effective. Traditional advertising venues like newspapers and network television are not likely to reach much of this audience. Ultimately, word of mouth is likely to be a factor in recruitment so any steps that can be taken to establish a "virtual" social network in the community should help to generate the "buzz" that is desired.

One final approach to consider with this population is direct mail. Admittedly, there is a negative connotation associated with "junk mail" and the response rate for most such campaigns is seriously low. However, given that the target population may already be thinking of joining a fitness center direct mail may not be a bad idea in this case. With the availability of consumer databases it is possible for a small amount of money to obtain the addresses for those who fit the profile of the target population for the area that will be served by the center.

At each step of this process an understanding of the demographic attributes of the target population is necessary. Here, as in other business contexts, the business demographer has a lot to offer in support of the marketing campaign.

10.2.4 Site Selection

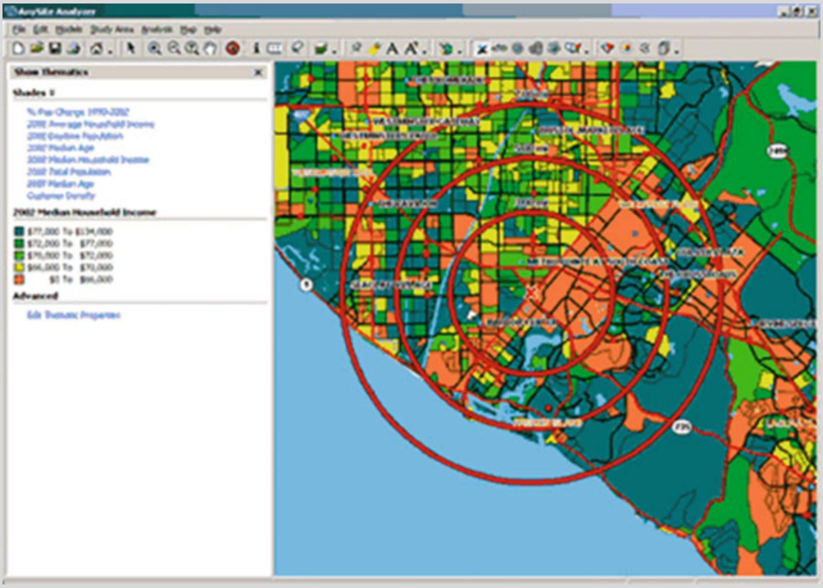
Geographic proximity to consumer markets is highly important since most retail transactions are made at specific locations. Productive retail sites are generally located in the midst of dense consumer populations or are readily accessible to the potential users of a firm's goods and services. Because almost all demographic data have a geographical dimension, demographers are well positioned to provide input into the site selection process. Evaluating a proposed site—or weighing the comparative merits of several competing sites—is another way in which demographers can support business decision making.

The site selection process typically begins with a blank slate in terms of geographical preferences (although there may be cases where a general area or even a specific site has been identified for some reasons). Assuming that there are no preconceived notions with regard to the nature of the target population for the product that is being marketed, a general profile of the overall service area is generally carried out. Thus, the area is profiled in terms of salient demographic attributes and, depending on the product being promoted, some attributes may be more important than others.

Typically, the description of a community or market is followed by the identification of distinct patterns or noteworthy attributes related to the target community or organization. These phenomena may involve unserved or underserved populations, a service niche that is not being addressed, a lack of access to certain goods or services, or a variety of other conditions. Identifying patterns and attributes takes description a step further and extracts from the numerous possibilities within the typical market the meaningful options (and threats) within that context.

An important step in the processing of data collected during research is the comparison of findings to relevant benchmarks. Depending on the plan, this may involve comparing one population to another, or tracking the attributes of a population over time. Similarly, an analysis of the data collected on a service area may involve comparisons to different sites in terms of their relevant attributes. Exhibit 10.4 illustrates the defining of a service area around a potential site in terms of distance based on radii.

Exhibit 10.4: A Radius-Based Market Area



Ultimately, the analyst must determine if a situation is “good” or “bad” as profiles for various potential sites are developed. Depending on the criteria utilized different sites can be ranked in terms of their potential with some sites considered appropriate for further analysis and other sites discarded out of hand.

Geographic information systems (GIS) have been developed that can assist demographers in the performance of spatial analyses. GIS software can be used to describe and analyze the geographic distribution, for example, of potential customers or competitor sites. It can be used to target population segments and select sites for commercial outlets or facilities. The software allows the data to be visualized and facilitates analyses of geographic and longitudinal variation.

Spatial analysis can be utilized to generate a variety of maps. The choice depends on the issues under study and the type of analysis being performed. The software typically has the ability to link two or more mapped variables and perform statistical analysis. Indeed, accessibility analyses on available health services, made possible by GIS software, have become a standard technique in planning studies. GIS software includes the ability to “geocode” data to a specific latitude and longitude. This means that, for displaying phenomena on maps, the exact location can be plotted.

Case Study 10.2: Selecting a Site for an Urgent Care Center

Over the past couple of decades "urgent care centers" have emerged as an alternative to physicians' offices and hospital emergency departments. There was a felt need for a service that was convenient and quicker than a physician's appointment and both faster and less expensive than the hospital emergency room. The urgent care center concept was developed to handle minor health conditions that could be routinely managed and did not require the level of staffing and equipment found in the typical doctor's office and certainly not the level of resources offered by an emergency department.

While the notion of quick, convenient and inexpensive healthcare is attractive, this is not a concept that appeals to everyone. Many patients have well-established relationships with their physicians, and others may be used to using the emergency department as a matter of course even for non-emergent conditions. Some patients may not have insurance and are deterred by the out-of-pocket costs levied by an urgent care center and others may have insurance that directs them to certain alternative services.

In this case, like most cases involving consumer choice, demographics play an important role. Not everyone is a candidate for urgent care use and the likelihood of choosing this form of care is associated with demographic attributes. Experience indicates that the primary users of urgent care centers are in the 20–45 age range, with males and females equally likely to utilize such a facility. There appears to be little difference in use rates among blacks and whites, while Hispanics are under-represented among urgent care users.

Important differences are found in usage patterns based on income and education. Those in the highest income groups and lowest income groups are less likely to utilize urgent care centers than those in the middle-income groups. A similar pattern is seen with regard to education, with those with moderate levels of education (e.g., some college) are more likely to use urgent care centers than those with very high or very low educational achievement. Household structure appears to be an important factor, with those living alone (typically never married or divorced) or married couples without children being better candidates than family households that include children. Dual-income couples are relatively heavy users of this type of facility. Finally, those residents exhibiting short tenure in the community (i.e., newcomers) who have not established physician relationships are also good candidates.

In this case a demographer was asked to evaluate three different potential sites in communities with similar population sizes for placement of a new urgent care center. The first step involved acquiring the requisite data on the populations of the three proposed service areas. Informed by information on the profile of the "typical" urgent care customer, the analyst acquired data on age, race/ethnicity, marital status and household structure, income, education and housing tenure. Since the total population for each of the sites was similar, the analysis focused on the demographic attributes that would distinguish one site from another. Of the three sites, one had a high proportion of younger, working-age residents with few Hispanics and socioeconomic characteristics that reflected moderate education levels and low-middle to middle-class incomes. That site also was characterized by a relatively transient population suggesting little in the way of established physician relationships.

In this case, the demographer's recommendation was fairly clear cut. One site clearly demonstrated more potential for the operation of a successful urgent care center than the other two. Of course, there are other considerations beyond the basic demographics of the service area population to be considered—e.g., traffic volumes, site visibility, competing facilities—but the demographer does have the information needed to further investigate the potential of the site with the most favorable attributes.

10.3 Data Sources

Data sources for business demography are generally the same ones used for other applied projects (Smith and Morrison, 2003). They include publicly available censuses, surveys, and consumer databases, proprietary surveys (e.g., of new or repeat purchasers); and firm-specific records. The availability and reliability of such data vary considerably across levels of geography and among states. Typically, the smaller the area, the more difficult it is to obtain useful data. Since business decisions often pertain to local markets, there is a premium on assembling reliable data for small areas.

Exponential increases in computing power and data storage capacity have greatly expanded the possibilities for organizing, integrating, and analyzing data. Computer networks enable analysts to share information and transfer data globally through the Internet. Powerful software packages have largely automated statistical analysis and reporting. Advances in geocoding and displaying spatial information through geographic information systems (GIS) have been especially influential, as many analyses call for data grouped into customer service areas, market analysis zones, and other uniquely defined geographic areas. The ability to use these computing tools effectively is crucial for many business demographers.

The concepts and measures of business demography focus primarily on dimensions relevant to commerce and enterprise: population composition (e.g., age, sex, race, income), consumer units (e.g., individuals, families, households), demographic events (e.g., births, deaths, marriage, migration), and the distribution of demographic characteristics and events across geographic areas (e.g., counties, census tracts, ZIP code areas).

It is an eclectic and continually evolving field, responsive to the opportunities that expanding data sources, statistical techniques, demographic methods, and information technology offer. Although its focus has been primarily on small areas, new applications and trends toward globalization call for the application of business demography to issues with national and international implication (Martins et al. 2012). Future opportunities in business demography promise to be plentiful and diverse.

Exercise 10.1: Site Selection for an Urgent Care Center

Based on the information provided in Case Study 10.1 students are to assess the following three sites in terms of their potential for supporting an urgent care center. After reviewing the data below, students should rank the three sites in terms of their suitability for the establishment of such a facility.

	Site A	Site B	Site C
Adult population			
20–44 years	10,000	20,000	15,000
45–59 years	25,000	20,000	15,000
60+ years	15,000	10,000	20,000
Marital status			
Never married	35%	50%	40%
Married	55%	30%	45%
Widowed/divorced	10%	20%	15%
Household structure			
Living alone	10%	20%	15%
Couple without children	40%	45%	50%
Couple with children	40%	15%	20%
Income level			
High	35%	10%	25%
Moderate	45%	60%	35%
Low	20%	30%	40%
Educational level			
High	30%	20%	25%
Moderate	50%	65%	55%
Low	20%	15%	20%
Residential tenure			
Less than 2 years	15%	25%	20%
More than 2 years	85%	75%	80%

Questions:

1. Which factors appear to be the most salient when it comes to evaluating the potential for the establishment of an urgent care center?

2. Are there any statistics that appear to stand out when it comes to assessing the potential for an urgent care site?
3. Which site appears to have the most potential?
4. Why is this site considered more desirable than the other two?

Exercise 10.2: Marketing Automobiles to Diverse Markets

You are in charge of marketing for an automobile dealership that handles a full range of vehicles (e.g., sedans, convertibles, SUVs, trucks, etc.). You have something to sell to just about everyone, as long as you can match the vehicle with the customer and figure out what will make them buy a vehicle from you.

Review the characteristics of the target population described in terms of its demographic and lifestyle characteristics below and answer the following questions:

- What type of transportation needs does this population have?
- What type of vehicle seems like a good fit?
- What salient demographic characteristics are considerations in marketing to this group?
- What should the marketing strategy be?
- What should the marketing message be?
- What marketing channel(s) should be used (e.g., TV, radio, newspaper, Internet, billboards, etc.)?

Group B: Flourishing Families

Affluent, middle-aged families and couples earning prosperous incomes and living very comfortable, active lifestyles

Overview

Typically found in communities located a short drive from malls and giant warehouse clubs, the four segments in Flourishing Families contain prosperous parents and children of all ages living life in suburban comfort. Most of the adults are married, in their 30s and 40s, college-educated and predominantly white with a large presence of Asians. Nearly two-thirds of households consist of married couples with children, whose ages range from pre-school to post-graduate. With high incomes and diversified assets, many parents have attained a level of financial stability that allows them to kick back and enjoy their quiet residential neighborhoods. Nearly one in five households contains a young adult, while some are still coping with the challenges, and high costs, of childrearing.

Scattered across the country in the bedroom suburbs of large cities from New York, N.Y., to San Francisco, Calif., Flourishing Families tend to live in spacious homes where they've built up significant equity. Many of the homes, which were built between 1970 and 2000, are starting to show some age. They're still valued at more than $300,000 thanks to their well-groomed yards, coveted locations and spacious interiors that can accommodate the young adults still living at home.

In Flourishing Families, most of the adults have turned their college educations into lucrative positions in management, law, education, public administration or scientific professions, and most households contain dual earners, resulting in a healthy six-figure income. The money supports a car-dependent culture where commuting to city jobs is a fact of life. For these family households, their vehicles of choice for cruising from the office to ball fields to grocery stores are SUVs and minivans from Japanese automakers who are known for their well-designed and reliable vehicles.

With kids of all ages in this group, their leisure activities revolve around family-friendly fun. These households are big on sports of all sorts. Some are outdoor sport enthusiasts and like cycling, skiing, ice skating, mountain biking and backpacking. Others focus on a round of golf or playing a match of tennis. They like to take their families on warm-weather vacations to Hawaii and the Bahamas. To keep their youngsters occupied on weekends, they head to museums, zoos and aquariums. The parents get some me-time while dining out, going to movies and enjoying cultural offerings like plays and classical concerts. Fitness buffs, they like weight training, aerobics and yoga classes.

There's money in Flourishing Families, and these households are willing to spend it on their children. This is the prime market for toys, sporting goods and digital games; they regard shopping at Sports Authority, GameStop, Michaels and A.C. Moore as entertainment. While the members of this group have the income to spend, many of the parents are also looking for bargains at Kohl's, Costco and T.J. Maxx. Many prefer the ease and convenience of shopping through catalogs and websites.

Group G: Young City Solos

Younger and middle-aged singles living active and energetic lifestyles in metropolitan areas

Overview

The two segments in Young City Solos contain younger and middle-aged singles living in city neighborhoods. More than 90% are unmarried. Most are in their 30s and 40s, white and childless, part of a demographic trend of delaying marriage while living alone or cohabitating with a partner. While economic insecurity is one reason some singles avoid marriage and having children, these young professionals report above-average incomes topping $75,000 a year, and they seem to be thoroughly enjoying their unattached status.

Young City Solos are concentrated in the nation's largest cities, in housing that caters to the increasing proportion of one-person households of home-owners or renters. Many live in well-appointed condos or apartments built during the last century. The homes, whether Victorian or postmodern in style, fetch above-average prices thanks to their in-town locations. Young City Solos boast above-average educations, with most having at least some college or a bachelor's degree. They work at a mix of professional, technical, sales and service-sector jobs, typically working for the government, a university, hospital or a large company. In these progressive segments, there's equality between the sexes at home and on the job. Even among cohabitating couples, their dual incomes support upper middle-class lifestyles.

Young City Solos lead fast-paced and active lifestyles. These unmarried folks devote a lot of their discretionary cash to nightlife activities, often going to bars, nightclubs, plays, dance performances, concerts and rock shows. They keep their healthy lifestyles by staying fit and joining a health club to make use of the cardio machines, weights and yoga classes. They like to jog, play tennis, bike, hike and swim. They dine out often at white-tablecloth restaurants, where they like gourmet food and dishes presented like art. Although they travel as much as the average, many have gone abroad in the last three years to visit Europe, Asia and the Caribbean. They like visiting places that allow them to meet new people and experience different cultures.

As a result of their typically small homes and even smaller closets, Young City Solos would hardly qualify as shopaholics. They're infrequent consumers who prefer local boutiques to national chains, though they will go to discount retailers. Despite their youth, they're financially experienced and have started building a retirement nest egg filled with a variety of stocks, preferred stocks and mutual funds. With many commuting to work by public transit, they're a relatively weak market for cars, especially large American vehicles. However, these earlyadopters make up for it in their passion for new electronics: They own smartphones and MP3 players, the better to indulge their passion for music.

Multitasking Young City Solos don't have much time for traditional media. They rarely subscribe to newspapers. They're often too busy to sit down to watch TV. They don't often listen to the radio, though they do like tuning into stations that offer news, talk, hot adult contemporary music, classic hits and contemporary hits. Though they're not big on print media, the will subscribe to certain magazines. They prefer the Internet for entertainment and they note that they're spending less time with other media because of it.

Group S: Struggling Societies

Economically challenged mix of singles, divorced and widowed individuals in smaller cities and urban areas looking to make ends meet

Overview

The four segments in Struggling Societies reflect the nation's least affluent group. Thesehouseholds contain economically-challenged singles and divorced and widowed individuals living in isolated towns and cities. With modest educations and lower-echelon jobs, many struggle to make ends meet. As a group, the households are ethnically mixed, without children and transient. Half have lived at the same address for fewer than five years. Many of these unmarried and unattached singles have moved into these rundown communities with few resources other than a hope of starting over. Struggling Societies are scattered across the U.S., but are found especially in small city markets in the South and Midwest. Even though home values are low, about two-thirds of the national average, only 40% own houses. Roughly half rent their residences, a mix of older ranchhouses and crowded apartment buildings. One in ten lives in mobile homes. In their mixed-use neighborhoods, homes are often surrounded by commercial businesses and buildings. Struggling Societies are not well-educated. Nearly half failed to finish high school. Almost 40% are unemployed. The majority work in mostly low-paying, entry-level jobs in health care, social services and the wholesale and retail trades. With household incomes 60% below the national average, these Americans can only afford to lead unpretentious lifestyles.

Their small-city locations afford members of Struggling Societies some low-cost entertainment options. They go to local establishments, nightclubs, billiards halls and the occasional play or concert. However, most activities are home-based, whether it's listening to music, watching TV, doing needlework or reading gaming magazines. These older adults pursue few athletic activities other than rooting for home-town teams playing basketball, football or baseball.

Even at the bottom of the socioeconomic ladder, Struggling Societies have a need for status recognition. Many of these households like to make a statement with their fashion, and they try to keep up with the latest styles—admittedly, sometimes spending more than they can afford. Most are price-sensitive shoppers who patronize discount department stores like Walmart,Kmart, Burlington Coat Factory and Payless Shoe Source. These consumers, however, regularly splurge for lingerie at Victoria's Secret and pricier outfits at Talbots.

Self-described TV addicts, many keep their TV sets on most of the day to watch sitcoms, movies, reality programs and game shows. They enjoy a variety of cable networks, including Soapnet, Lifetime, Oxygen, AMC, BET and Cinemax. This is a group filled with music fans, and they tune their radios to stations that play soul, gospel, rhythm and blues and salsa. While many of these households pick up a newspaper, they typically only read the classifieds, food and news sections. Group members say that most magazines are worth the money. A high number concede that they like advertisements, especially those they see on TV, at movie theaters and on buses and subways. They're particularly fond of entertaining ads and they say that they remember ads when shopping and find them helpful.

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Additional Resources

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Chapter 11
Health Demography

Abstract Health demography is a subdiscipline of demography that has gained in significance over recent years as a result of the increased interest in the health status of the U.S. population and the operation of the healthcare system. This chapter describes the activities of health demographers and the ways in which demographic data, concepts and techniques are applied to the study of concrete health problems related to health and healthcare.

11.1 Introduction

Health demography is a subdiscipline within the field of demography that involves the application of the content and methods of demography to the study of health and healthcare. It focuses on the application of demographic concepts and methods to the understanding and solution of concrete problems in healthcare and it informs health policy setting. “Health” and “healthcare” refer, respectively, to the condition of health as experienced by individuals and populations and to efforts in place—both formal and informal—for managing a population’s health. Health demography further concerns itself with the manner in which demographic attributes influence both the health status and health behavior of populations and how, in turn, health-related phenomena affect demographic attributes.

The scope of health demography is quite broad, and there is little within the discipline of demography that does not have some relevance for the study of health and healthcare. At the same time, virtually every aspect of “health” is amenable to study by means of demographic techniques and perspectives. Whether the issue is the cause or consequence of disease, variations in health status among populations, utilization levels for various health services, the attitudes of health professionals, the study of medical outcomes, or even the organization of the healthcare delivery system, it can be better understood through the use of demographic perspectives, concepts, methods, and data.

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The scope of health demography is quite broad, and virtually every aspect of health and healthcare can benefit from the application of demographic concepts, techniques and data.

The subject matter of health demography is not new. Its roots are found in a number of existing disciplines. In fact, health demography represents a synthesis and reformulation of concepts and substantive data previously developed in a variety of other fields. Health demography's ancestry includes epidemiology which in its modern usage refers to the study of the origin and progression of illness within a population. The scope of the field has steadily broadened from a focus on epidemic diseases to the study of the cause, course, and correlates of a wide variety of health conditions. The notion of "social epidemiology" has become widely accepted by a variety of disciplines and emphasizes the distribution of illness within the population and the health behavior of various social groups. Its emphasis on populations rather than individuals makes it akin to demography, and epidemiological investigations have increasingly shifted from the relationship between environmental disease agents and human health conditions toward the link between demographic characteristics and the prevalence and distribution of various health risks.

Medical sociology has also contributed to the evolution of the field of health demography. By the 1960s medical sociology had taken on a strong social epidemiology flavor. Research findings that established a connection between poverty and poor health generated interest in the social and demographic correlates of health status and health behavior. Medical sociologists have subsequently led the effort to document the relationship between health characteristics and age, sex, race, marital status, religion, and other demographic variables. They have also demonstrated the extent of interaction among various demographic factors and have been influential in redefining of the concepts of health and illness. Currently, much of the emphasis in medical sociology—and, indeed, in all health-related disciplines—is focused on the persistent health disparities found within the U.S. population, disparities that exist primarily along demographic dimensions. Other contributors to health demography include medical anthropology, medical geography and medical economics.

11.2 Applications of Demography to the Study of Health and Healthcare

There are at least three different realms in which health demography can make an impact. First, the contribution that health demography can make to the field of social epidemiology is becoming increasingly apparent. As chronic disease came to dominate the morbidity configuration, the distribution of morbidity and mortality along demographic dimensions became more and more obvious. Today, to understand patterns of disease distribution within the U.S. population is to understand the demographics of disease. Emerging morbidity configurations reflect demographic attributes as, for example, children (particularly those at low socioeconomic levels) increasingly exhibit chronic disease once reserved for older adults. Changing patterns of mortality and life expectancy are being driven by certain subgroups within the population and, now, the epidemic of opioid addiction and overdose exhibits clear-cut demographic correlates.

The most direct application of the insights developed by demographers involves the search for solutions to the health problems that plague the U.S. population. The problems are numerous as the population appears to be getting sicker, chronic disease prevalence is increasing faster than warranted by demographic trends, communicable diseases are re-emerging as health threats, and "diseases of despair" take an increasing toll on the population. These are no longer strictly medical problems but increasingly social problems. As such their solution cannot be found under a microscope but in the demographically patterned behaviors of the population and its various subgroups.

A second area in which health demography can and does make an important contribution is to the "business" of healthcare. Healthcare accounts for nearly 20% of the gross domestic product and nearly 11% of the U.S. workforce. It is a three trillion dollar "industry" that is increasingly driven by the characteristics of the population it is designed to serve. There is virtually no aspect of the business of healthcare that does not lend itself to the application of demographic concepts, techniques and data. Decisions are made every day by health planners, administrators and business developers that rely heavily on an understanding of the demographics of patients and the general population. These decisions relate to such diverse tasks as product/service development, site selection, facilities planning, staffing allocation, acquisition decisions and myriad other activities associated with healthcare as a business. Even the large not-for-profit sector of the healthcare industry has to pursue business principals in order to achieve its mission. (Case Study 11.1 describes one way in which demographics can be applied to a concrete problem within the healthcare sphere.)

There are three major "realms" in which demography can be applied to healthcare—social epidemiology, the "business" of healthcare, and healthcare policy-making.

Today, the business of healthcare is rapidly moving toward a "population health model", opening up numerous opportunities for the application of demography (Thomas, 2017). The emerging population health model turns the traditional healthcare system on its head and emphasizes the management of populations rather than individual patients. Healthcare providers are increasingly being rewarded for improving the health status of groups of consumers rather than individual patients.

In order to accomplish this health professionals need to understand the characteristics of various groups within the population along with their health-related attributes. Demographers are uniquely positioned to assist health professionals in identifying and profiling key segments of the population allowing healthcare providers to more efficiently manage targeted groups. Importantly, it is necessary to identify the factors that distinguish one segment from another in order to tailor interventions to the particular characteristics of the targeted group.

The third area in which health demographers can have an impact is in the area of health policy. Much of the controversy surrounding the delivery of health services in the U.S. today reflects the issues related to access to care for various segments of the population. The headlines are filled with articles highlighting the issues surround the Medicare program for seniors, the Medicaid program for the disadvantaged, the Affordable Care Act (ACA), the effectiveness of Veterans Administration health services, and so forth. These are not medical problems per se but they reflect the changing demographic attributes of the U.S. population. The aging of the baby boomers is beginning to make its mark on the healthcare system, while the surge in the number of people living in poverty places strains on the Medicaid program. A major impetus for the introduction of the ACA was the large proportion of the population that lacked health insurance, and a new generation of veterans has different characteristics from those of the past (in particular the high proportion of females). These policy-related issues can only be understood when viewed with "demographic eyes."

While the development of a baseline understanding of morbidity is important, ultimately the challenge is to apply this information to concrete problems in the real world. Applied demographers, population scientists, epidemiologists and others use this information to plan public health initiatives, develop treatment modalities, improve the delivery of care, and develop marketing programs for healthcare organizations. In order to address the pressing challenges of the day, morbidity data can be utilized to better manage chronic conditions, for the development of effective health insurance plans (private and public), to address the financial challenges facing Medicare, and to deal with myriad other challenges within the healthcare arena. Case Study 11.1 illustrates an application of demography to the business of healthcare.

Case Study 11.1: Planning an Obstetrical Facility

Planning for any health facility represents a challenge and the establishment of an obstetrical facility can be a complicated process. From the first step on, the process requires considerable research and the application of a number of demographic concepts. The first challenge involves the delineation of the service area for an OB unit. How far is it reasonable to expect pregnant women to travel to deliver a baby (or for prenatal and postnatal services)? The administrators may already have some idea of the facility's service area for general care, but are OB patients different? They are, in fact, and a hospital is likely to attract OB patients from a broader area than patients for many other services. The delineation of the OB service area will, therefore, depend on the availability of competing services, the location of obstetricians' offices, and access to transportation.

Having delineated the appropriate service area, it is then necessary to calculate the demand for obstetrical services. How many deliveries can be expected annually from the population being served? This, of course, can be calculated in a number of ways. The simplest—and probably most misleading—of these would be to determine the crude birth rate for the target population. This rate could be misleading, however, in that the denominator is the entire population and large segments of the population (e.g., men, very young and very old women) are not "eligible" for obstetric services. Nor does the crude birth rate take such factors as age, race, and marital status into consideration. Further, if the data are only available for the entire county, applying the countrywide crude birth rate to the target population at the ZIP Code level may mean that an average is being used that may not be reflective of the characteristics of the population within that service area.

A more refined indicator (e.g., general fertility rate) would be preferable and would better indicate the actual fertility experience of the target population. If it is not available, one could apply some standard rate that accounts for age, sex, race, and even income distribution. Any ethnic concentrations within the service area should also be noted, as many such groups (e.g., Hispanics) are likely to display different fertility patterns than the general population.

Once the fertility behavior of the target population has been determined, it should be possible to apply the appropriate rate and estimate the yield of births from the service area. However, it will be a year or two before the facility is operational, and perhaps five years before its financial viability can be determined. Thus, the projected number of births for future time periods is more crucial than the number of current births. Here the various projection techniques available to the demographer can be employed. One might first want to examine overall population trends; that is, is the service area population increasing, decreasing, or stable? Is the service area growing, i.e., are housing units being added? A projected decline in the population base does not bode well for a new facility. More importantly, however, how is the composition of the population changing? A growing population will not be meaningful if it is rapidly aging.

Once a future population has been established, the potential number of births can be projected. The planning does not end here, however, since a number of other factors need to be taken into consideration. The economic status of the target population needs to be evaluated. Further, the availability of medical manpower needs to be considered, since a new facility with no physician support or an inadequate number of neonatal nurses will not be viable. The risk level of the population must also be considered. Is this a population with high rates of premature and low birth-weight babies or a population that utilizes significant levels of prenatal care? If so, special facilities and services may be necessary.

The projected birth figure for the service area population is only meaningful if there is no competition. In most areas, there will be more than one facility competing for obstetrical cases. The new facility cannot expect to obtain all potential births, but only its market share. The current distribution of births among existing facilities must be determined in order to estimate the share that the new facility will capture, assuming all other factors remain constant. Of course, market shares can shift and are affected by numerous factors. Information on deliveries can often be obtained from state health agencies or purchased from data vendors who calculate market shares. Some realistic estimate of the capturable market share must subsequently be made in order to determine the true potential utilization for the planned facility.

As can be seen, virtually all aspects of demography are utilized in the planning of this type of facility, and the process can even be more complicated than outlined above. This helps explain the booming business in the sale of demographic data and the growing number of individuals with demographic training being utilized by healthcare organizations.

11.3 Demographic Processes and Health Demography

The emergence of health demography as a sub-discipline had its roots to a certain extent in the study of fertility and mortality, two of the major demographic processes. These two areas of demographic study were discussed earlier in the text and will only be summarized here. A related topic, morbidity, has not been previously addressed but will be introduced in this chapter.

11.3.1 Fertility Analysis

Fertility behavior is viewed broadly here and includes pre-pregnancy behavior, prenatal care, health-related activities during pregnancy (e.g., cigarette smoking), pregnancy outcome (e.g., birth, miscarriage and induced abortion), and post-natal care. Demographic applications to the study of fertility have been particularly useful when it comes to the impact of demographic attributes on health-related pregnancy outcomes.

There are a number of adverse outcomes associated with fertility and most exhibit a correlation with demographic attributes. In fact, the significant disparities that are found within the population are almost always a function of demographic differences within that population. The U.S. population exhibits levels of adverse outcomes that compare unfavorably to comparable countries. The level of premature births and low birth-weight births place the U.S. near the bottom of industrialized nations. The level of out-of-wedlock births—with all of the social and economic implications that carries—far exceeds those of similar countries, and the rate of teen births would be considered outrageous by most.

11.3.2 Mortality Analysis

A previous chapter was devoted to mortality so the discussion here will focus on the health-related aspects of mortality analysis. Demographers have contributed greatly to our understanding of mortality and health-related issues both in terms of the development of mortality measures and the identification of death patterns within the population. Comparisons of deaths, death rates and life expectancy across geographic units provide insights into variations in health conditions and health services. Compiling death counts over a period of years has helped identify trends with regard to increases or decreases in mortality. Deaths are also cross-classified by the medical, social, and economic characteristics of the deceased (e.g., cause of death and age at death).

> *Health demography has a lot to contribute to our understanding of basic demographic processes such as fertility and mortality.*

Death like other health-related phenomena is not distributed randomly within a population. The preponderance of chronic diseases in the U.S. and other comparable societies means there are significant demographic correlates with mortality. The key contribution of health demography to the study of mortality is the insights developed into the correlation between demographic attributes and aspects of mortality—comparative death rates, differences in causes of death and, more recently, disparities in morbidity and mortality among various subgroups in society. Different demographic subgroups exhibit different mortality rates with some groups clearly more "burdened" than others. Causes of death are clearly distributed along demographic lines, and emerging causes of death (e.g., opioid overdose, "diseases of despair") and increasing mortality rates are restricted to certain demographic subgroups.

One frequently utilized mortality indicator is the infant mortality rate, and this is sometimes considered a proxy for a population's overall health status. Although this measure only applies to a limited segment of the population (i.e., those under 1 year of age), it is considered by many as more useful than the overall mortality rate. The premise is that the infant mortality rate is much more than an outcome measure for the healthcare system. Rather, the level of infant mortality is a function of environmental safety, diet, prenatal care, the educational and economic status of the parents, the age of the mother, the occurrence of neglect and abuse, and a number of other factors. Thus, infant mortality is thought to reflect the combined impact of multiple contributors to health and well-being.

As with the overall mortality rate, however, infant deaths occur rarely enough that measures of infant mortality have less salience as indicators of a population's health than they did historically. Although infant mortality was dramatically reduced as a cause of death for African-Americans during the last century, it continues to be a serious health threat for nonwhites. The infant mortality rate for African-Americans in 2011 was more than twice that for whites (Hoyert & Xu, 2012). Other racial and ethnic groups recorded quite disparate rates of infant death. Certain Asian-American groups, for example, report much lower than average infant mortality, while Hispanics as a group record infant mortality rates between those of whites and blacks. Native Americans and native Alaskans historically have recorded very high infant mortality rates; however, since the 1950s, their rates have come to resemble the U.S. average. The Hispanic infant mortality rate is something of an anomaly, given the relatively poor health status of this population and this group's lower level of access to health services. The low Hispanic infant mortality rate is generally attributed to the emphasis on family within this culture.

11.3.3 Morbidity Analysis

Morbidity analysis has become a major area of emphasis for health demographers. As morbidity has come to be more reflective of the nature of a society's health problems than mortality, the interest in the study of morbidity has increased. The current concern over disparities in health status—disparities most often described in demographic terms—has attracted increased attention to what demography can bring to this discussion, and as a result the study of morbidity is a key component of health demography.

While "morbidity" may be used to refer to the health status of an individual or a group, demographers are almost exclusively interested in morbidity as associated with populations and rarely with the morbidity of individuals. The exception to this might be the situation in which the identified health status of individuals based on some assessment tool is aggregated to generate the morbidity status of the population in question. The interest in morbidity analysis has increased concomitant to the growing appreciation of the demographic correlates of health status and health behavior. The fact that the distribution of morbidity within the U.S. population mirrors the distribution of demographic characteristics has reinforced the importance of health demography.

Public health officials have a particular interest in morbidity patterns, although from a different perspective than clinicians. With their emphasis on population health, public health officials focus on broad patterns of disease within the population and examine the association between disease incidence and the population's demographic attributes. Efforts by public health officials to reduce morbidity begin with an understanding of the demographic characteristics of the target population.

Health policy analysts and policy-makers have a keen interest in the morbidity conditions that affect the U.S. population and its various subgroups. Given the impact on the U.S. economy of activities within the healthcare arena there is significant and growing interest in the factors that contribute to the increasing cost of providing for the healthcare needs of the U.S. population. Government policy analysts responsible for programs such as Medicare, Medicaid and Social Security have an urgent need for comprehensive, timely and detailed data on American morbidity patterns. Such information is used to inform policy decisions with regard to issues as basic as reimbursement rates for physicians under Medicare to issues as broad as eligibility for the Medicaid program. The role of the epidemiological transition in changing the nature of illness is discussed in Exhibit 11.1.

Exhibit 11.1: Demographics and the Epidemiological Transition

During the 20th century, the United States and most other developed countries experienced an "epidemiologic transition". The epidemiologic transition involved a shift from a predominance of acute conditions to a predominance of chronic conditions within their populations. This phenomenon was primarily a consequence of the demographic transition affecting these countries earlier in the century and to advances in society's ability to manage health problems. In the former case, the aging of the population resulted in a dramatic change in the types of health conditions affecting its members. In the latter case, the introduction of public health measures and, to a lesser degree, advances in clinical medicine eliminated certain health conditions and inadvertently brought other conditions to the fore.

Prior to the epidemiologic transition, the most common health conditions were respiratory conditions, gastrointestinal conditions, infectious and parasitic conditions, and injuries. Even today, in traditional societies and populations with a younger age structure cholera, yellow fever, skin diseases, nutritional deficiencies and similar acute conditions remain common. Acute conditions appeared to affect a cross-section of the population sometimes seemingly at random, while chronic diseases appeared to be much more selective in their impact. In the 20th century, emergent chronic diseases reflected the combined affect of heredity, environment, lifestyles and even access to healthcare.

Post-epidemiologic transition, populations in developed countries and those with older populations are more likely to be affected by heart disease, cancer, diabetes, arthritis, chronic respiratory diseases and similar chronic conditions. As a practical matter, most members of traditional societies did not live long enough to contract chronic conditions and, when they did contract them, they could not be managed and early death ensued. From a demographic perspective, this meant that, for the first time, demographically related disparities in health status might become common within a population. For demographers and others concerned about the population's morbidity profile, the shift from a predominance of acute conditions to a predominance of chronic conditions has been momentous.

One of the consequences of the epidemiological transition was the repatterning of health conditions along demographic lines. A significant body of research has documented the differential distribution of disease among various subgroups within the U.S. population. An association can be demonstrated between morbidity rates and such factors as age distribution, sex ratio, racial and ethnic makeup, and even attributes such as marital status, income and education. The fact that disease patterns can be determined based on geography is more often than not a function of the demographic attributes of residents of different geographic areas. Widespread health disparities have been observed based on analyses of the differential distribution of disease among various demographically delineated subpopulations.

11.4 Measuring Morbidity

As the study of morbidity has gained importance demographers have developed measurement techniques or adopted then from other disciplines. Most of the measurement techniques are straightforward although some borrowed from epidemiology can be complex. Exhibit 11.2 provides basic calculations for morbidity rates.

Exhibit 11.2: Calculating Morbidity Rates
The morbidity rate can be calculated using a simple formula assuming the necessary data area available. The examples below present morbidity calculations with the results shown as a percent and as a rate:

Morbidity percent:

$$\text{Morbidity proportion} = \frac{\text{Number of cases of disease}_x \text{ during time}_x}{\text{Population at risk during time}_x} = \_\_\_\_\_\%$$

$$\text{Morbidity proportion} = \frac{\text{100 cases of asthma in 2010}}{\text{1000 population in 2010}} = 10.0\%$$

Morbidity rate:

$$\text{Morbidity rate} = \frac{\text{Number of cases of disease}_x \text{ during time}_x}{\text{Population at risk at time}_x} \times 1000 = \_\_\_/1000$$

$$\text{Morbidity rate} = \frac{\text{100 cases of asthma in 2010}}{\text{1000 population in 2010}} \times 1000 = 100/1000$$

While the overall morbidity rate offers a global view of a population's health status, more detail is often required. Two measures used by epidemiologists for further quantifying the level of morbidity—incidence and prevalence rates—represent variations on the morbidity rate. An *incidence rate* refers to the number of new cases of a disease or condition identified over a certain time period expressed as a proportion of the population at risk (or the number of reported cases during a specific time period divided by the population at risk). A *prevalence rate* represents the totality of morbidity at a specific point in time. The prevalence rate is calculated by dividing the total number of persons with the disease or condition in question by the population at risk at a specific point in time. Thus, the prevalence rate includes all cases extant at a point in time (i.e., existing cases plus newly diagnosed cases).

The prevalence rate always exceeds the incidence rate, since the latter includes both new cases identified during the time period and existing cases. The only time the two rates are nearly comparable is when the condition is acute and of very short duration. For example, the incidence rate would almost equal the prevalence rate at the height of a 24-hour virus epidemic since victims recover almost as quickly as they are affected. Exhibit 11.3 describes the calculation of incidence and prevalence rates.

Exhibit 11.3: Calculating Incidence and Prevalence Rates

The calculation of the incidence and prevalence rates for AIDS illustrates the use of the two different rates. The incidence rate for persons diagnosed as having AIDS in 2005 in the United States was:

$$\frac{\text{AIDS cases diagnosed during 2005}}{\text{Population at risk mid-2005}} = \text{cases per } 100{,}000 \text{ population}$$

The prevalence rate for AIDS at the end of 2005, on the other hand, would be calculated as follows:

$$\frac{\text{AIDS cases diagnosed during 2005} + \text{existing cases of AIDS}}{\text{Population at risk at the end of 2005}}$$
$$= \text{cases per } 100{,}000 \text{ population}$$

The incidence rate is a valuable measure in epidemiological investigations. If a new or mysterious condition afflicts a population, epidemiologists can trace the spread of the condition through the population by backtracking using incidence data. The cause or population of origin of a new disease can often only be determined by identifying the characteristics of the victims and the conditions under which the disease was contracted. The exact date of occurrence becomes crucial if the epidemiological detective is to link the onset of the disease to a particular set of circumstances. AIDS is a case in point wherein the means of transmission may be identified based on the characteristics of the affected individuals.

The prevalence rate can be used in much the same way when the condition is a chronic one. There is less interest in determining the origin and progression of a disorder within a population than in determining the number of patients with that condition within a population at a given pint in time. This is precisely how many hospitals and other healthcare providers forecast demand for their services.

A related measure that might be utilized is the *proportional morbidity rate (PMR)* or the proportion of *all* diseased individuals in the population with the particular disease under discussion. In this case, the denominator is not the total population but the population of affected individuals. Among the population with any chronic disease, for example, what proportion suffers from diabetes? The PMR can also be used to track changes in morbidity levels over time by comparing the PMR for a population for two or more time periods. The proportional morbidity ratio can be used to compare the relative morbidity for two populations (comparative morbidity) by simply dividing the PMR for Population A by the PMR for Population B. Exhibit 11.4 describes the calculation of proportional and comparative morbidity ratios.

Exhibit 11.4: Calculating Proportional and Comparative Morbidity Ratios

The proportional morbidity rate is calculated using the following formula:

$$\text{Proportional morbidity ratio} = \frac{\text{Number of cases of a specified condition during time}_x}{\text{Total cases during time}_x} = \_\_\_\_\_$$

Using a concrete example, the following proportional morbidity rate is generated:

$$\text{Proportional morbidity ratio} = \frac{\text{100 diabetes cases during time period x}}{\text{1000 total cases during time period x}} = 10.0$$

The proportional morbidity ratio can be used to compare the relative morbidity for two populations by simply dividing the PMR for Population A by the PMR for Population B. This generates a proportional morbidity ratio. To wit:

$$\text{Comparative morbidity ratio} = \frac{\text{PMR}_{\text{PopA}}}{\text{PMR}_{\text{PopB}}} = \_\_\_\_\_$$

or

$$\text{Comparative morbidity ratio} = \frac{10}{15} = 0.67$$

This measure could also be considered an indicator of *relative risk* determined by the ratio of two incidence or prevalence rates. Typically, the rate for the population being analyzed would be divided by the rate for a control or reference population. Relative risk is useful for comparing populations affected by a certain condition to populations not affected by that condition. For example, the prevalence rate for asthma in a city characterized by a high level of air pollution might be compared to the rate for a city with a low level of pollution. Dividing the rate for the former by the rate for latter will generate a measure of relative risk.

Two additional rates utilized by demographers are case rates and case fatality rates. A *case rate* is merely an expression of the reported incidence of a disease per 1000, 10,000, or 100,000 persons and is not as finely tuned as a rate that is adjusted for the population at risk. This is comparable to the basic morbidity rate described above. The *case fatality rate* is generated by dividing the number of persons who die from a certain disease by the number of persons who contracted that disease. The quotient is expressed as a percentage. For example, through 1996, 7629 children had contracted AIDS and 4406, or about 58%, had died.

One other way of looking at the likelihood of one population being affected compared to other populations is through the calculation of *odds ratios*. The odds represent the chances of one population having a condition compared to the chances in other populations—e.g., the chances of being exposed to a disease in one population compared to the chances of exposure in another population. As with relative risk, the calculation involves dividing the odds for one population by the odds for another population. For calculating relative risk and odds ratios the numerators are the same; it is the denominators that differ.

Another consideration when calculating rates for morbidity and mortality is the determination of the population at risk. The population at risk is the number of persons who have some non-zeroprobability of contracting the condition in question. In most cases, the calculation of morbidity rates requires information on the number of identified cases for the disease(s) in question (the numerator) and the number of people at risk for contracting that disease or diseases (the denominator). The numerator—that is, the existing number of cases of the condition within the denominator—would be drawn from epidemiological data (with all the caveats that implies). The denominator in this equation—the population at risk—is usually readily available since it is typically a known quantity. As noted elsewhere, identifyingthe population at risk is often a challenge in its own right.

For many conditions, the population at risk is synonymous with the total population, and the infection rate is relatively easy to calculate. For a condition that is pandemic—e.g., seasonal flu—essentially the entire population is at risk. Thus, the CDC calculates the influenza rate using the number of new cases identified for a specified time period and assumes that the total population is essentially at risk. Selective risk has become more common as chronic diseases—particularly those that are lifestyle related—have come to dominate the morbidity spectrum. Certain subsets of the population may have a predisposition toward a specific disease (e.g., African-Americans and sickle cell anemia), be at risk due to selective exposure (e.g., coal miners and black lung disease), attend the same event (e.g., food poisoning at a banquet), or practice risky behavior (e.g., male homosexuals and HIV/AIDS). For these reasons the specification of the denominator may be a challenge, requiring the analyst to have an in-depth understanding of the health condition under study.

11.5 Standardizing Health Data

It is sometimes necessary to standardize the morbidity rate so that it is expressed as a proportion of the expected rate compared with a standard group. Standardization is necessary when two or more populations are being compared in terms of their morbidity status or when a population's morbidity status is being analyzed over time. A general morbidity rate, while useful for some purposes, may offer a misleading view of a population's morbidity status if the population does not exhibit a "normal" demographic profile.

A case in point involves the state of Florida where morbidity rates for chronic disease are found to be inordinately high. These rates defy the conventional wisdom that Florida is a healthy place to live. Even a casual observer is likely to note the "abnormal" age structure of the state's population, since Florida exhibits a much older age structure than the nation as a whole. In order to determine the "true" overall morbidity rate or the rates for specific diseases, the population structure must the statistically adjusted to resemble some "standard" population (most often the U.S. population). Once the age structure has been standardized, new morbidity rates can be calculated that represent a more accurate depiction of the state's actual morbidity level.

This approach is referred to as *direct standardization*. *Indirect standardization* involves a similar methodology but, in that case, the morbidity rate for each disease (rather than the population) is adjusted to reflect a more "normal" disease rate. This produces the number of "expected case" that can then be compared to the number of "observed cases," allowing the analyst to draw conclusions about the morbidity status of the two populations based on the differences between expected cases and observed cases. Exhibit 11.5 describes the process (originally presented in Chap. 7) used to standardize health data.

Exhibit 11.5: Standardization of Health Data

Standardization is a method used by epidemiologists and population scientists to adjust measures of vital processes for compositional factors that have an effect on those rates. The number of cases of disease occurring in any year is a function of three components: health status, population size and demographic attributes (e.g., age). In comparing morbidity rates for two or more populations, it is important to hold population size and age structure (and perhaps other attributes) constant when morbidity rates are being constructed.

The calculation of rates addresses concerns over differences in population size and allows the analyst to compare the health status of two populations that are different demographically. A basic morbidity rate that uses the total population as the denominator is likely to be the first rate calculated. However, the overall morbidity rate may be misleading since the level of morbidity is influenced by differences in the age structures of the populations in question. That is, areas with relatively young populations (and hence less risk of chronic disease) are likely to report low morbidity rates, while areas with relatively old populations (and greater risk of chronic disease) are likely to report high morbidity rates independent of the size of the respective populations. For this reason, the unadjusted morbidity rate is not a good measure for comparative purposes.

It is possible to adjust or standardize rates in order to control for age structure and, often, other factors (e.g., race). One method for accomplishing this is to select a "standard" age structure (e.g., the age structure for the United States), apply the incidence rate from two different populations to the standard age distribution, and then compare the number of cases after the adjustment. This process generates the number of cases for the respective populations *as if* their age structures were the same. The revised number of deaths (the numerator) can then be divided by the population size and an age-adjusted morbidity rate generated.

Using a specific disease as an example, the following table illustrates a method for adjusting the incidence rate for a particular population.

Standardizing the incidence rate for diabetes

Age group	Community population	Rate[a]	Cases	Standard population	Rate[a]	Cases
0–14	13,000	15	195	5000	15	75
15–24	12,000	30	360	5000	30	150
25–44	10,000	65	650	14,500	65	9425
45–64	8000	250	2000	15,500	250	3875
	7000	425	2975	5000	425	2125

(continued)

(continued)

Age group	Community population	Rate[a]	Cases	Standard population	Rate[a]	Cases
65 and over						
Total	50,000		6180	50,000		15,650
Incidence rate			123.6/1000	313.0/1000		

[a]Rate per 1000 population

An inspection of the data indicates that the community exhibits a very young population reporting relatively few cases of diabetes. However, when this community's population is adjusted to resemble a more "normal" population, the number of expected cases increases dramatically, and the prevalence rate increases from 123.6 to 313.0 per 1000.

The same principles of standardization can be used to adjust rates for other factors, such as education, race, and ethnicity. A similar process can be utilized to adjust mortality rates by holding certain factors constant. For example, the death rates for a predominantly white population and a predominantly African-American population might be recalculated using a standardized method that assumes that the populations have comparable racial characteristics.

These examples represent a relatively "crude" view of a morbidity rate since they do not take into account the demographic makeup of the population in question. For many health conditions a rate calculated based on the total population may not be appropriate. If data are available a better estimate can be generated by using rates specific to age, sex, race or some other factor known to affect the amount of morbidity attributable to the condition under study. At a minimum, it would be desirable to adjust the estimates for the age structure and sex breakdown for the population being analyzed.

11.6 Demographics and Health Indicators

The morbidity characteristics of a population are related directly and indirectly to demographic structure of that population. On the one hand, the demographic makeup of the population is a key determinant of the type of health problems exhibited by that population. On the other hand, the morbidity profile of a population influences the demographic structure of that population. In addition, the key demographic processes characterizing a population (i.e., fertility, mortality and migration) each influences the morbidity patterns of the population, while that population's morbidity patterns concurrently influence its morbidity processes. For the U.S. population today, factors such as age distribution, sex ratio, racial and ethnic makeup, and even attributes such as marital status, income and education influence the extant types of health problems.

An overriding issue in America today is the changing age distribution and its implications for morbidity. As the U.S. population has aged it has undergone an epidemiological transition in which chronic conditions have replaced acute conditions as the predominant health problems and most frequent causes of death. The aging of the population has resulted in a growing "excess" of women further affecting the morbidity profile. Increasing racial and ethnic diversity (not to mention unprecedented levels of immigration) has had an impact on morbidity patterns, and even such factors as changing household structures and occupational patterns influence a population's morbidity profile.

With the emergence of chronic disease as the major health threat, the importance of demographic attributes as a factor in morbidity patterns became much more important.

Similarly, the morbidity profile of the population has implications for its demographic makeup. Sickness (and subsequent death rates) have a significant impact on population size and composition. A reduction in infant and childhood diseases with a concomitant reduction in infant and child mortality has been a major determinant of increased life expectancy. On the other hand, higher morbidity rates for some segments of the population result in higher levels of disability which in turn impact the educational and economic potential of these populations. Preventable deaths at an early age ultimately modify the demographic profile of these populations. Exhibit 11.6 describes the demographic roots of the opioid epidemic.

Exhibit 11.6: The Demographic Roots of the Opioid Epidemic

The emergence of opioid addiction as a public health problem is being increasingly recognized, and recent epidemiological data indicate that deaths from opioid overdose are skyrocketing. Opioids are a class of drugs that include the illicit drug heroin as well as the licit prescription pain relievers oxycodone, hydrocodone, codeine, morphine, fentanyl among others. Opioids are chemically related and interact with opioid receptors on nerve cells in the brain and nervous system to produce pleasurable effects and relieve pain. Addiction is a primary, chronic and relapsing brain disease characterized by an individual pathologically pursuing reward and/or relief by substance use and other behaviors.

Recent research indicates that opioid addiction is a growing problem. Some 24 million Americans (9.2% of the population) used an illicit drug in 2012, which was an increase from 8.1% in 2008, numbers that are expected to continue to rise. Of the 20.5 million Americans 12 or older that had a substance use disorder in 2015, 2 million had a substance use disorder involving prescription pain relievers and 591,000 had a substance use disorder involving heroin. It is estimated that 23% of individuals who use heroin develop opioid addiction.

Drug overdose is the leading cause of accidental death in the US, with 52,404 lethal drug overdoses in 2015. Opioid addiction is driving this epidemic, with 20,101 overdose deaths related to prescription pain relievers, and 12,990 overdose deaths related to heroin in 2015. From 1999 to 2008, overdose death rates and substance use disorder treatment admissions related to prescription pain relievers increased in parallel. The overdose death rate in 2008 was nearly four times the 1999 rate; sales of prescription pain relievers in 2010 were four times those in 1999; and the substance use disorder treatment admission rate in 2009 was six times the 1999 rate. In 2012, 259 million prescriptions were written for opioids, which is more than enough to give every American adult his own bottle of pills.

While the number of older addicts is growing, the very young (those aged 12–17 years) still comprise a large proportion—about 26%—of the total population of those with opioid addiction. In 2015, 276,000 adolescents were current nonmedical users of pain reliever, with 122,000 having an addiction to prescription pain relievers. In 2015, an estimated 21,000 adolescents had used heroin in the past year, and an estimated 5000 were current heroin users. Additionally, an estimated 6000 adolescents had a heroin use disorder in 2014. Most adolescents who misuse prescription pain relievers are given them for free by a friend or relative. The prescribing rates for prescription opioids among adolescents and young adults nearly doubled from 1994 to 2007.

The image of the opioid addict as a young person, however, is fast becoming outdated as a new demographic has emerged. According to various sources, Americans aged 50–69 years represent the fastest growing population of opioid addicts, and the number of people aged 65 years and over who have at some point abused opioids increased by 34% from 2011 to 2012. Young college students are yielding the stage to working-age people and older adults. Women are more likely to have chronic pain, be prescribed prescription pain relievers, be given higher doses, and use them for longer time periods than men. Women may become dependent on prescription pain relievers more quickly than men, and 48,000 women died of prescription pain reliever overdoses between 1999 and 2010.

Although the largest segment (41%) of opioid abusers lives in large urban areas, followed by smaller urban centers and then rural areas, the abuse rate per person is higher in rural areas. There are lot of people who are inappropriately using opioids at any age, and that includes senior citizens. Until recently, there were not many people over the age of 50 who were abusing opioids because they weren't exposed. While in the past older patients may not have received any pain therapy at all, today they may be getting an opioid because there are few other treatment options available.

The surging rate of opioid addiction and overdoes among rural white residents was also associated with certain other demographic variables. Monnat (2016) found that a high proportion of the affected population that was poor, unemployed, disabled, in single-parent families, living on public assistance, or living without health insurance.

Sources: American Society of Addiction Medicine (2017), Anderson (2014), and Monnat (2016).

11.6.1 Biosocial Characteristics and Health

The health of a population is influenced by a number of factors and biosocial attributes are correlated with a number of health indicators. There has been long-standing acceptance of the notion that morbidity patterns are linked closely with age. Conventional wisdom suggests that as a person ages, health problems become more numerous and more serious. While there is some truth to this assertion, research conducted in recent years indicates that the situation is more complex than had been previously thought. Patterns of morbidity, disability, and mortality display complicated relationships with the age structure of the population.

The conventional wisdom that the number of health problems increases as the population ages is a somewhat misleading notion. Although it is true that the prevalence of *chronic* conditions does increase with age, and there appears to be a clear cumulative effect, the incidence of *acute* conditions actually declines with age. Thus, while the younger age cohorts are characterized by high rates of respiratory conditions, injuries, and other acute conditions, the elderly are relatively free of these. Instead, they face a growing number of chronic conditions such as hypertension, arthritis, and cancer. It has been suggested that the average *number* of conditions does not differ much from the youngest age cohorts to the oldest. The differential is primarily in the types of conditions common to the various age cohorts and in the severity of those conditions (National Center for Health Statistics, 2012).

There is a well-documented relationship between the prevalence of mental illness and age, although the nature of the relationship has undergone substantial modification in recent years. Until the 1970s, it was believed that aging had a cumulative effect on mental health just as it did on physical health (U.S.

Department of Health and Human Services, 1999). However, many observers argued that this pattern reflected selectivity in terms of the mental disorders measured, use of statistics on institutionalized patients, and the tendency to attribute many symptoms of old age to mental illness. In terms of observed cumulative prevalence of mental disorders, in fact, those 30–44 years exhibit the highest rate (55.0%) while those 60 years and older the lowest (26.1%). Figures from this same study indicate that the age of greatest mental illness risk is a function of the type of disorder. Depression, for example, is more common among those 18–25 years and least common among those 50 years and older (with an average age of unset of 23 years). Similarly, those 18–29 years exhibit the highest rates of bipolar disorder, those 30–44 years the highest rate for anxiety disorders and obsessive-compulsive disorders, and those 45–59 years the highest rate for post-traumatic stress disorders. For essentially every mental disorder examined, the elderly exhibited the lowest rate.

The relationship between age and health status is complicated. It is not so much that people have more health problems as they age but that they suffer from different kinds of health problems.

These figures suggest a non-monotonic and much more irregular relationship, primarily reflecting a rethinking of the conditions classified as mental disorders. The inclusion of alcoholism, drug abuse, and suicide under the heading of mental illness has created a “morbidity bulge” in the 15–25 age cohort. At the same time, attributing many symptoms of aging to Alzheimer’s disease has reduced the perceived prevalence of mental illness among the elderly.

Not surprisingly, there is a clear correlation between age and the level of disability characterizing a population. The proportion of the population experiencing some level of activity limitation increases steadily with age, and the oldest age cohorts are characterized by limited-activity days several times as numerous as those for younger age cohorts. For example, 6% of the 15–44 age cohort in 2010 reported *some* limitation of activity. The comparable figure for the 65–74 age group was over 26% (National Center for Health Statistics, 2011).

The most well-established relationship has been the association between age and mortality, with mortality sometimes used as a proxy for morbidity. Overall, there is a direct and positive relationship between age and mortality in contemporary U.S. society. The 2014 age-specific mortality rate of 11.5/1000 for those aged 5–9, the cohort with the lowest death rate, increases gradually up through age 50. From the mid-fifties on the increase in the mortality rate is dramatic (Kochanek, Murphy, Xu, & Tejada-Vera, 2016).

More important from a morbidity analysis perspective the causes of death vary widely among the age cohorts. For example, the leading causes of death for infants (under 1 year) are birth defects, respiratory conditions, and infectious diseases. The leading causes for young adults are accidents and suicide; for young adult

African-Americans homicide is added to the list. The elderly are more likely to fall victim to the major killers: heart disease, cancer and stroke. Ultimately, each age cohort has its own peculiar cause-of-death configuration. To a certain extent these differences in mortality patterns reflect differences in morbidity patterns. However, the emergence of chronic diseases has complicated the relationship between morbidity and mortality in that chronic diseases are not necessarily the direct cause of death.

One of the most perplexing but important associations discussed in this context is that between sex and morbidity. There is perhaps no other demographic variable for which differentials in health status are so clear-cut. Yet, at the same time, there is probably none for which more questions are raised concerning the meaning of the findings and the possible explanations for observed relationships.

Any discussion of the relationship between sex and health status must begin with what has become a maxim: Women are characterized by higher levels of morbidity than men, but men have a higher mortality rate. Although this is a somewhat simplistic summary of a complex situation, there is a great deal of evidence to suggest that, by any measure of morbidity one would care to use, women are "sicker." On the other hand, there is no doubt that mortality rates are higher and life expectancy is lower for males in contemporary U.S. society (Centers for Disease Control and Prevention, 2015).

> *Any discussion of the relationship between sex and health status must begin with what has become a maxim: Women are characterized by higher levels of morbidity than men, but men have a higher mortality rate.*

When the prevalence of chronic diseases is reviewed, it is found that males report higher rates of heart disease (e.g., coronary heart disease, hypertension), although the rate for strokes is similar for males and females (National Center for Health Statistics, 2012). On the other hand, females report higher rates for respiratory conditions (e.g., asthma, chronic bronchitis) although males and females report similar rates for emphysema. Women account for virtually all cases of breast cancer and men for all cases of prostate cancer. Arthritis is more common among women as are migraines and severe headaches. While females report an even higher level of chronic conditions than acute conditions, these tend to be conditions that are not life-threatening. Although males are sick less often and report fewer symptoms, when men do become ill the condition is likely to be more serious or even fatal.

The relationship between sex and mental health status is fairly well documented, although the conclusions are not without controversy. Based on reported symptoms, clinical evaluations by community researchers, and frequency of presenting themselves for mental health care, females appear to be characterized by a higher level of mental disorder. Women are more likely to report frequent feelings of sadness, with this condition reported by 14% of women and 10% of men. Women also report higher levels of nervousness and restlessness (National Center for Health Statistics, 2012). Women exhibit higher scores on indices of depression, hysteria, and paranoia as well as on less severe mental disorders, but men exhibit a greater prevalence of antisocial disorders, authority problems, and Type A behavior (World Health Organization, N.D.). In the major national study conducted on psychiatry morbidity, women were 70% more likely to experience a major depressive disorder (Kessler et al., 2003). This same study, however, concluded that there was little difference in the lifetime prevalence between men and women when all disorders are considered.

Males, while scoring "better" on the indicators of morbidity discussed above, are at greater risk of mortality. In effect, the age-adjusted mortality rate for males is slightly higher than that of females, with males recording a mortality rate of 8.2 per 1000 in 2011 compared to 6.3 per 1000 for females. For each of the 15 leading causes of death in 2007, males recorded a higher mortality rate, and for three causes the male/female ratio was over 3:1 (Xu, Kochanek, Murphy, & Tejada-Vera, 2010). The mortality rate for males is in fact higher at every age. Indeed, the death rate for males is even higher than that for females during the prenatal period, indicating that the greater mortality risk characterizing males predates birth. At ages 15–24 and 35–44, the mortality rate for males is almost three times as high. The differential in sex-specific mortality rates translates into differential life expectancy, with females born in 2010 expected to live 81.0 years on the average compared to a life expectancy of 76.2 years for males (National Center for Health Statistics, 2013).

A major killer of infants is chronic respiratory disease, a condition more common among male infants. Accidents are the major cause of death for children aged 1–14, with males having approximately twice the risk of accidents. Homicide is a major cause of mortality for those 15–25, with males accounting for most of the homicide deaths. Similar patterns can be found for subsequent age cohorts and other health conditions (National Center for Health Statistics, 2010).

With regard to disability, comparable proportions of males and females are characterized by some level of activity limitation. The 2012 National Health Interview Survey found 18% of females and 13% of males to exhibit at least one physical disability. Females, however, accumulate on the average more work-loss days, more school-loss days, and more bed-restricted days (National Center for Health Statistics, 2012). Women reported an average of six bed-days per year related to some disability compared to 4 bed-days for men.

The most commonly observed disparities in health status are between whites and African-Americans with the latter exhibiting more unfavorable health status on virtually every indicator.

When the various racial groups in the United States are examined in terms of morbidity patterns, significant differences are found. The major distinction is between whites and blacks, with Asian-Americans and American Indians manifesting less distinct morbidity characteristics (National Center for Health Statistics, 2011). The discrepancy by race is substantial, however, with African-Americans reporting much less favorable health conditions than whites. Given that blacks have a younger age structure, the true differential is even larger than observed disparities.

Clear-cut differences in morbidity are found primarily between whites and African-Americans. The number of symptoms, the number of illness episodes, and the severity of the conditions all place African-Americans at a morbidity disadvantage. Although relatively more prone to acute health conditions, African-Americans actually suffer higher rates of both acute and chronic conditions than whites. African-Americans represent 12% of the population, for example, but account for 28% of the diagnosed hypertension (Lloyd-Jones et al., 2010). The morbidity disadvantage for African-Americans is reflected in the proportion overweight or obese, with a rate of 69% recorded for this group compared to 54% for whites (Mead et al., 2008). Further, all things being equal, African-Americans contracting life-threatening conditions are more at risk of death than are whites with the same condition (see, for example, American Lung Association, 2011). Even at higher income levels, African-Americans report higher levels of chronic disease than comparable whites.

Differences in cause-specific morbidity exist between various racial and ethnic groups, with the epidemiology of cancer reflecting this phenomenon. Whites in the United States are more likely to suffer from colon/rectal cancer, breast cancer, and bladder cancer, for example, than are African-Americans. On the other hand, the incidence of lung, prostate, stomach, and esophageal cancer is higher for African-Americans. Asian-Americans and Hispanics are less likely to suffer from heart disease and respiratory disorders than either whites or African-Americans (National Center for Health Statistics, 2012). Rates for HIV/AIDS are particularly associated with race and ethnicity, with the incidence for African-Americans many times higher than that for non-Hispanic whites and the Hispanic rate notably higher than that for whites (Mead et al., 2008).

The distribution of mental illness with regard to race and ethnicity has been of great interest to researchers and health professionals. Contrary to the conventional wisdom, the leading national study on psychiatric morbidity (Kessler et al., 2003) found that African-Americans were actually 30% *less* likely to experience *any* mental disorder over their lifetimes compared to whites. To the extent that differences do exist, the disparity appears to be not in prevalence but in types of disorders. Blacks seem to be characterized by more severe forms of disorders (e.g., psychoses), and whites by milder forms (e.g., neuroses), although this same study indicated that blacks were 40% less likely to experience a major depression disorder over their lifetimes.

Indicators of disability are found to be higher among African-Americans than among other racial groups. Data from the 2010 National Health Interview Survey indicated that 12.2% of the white population had some limitation due to disability, compared to 16.5% of the African-American population (National Center for Health Statistics, 2011). In addition, African-Americans are characterized by higher levels of disability than whites, whether measured by the actual presence of handicaps or by such proxy measures as work-loss days and bed-restricted days. This disability disparity for African-Americans exists at even high income levels. The disability rate for Hispanics is one-third lower than the average.

Non-Hispanic whites have historically exhibited the most favorable mortality rates but are now being displaced by Asian-Americans as the population with the lowest risk of death.

Mortality rates for the black population are considerably higher than those for the white population. When mortality rates are examined for 2011, the overall mortality rate for the U.S. population is 7.4 per 1000 population. The age-adjusted mortality rate for the white population as a whole was 7.4 deaths, compared to 8.8 for blacks (National Center for Health Statistics, 2010). Age-adjusted mortality rates for other groups in 2011 were 5.4 for Hispanics, 6.0 for American Indians and 4.1 for Asian-Americans. African-Americans are characterized by higher mortality risks at nearly all ages and for nearly all causes (Rogers, Hummer & Nam, 2000). (Note that all of these rates are age adjusted, thereby eliminating any distortion caused by differentials in age distribution.)

Further, important differences exist between blacks and whites in terms of the common causes of death, and to a great extent these differentials reflect differences in morbidity characteristics. Whites in the United States are more likely to die from chronic conditions, especially those associated with aging. Blacks and members of certain ethnic groups are relatively more likely to die from acute conditions. Further, nonwhites are more likely to be affected by environmentally caused health problems and life-threatening problems associated with lifestyles (such as homicide, HIV/AIDS, and accidents). In contrast, the dominant causes of death among the white population are heart disease, cancer, and stroke. African-Americans, on the other hand, are more likely to die as a result of infectious conditions, respiratory and digestive systems conditions, and the lifestyle-associated problems noted above. Mortality disparities for some health conditions are found to exceed the morbidity disparity.

Much of the mortality advantage characterizing Asian-Americans and Hispanics has been attributed to the foreign-born among these populations. Subsequent generations of Asian-Americans and Hispanics, it seems, do not fare as well in comparative mortality analyses. Interestingly, Native Americans have made the greatest gains of any group in reducing mortality in recent years, with an age-adjusted mortality rate in 2011 of 6.0 per 1000 (National Center for Health Statistics, 2010). Native Americans record the lowest mortality for cancer of any group but by far the highest mortality rates for diabetes, suicide, and accidents.

Another relatively important cause of death for blacks is infant mortality. Although infant mortality was dramatically reduced as a cause of death in the United States during the last century, it continues to be a serious health threat for nonwhites. The infant mortality rate for African-Americans in 2011 was more than twice that for whites, 11.4 per 1000 live births versus 5.1 (Hoyert & Xu, 2012). The rates for both groups have declined since the late 1980s, with the gap between the two actually narrowing in recent years. The Hispanic infant mortality rate is something of an anomaly, given the relatively poor health status of this population and this group's lower level of access to health services. The low Hispanic infant mortality rate is generally attributed to the emphasis on family within this culture. Exhibit 11.7 presents evidence that Americans are getting sicker.

Exhibit 11.7: Are Americans Getting Sicker?: Tracking the Level of Morbidity

An issue that is increasingly raised is whether Americans are becoming sicker or healthier than they used to be. While conventional wisdom suggests that we have steadily become healthier as a population over time, there is statistical evidence dating in some cases as far back as the 1980s to suggest otherwise. While it could be argued that more Americans are living longer, healthier lives than their ancestors, there is a growing body of evidence that the U.S. population may be experiencing a reversal of health fortunes.

The answer to this question is complicated by the lack of a standard measure of morbidity. Researchers on this topic do not have access to any global indicator that they can point to. Aggregate measures (e.g., the combined prevalence of chronic conditions, overall disability) might be considered although there is likely to be disagreement over what diseases to include in any aggregate measure. Specific conditions could be considered (e.g., major health threats like heart disease and cancer, contributors to poor health such as obesity) but, again, there is likely to be disagreement over with conditions to include.

A common although subjective approach to determining the overall morbidity level is through the use of self-reported health status. Various surveys ask respondents to rate their health status on a scale from poor to excellent. The results on some surveys have indicated, in fact, a decline in the proportion of the U.S. population rating their health as "very good" or "excellent", and an increase in the proportion rating their health as "poor" or "fair" between 1997 and 2010. This level of self-reported health status reflects a departure from the steadily increasing health status reported prior to 1997. These findings of decreasing health status are not consistent across all surveys, with a continued improvement in health status noted in others.

Other researchers have pointed to the steady increase in the prevalence of chronic disease within the U.S. population. Of course, with the aging of the population, one should expect a decline in the incidence of acute conditions and an increase in the prevalence of chronic conditions. However, the prevalence rates for many chronic conditions are higher today for various older age groups than they were a generation ago, suggesting that more people are living longer but with more chronic conditions. Further, it is noted that certain acute conditions remain at epidemic levels (e.g., sexually transmitted infections) while many communicable diseases long eliminated if not eradicated from our population are making a comeback (e.g., measles, mumps, malaria).

Of particular concern are rising rates of non-communicable chronic conditions such as obesity, diabetes, high blood pressure, heart disease, and cancer. In 2005, nearly half of adults—133 million—had at least one chronic illness. In 2009–2010, more than one third (35.7%) of U.S. adults were obese, and 8.3% had diabetes. In 2005–2008, over 30% had high blood pressure. The prevalence of these conditions has grown substantially over the last 20 years and these trends are eroding previous advances the U.S. made in life expectancy and other determinants of population health. This notion is reinforced by the fact that a higher proportion of the population (in all age groups) is classified as disabled.

Of even more concern is the purported declining health status of America's children. The Institute of Medicine (IOM) reported in 2012 that "the current generation of children and young adults in the United States could become the first generation to experience shorter life spans and fewer healthy years of life than those of their parents." Of particular concern is the increase—driven to a great extent by the high and increasing rate of obesity—in the rise of chronic conditions among children. Conditions such as heart disease and diabetes were unknown among children in past generations but, along with other chronic conditions typically associated with the elderly, are becoming increasingly common.

Given all of the available evidence it is difficult to definitively conclude whether Americans are continuing to get healthy or are now becoming sicker. At the end of the day, the answer is probably: It depends. That is, depending on the metrics examined, the time period under consideration, and the population included, it is possible to end up with either result. However, the fact that a growing number of indicators suggest that Americans are becoming sicker is noteworthy. Clearly additional research is required to settle this issue.

Sources:

Institute of Medicine (2012), Saloman, Nordhagen, Oza, &Murray (2001).

11.6.2 Sociocultural Characteristics and Health

Differences in health status are similarly substantial when sociocultural characteristics are considered. Early on in the study of demographic influences on morbidity, it was concluded that marital status was a predictor of both health status and health behavior (Verbrugge, 1979). Married individuals are found to have lower levels of morbidity and to perceive themselves as being in much better health than their unmarried counterparts. Married persons also report a higher level of physical and psychological well-being than those who are not married (Shoenborn, 2004). Further, it has been found that married individuals, when affected by a health condition, experience less serious episodes, face more favorable prognoses, and report more favorable outcomes than unmarried individuals facing the same condition. For some conditions, however, the never married are better off than the married (National Center for Health Statistics, 2012).

A notable exception to these patterns relates to the incidence of acute conditions and certain chronic conditions. Married men and women report slightly more acute conditions than never married men and women. However, the married are still better off overall than the divorced and widowed. It has been suggested that the never married may suffer fewer episodes of acute conditions but are affected by more serious and prolonged conditions. It may be the case that married persons are more likely to have their acute conditions diagnosed.

The preponderance of research now indicates that the different marital statuses are at varying risks of mental illness. While the married appear to be much better off overall in terms of mental health than are those in any of the other marital categories, there is less consensus concerning the relative risk for mental disorders for the never married, the divorced, and the widowed. When mental health is measured in terms of feelings of sadness, hopelessness and worthlessness, the married report the lowest rates across the board. The never married report the second lowest rates with the widowed and divorced exhibiting much higher rates that either of these two groups (National Center for Health Statistics, 2012).

Married individuals exhibit more favorable health status for virtually every indicator than the unmarried, although some suggest that being in a stable relationship regardless of marital status supports better health.

With regard to disability, only 13% of married people were found to have physical limitations in the 2009 National Health Interview Survey, compared to 15% or more for those in other marital status categories. The pattern is similar with regard to other indicators of disability. However, the NHIS found that married individuals report more work-loss days per year (3.4) compared to 2.8 days for the never-married, but less than the 5.4 days reported for the divorced and 6.0 days for the widowed (Pleis, Ward & Lucas, 2010).

It has been found that no matter what indicator is utilized, there is generally an inverse relationship between income and level of morbidity for both physical and mental disorders. As income increases, the prevalence of both acute and chronic conditions decreases. When symptom checklists are utilized, the lower the income the larger the number of symptoms identified. Morbidity differences based on income are particularly distinct for chronic conditions. For the lowest income group the prevalence rate is higher for heart disease, diabetes, emphysema, kidney disease and arthritis. An exception is found in the case of cancer, wherein the highest income group reports a slightly higher rate (National Center for Health Statistics, 2012). Higher rates are also recorded among the lowest income groups for most chronic respiratory conditions. Note that, if the lowest income group is broken down further (e.g., into <$15,000, $15,000–$24,999, etc.), the disparities exhibited would be even greater at the lowest income levels.

Not only are there more episodes of certain types of both acute and chronic conditions recorded as income decreases, but the severity of a condition is likely to be greater when income is lower. When afflicted by acute conditions, the poor tend to have more prolonged episodes characterized by greater severity. Interestingly, in a society that has become characterized by chronic health conditions, acute disorders remain surprisingly common among the lower income groups. In fact, the disease profile of many low-income communities more closely resembles that of a less developed nation than it does the United States. It has also been found that living in poverty in childhood can have detrimental health effects later in life (Evans & Kim, 2007).

Early on in the study of the social epidemiology of mental disorder, it was asserted that the lower classes were more prone to psychiatric pathology than the affluent (Hollingshead & Redlich, 1958). However, more recent studies have failed to consistently demonstrate a clear relationship. What has been demonstrated is the fact that the relative prevalence of mental illness by social class depends heavily on the type of disorder examined. Further, for some disorders apparent correlations with other variables (e.g., race and age) are moderated when socioeconomic status is controlled (Mossakowski, 2008). A more recent study (Jitender, Afifi, McMillan & Asmundson, 2011) found a direct relationship between income levels and psychiatric symptoms, with the number of DSM indicators increasing with decreasing income.

Although the possibility of diagnostic bias is always present, the preponderance of evidence indicates that different disorders characterize those at different socioeconomic levels. Further, those at the lower income levels are likely to be characterized by more severe disorders. This explains why early studies concluded that mental disorders were concentrated within lower-income groups; the available statistics were for schizophrenia cases recorded at public mental hospitals. It is still felt that schizophrenia, certain forms of depression, and sociopathy are more common among lower income groups. Manic-depression and neuroses, on the other hand, appear to be more common among upper income groups. The rate of suicide, it should be noted, is much higher for the affluent than for the non-affluent.

Income is considered to be one of the best predictors of health status, with virtually every indicator of ill-health exhibiting an inverse relationship with income.

There is also an inverse relationship between income and indicators of disability. Among the population with annual household incomes in 2010 less than $35,000, 20.6% reported some limitation of activity due to chronic conditions. This figure drops dramatically to 8.9% for the $35,000–49,999 income group. The rate continues to drop to a level of only 6.6% for those with household incomes of $100,000 or more (National Center for Health Statistics, 2011). When examined in terms of poverty status, it is found that 28% of the poor report disabilities, compared to 22% of the near-poor and 12% of the non-poor. Further, the lower the income, the greater the number of bed-disability days, work-loss days, school-loss days, and restricted activity days.

The mortality rate for the lowest income group is considerably higher than that of the most affluent, even after adjusting for age (Rogers et al., 2000). The poor are also characterized by relatively high levels of infant mortality and even maternal mortality. Virtually all infant mortality in the United States today is accounted for by the lowest income groups, and maternal mortality (which has been virtually eliminated society-wide), is disturbingly common among the poor and appears to be increasing.

The relationship between educational level and morbidity exhibits a similar pattern to that for income. The better educated report fewer episodes of acute conditions and fewer chronic conditions than the poorly educated (National Center for Health Statistics, 2012). The prevalence of heart disease (e.g., coronary heart disease, hypertension) increases as educational level decreases. The same pattern—higher rates with declining education holds—for chronic respiratory conditions, arthritis and diabetes. The proportion of the population reporting diabetes, for example, decreases from 15% for those with less than a high school education to 7% for those with at least a bachelor's degree.

The relationship between educational level and mental illness, like that for physical illness, appears fairly clear cut. In fact, some researchers have suggested that the income differentials noted above are in reality a function of differing levels of education. For example, adults with less than a high school education report the highest rates of sadness, hopelessness and worthlessness, while those with at least a bachelor's degree report the lowest rates. Further, the poorly educated are more likely to report feelings of nervousness and restlessness. As the level of education increases, there appears to be an increase in the prevalence but a decrease in the severity of disorders. The better educated appear to be more characterized by neurotic conditions, while the less educated appear to be more frequently psychotic. Ironically, the rate of suicide is much higher among the better educated.

The level of disability exhibits a clear pattern with regard to educational attainment. Research by the National Center for Health Statistics (2011) found that 25% of those with less than a high school diploma reported difficulties with physical functioning, compared to 20% of those with a high school diploma, 17% of those with some college, and 10% of those with at least a bachelor's degree. Further, adults with less than a high school education reported eight bed-days annually due to some disability, compared to three bed-days annually for the best educated. This is true for disability arising from both acute and chronic physical conditions. An analysis of data from the National Health Interview Survey found an inverse relationship between educational levels and chronic conditions, limitation of activities, and number of bed days for disability.

The pattern with regard to mortality also resembles that exhibited for income. The death rate for the poorly educated is much higher than for those with higher educational achievement (National Center for Health Statistics, 2010). According to NCHS data, the risk of mortality for those with a high school education is 60% higher than that for those with a graduate degree (Rogers et al., 2000).

Like the poor, the causes of death for the poorly educated are more likely to be the acute problems associated with less developed countries than the chronic conditions characterizing much of American society. Also like the poor, the poorly educated are likely to be characterized by lifestyle-related deaths such as homicides and accidents. Education, in fact, has been shown to demonstrate a stronger association with mortality than does income (Rogers et al., 2000).

Infant mortality, once a leading cause of death, has been virtually eliminated from the groups with the highest educational levels. The poorly educated as it turns out account for the bulk of infant deaths. The correlation between educational level and infant mortality rates is reflected in differences in low birth weight babies and premature births for those at different educational levels. Nine percent of mothers with less than a high school education deliver low birth weight babies, while this figure drops to 5.5% for women with one or more years of college (National Center for Health Statistics, 2010).

Morbidity patterns related to the workforce can be examined in terms of occupation, industry and employment status. There is a direct and positive relationship between the status of the occupation one holds and morbidity. In general, the higher the occupational prestige, the better the health status. Those at lower occupational levels tend to be characterized by higher rates of morbidity and disability. Like the poor and the uneducated, they tend to be characterized both by more conditions and by more serious conditions. Levels of disability (as measured by restricted activity days and lost days from work and school) are higher for lower occupational levels.

One of the few studies on morbidity and occupational status found that living and working conditions, psychosocial stress, and health and sickness behavior were more deleterious among blue-collar workers than among white-collar workers, resulting in higher morbidity and mortality rates for blue-collar workers. Psychosocial stressors at work were related to mental strain, perceived health, and absenteeism. Stress symptoms were strongly associated with perceived health, locomotor symptoms, smoking, drinking, and absenteeism. In follow-up research the baseline indicators of stress predicted future chronic illness and angina pectoris, but not hypertension or myocardial infarction.

Mortality rates and longevity vary directly with occupational status. Mortality rates for professionals are significantly lower than those for unskilled laborers, for example. A study in Sweden and Germany found a link between mortality and occupational status, with the risk of death for the lowest occupational group (unskilled laborers) being nearly twice that of the highest (professionals), although the authors note that income and education are confounding factors (Geyer et al., 2006). Additional research by Rogers et al. (2000) has reaffirmed this finding as it relates to the U.S. population. The causes of death for those lower in terms of occupational status are similar to those for the poor and uneducated.

The relationship between various occupations and industries and health status can also be examined. It is found that certain occupations tend to be characterized by inordinately high levels of both morbidity and mortality. High-morbidity occupations often include those whose workers are exposed to environmental risks. Healthcare workers, for example, are characterized by high levels of work-related injuries and illnesses (but very low levels of work-related deaths). The single most dangerous occupation today is cellphone tower workers, having recently edged out commercial fisherman and lumberjacks.

It is also found that certain industries tend to be characterized by inordinately high levels of both morbidity and mortality. Among the standard industrial categories utilized by the U.S. Department of Labor the industry recording the highest level of occupational illnesses and injuries is manufacturing, with a rate of 373 per 1000 workers in 2008. This compares to a rate of 10 per 1000 for utilities workers. The highest death rates by industry in 2008 were recorded by farming/fishing/forestry with 30.4 deaths per 100,000 employed workers. This compares to finance and insurance with 0.3 deaths per 100,000 workers (National Center for Health Statistics, 2010). While those employed in healthcare are characterized by a relatively high level of occupation-related illness and injury, the death rate for healthcare and social assistance workers is only 0.5 per 100,000.

One other consideration when examining work-related morbidity is the issue of employment status. Employment status may be more significant than that of occupational differentials and has garnered renewed attention in the light of the recent recession. When the employed are compared to the unemployed, clear-cut differences surface in terms of physical and mental illness (Brown et al., 2012). The unemployed appear to be sicker in terms of most health status indicators, with higher levels of morbidity and higher levels of disability than the employed. While it could be argued that poor health leads to unemployment, it has been found that otherwise healthy individuals who have undergone loss of employment often develop symptoms of health problems. In fact, even perceived threats to job security have been associated with an increase in morbidity (Ferrie, Shipley, Marmot, Stansfeld, & Smith, 1998). It has also been suggested that, among those who cannot find employment, developing an illness serves as something of a rationale for a failure to find work. Recent research on 54 countries (including the U.S.) found that the 2008 global recession contributed to a jump in suicide rates. The suicide rate in 2009 was 6.4% higher in developed countries than expected, with males aged 45–64 exhibiting the greatest risk of suicide during this period (Chang et al., 2013).

The same pattern holds for employment status and mental illness. The unemployed tend to be characterized by higher levels of mental illness symptoms than the employed. In fact, for both physical and mental disorders, it has been suggested that the lack of social integration resulting from unemployment serves as a "trigger" for various health problems.

Conclusions concerning the distribution of disease based on demographic characteristics have to take into consideration the likelihood of the interaction of various demographic variables. There are correlations, for example, between income and education with these two variables often interacting with each other. If first-order analyses are conducted erroneous conclusions may, in fact, be generated. Perhaps the best-known example of this is the perceived relationship between race and health status. The generally negative health status associated with African-Americans relative to non-Hispanic white Americans can be virtually eliminated when socioeconomic status is factored into the equation (Williams & Collins, 1995).

Examining the factors affecting the morbidity of the population as a whole often masks important differences that exist among subgroups. It is not unusual to have a figure for a county, for example, that reports an average rate when virtually no subpopulation actually exhibits that rate. In Shelby County, Tennessee, in 2005 the county-wide infant mortality rate was 13 per 1000 live births. What this rate doesn't tell us, however, is that the figure for African-Americans is 19 per 1000 and that for whites is 6 per 1000. For that reason it is important to decompose these figures and examine subsets of the population under study based on race, sex, age or some other attribute relevant under the circumstances.

It is also important to examine morbidity for segments of the population that reflect a combination of different variables. For example, when levels of morbidity for various conditions are examined, the study population is often broken down into the race/sex categories of white males, white females, black males and black females, with the differences between the subgroups examined. This allows for a more in-depth appreciation of the morbidity indicator under study and should be a prerequisite for anyone seeking to understand an indicator's significance within that population.

One other issue when considering the demographic correlates of health and illness is the potential interrelationship of the variables in question. While demographic attributes are addressed separately in the sections that follow, the likelihood of interaction between the attributes being considered needs to be kept in mind. An obvious example is the well-known relationship between education and income, but there are other potential interactions as well (e.g., race and income, occupational status and education). While every possible interaction cannot be addressed in this chapter, readers should remain sensitive to the possibility of the interaction of demographic variables with one another.

Exercise 11.1: Planning Hospital Services

Your hospital has been given responsibility for the care of the total county population. This population has a high proportion of children and a low proportion of seniors (median age = 30). The population is 85% white and living primarily in family households. Income and educational levels are higher than average.

On the list of services below, indicate with a check those services that you would plan to offer to this population. Be prepared to present any assumptions you are making and to justify the services that are being provided.

	Adult day care		Obstetrics services
	Inpatient substance abuse		Occupational health services
	Outpatient substance abuse		Oncology services
	Arthritis treatment center		Open heart surgery
	Assisted living		Outpatient surgery
	Birthing room/LDR		Pediatric intensive care services
	Breast ca screening		Physical therapy inpatient
	Burn care		Physical therapy outpatient
	Cardiac intensive care		Psychiatric acute inpatient care
	Case management		Psychiatric child adolescent services
	Children wellness program		Psychiatric geriatric services
	Community outreach		Psychiatric outpatient services
	Crisis prevention		Psychiatric partial hospitalization services
	CT scanner		Radiation therapy
	Emergency department		Reproductive health
	End of life care		Skilled nursing
	Freestanding outpatient center		Social work services
	Geriatric services		Sports medicine
	Transportation to health services		Support groups
	Health screenings		Teen outreach
	HIV/AIDS services		Transplant services
	Hospice program		Trauma center
	Med-surg intensive care		Ultrasound
	Neonatal intensive care		Urgent care center
	Nutrition program		Women's health center

The class can be divided in groups and the following populations used as the basis for determining the configuration of services:

- The county's nursing home population. This population has an age range of 50–95 and a median age of 72. The population is 80% female and in frail health.

- The county's large population of orphans. This population has an age range of 1–18 and a median age of 10. The population is 45% female and 55% male and in reasonably good health.
- The county's large prison population. This population has an age range of 18–80 and a median age of 35. The population is 100% male, 50% African-American, 15% Hispanic and suffers from the range of health problems associated with a rough life and incarceration.

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Chapter 12
Political Demography

Abstract This chapter describes the field of political demography and the applications of demographic techniques to the political process and to policy setting. The impact of demographics on political activity is described and the uses of demography in the electoral process are discussed. The policy-setting process is reviewed and the relevance of demographic concepts and data for this process is described.

12.1 Introduction

Within the political arena there is a long history of the use of demographic data and, to a lesser extent, demographic concepts and methods. It could be argued that politicians, campaign managers, and political consultants were paying attention to the demographics of voters well before demography had emerged as a distinct discipline. This sometimes superficial application of demographics to politics focused on the voting patterns of various demographic segments within the population. It did not require much in the way of insightful thought to realize that there were likely to be differences in the voting patterns of the rich and the poor, blacks and whites, Northerners and Southerners, and so forth.

Applications of demographic concepts, methods and data have principally occurred in two areas: the electoral process and the development of public policies. In the realm of politics the implications of demographics are ubiquitous. While there is some overlap between politics and policy, most consider them distinct realms of endeavor with their respective goals and practitioners. These two spheres of activity will be discussed separately in this chapter.

While there has always been a correlation between demographic attributes and political behavior, the increasing polarization of the electorate, the growing diversity of the U.S. population, and the intransigence of certain cultural patterns have all served to increase the influence of demographics within the political sphere. In the past many people prided themselves on voting for the man (or the issue) rather than the political party. This meant there was significant crossover by supporters of the two main political parties. The parties might be depicted as overlapping circles

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with a certain portion of the ground held in common and distinct realms relegated to each of the parties. There were moderate Republicans who were comfortable with conservative Democrats. These political animals have largely disappeared (particularly on the Republican side) and there is no common ground anymore. While it once could be maintained in referring to the two parties that it was the "same crap, just different piles", that sentiment is hard to support today.

There has been a longstanding association between demographics and politics, but the demographic trends of the past few years have served to further segment the electorate along demographic lines.

A second factor that has made demographics increasingly salient for the political process is the re-emergence and/or re-entrenchment of various regional and cultural perspectives. A quarter century ago, social commentators predicted the homogenization of the U.S. population. Under the influence of mass media, it was assumed that social patterns would converge and that everyone would begin to speak like a mid-western news commentator. Not only has the U.S. population not become homogenized in the successive years, it has in fact become more heterogeneous. Part of this has been driven by the political process itself. The Republican party has pursued a "Southern strategy" since the 1960s that has served to highlight and even exacerbate regional perspectives on politics. Other vested parties have attempted to organize political movements that focused on various cultural subsets of the population such as African-Americans, American Indians, and youth. The reawakening of an appreciation for the cultural heritage of many groups has served to reemphasize their differences with the larger society and influence their political perspectives.

Perhaps the most significant factor supporting a demography-as-destiny perspective has been the growing racial and ethnic diversity of the U.S. population. While re-entrenchment of existing groups has occurred, the more dominant trend is the emergence of new cultural subsets as factors in political behavior. The most significant of these groups is the segment of the population included under the "Hispanic" or "Latino" umbrella. Now accounting for over 15% of the population (and perhaps even more with uncounted aliens included) Hispanics have become an increasingly influential voting bloc. African-Americans remain a significant group of voters and Asian-Americans are the fastest growing racial group today. This diversity is not limited to race and ethnicity, however. Religious affiliation has long been a predictor of voting behavior but, today, the balance has changed dramatically as long-dominant Protestant and Catholic voting blocs have become fragmented, new voting blocs of Hindus, Muslims and Buddhists have emerged, and those with *no* religious affiliation have become the fastest growing "religious" segment.

The interface between demography and politics is so significant that many observers consider demographics to be destiny within the political arena. Our political orientation is more often than not influenced by our demographic attributes and the demographically defined groups we interact with. While we may think that we make our political choices as independent thinkers, most of our political positions and actions reflect the demographic attributes associated with us. Over the past 20 years or so, the U.S. electorate has become increasingly polarized, with much of this political stratification taking place along demographic dimensions. One only has to look at the distribution of those voting for Obama and Romney, respectively, in 2012 or Obama and McCain in 2008 to see the extent to which demographic attributes served as a predictor of voting behavior. The unexpected electoral college victory of Donald Trump in the 2016 presidential election can be clearly attributed to demographically driven voting patterns.

12.2 The Demographics and Politics Interface

There are few aspects of politics that do not have a demographic dimension. The increasing polarization of the American electorate has served to exacerbate differences among voters of different political persuasions and to further differentiate subgroups in terms of demographics. From start to finish in the political process–beginning with *a priori* political orientation and ending with actual voting behavior—is influenced by demographics.

American's political orientation is not easily discerned, especially with so many cross-cutting relationships and varied cultural perspectives. A simple way of looking at political orientation would be to examine membership in the two major political parties. Yet, the majority of the population is "independent" in the sense they are not formally registered with either party (or are part of the segment of voters that identifies with a third party). Even within party membership, there is likely to wide variation in the perspectives of party faithful although, it could be argued, recent years have seen polarization reduce the intra-party variation. Thus, while there used to be some relatively liberal Republicans and relatively conservative Democrats, those political creatures are almost impossible to find today.

In the absence of any clear-cut measure of political orientation some analysts have attempted to develop a typology based on political leaning. Inevitably, these typologies very much reflect demographic differences within the population. An example is the Pew Charitable Trust typology of political leaning highlighted in Exhibit 12.1.

Exhibit 12.1: Determining Political Leaning

The Pew Charitable Trust has a long history of tracking social trends and represents one of the major sources of data on social phenomena. Pew has developed a typology of political orientation or "leaning" that can be used to segment the population into meaningful subgroups reflecting different political perspectives. In order to develop the typology Pew conducted a national survey using questions that were thought to elicit information that reflected a person's political orientation. Pew divided the national survey's respondents into eight politically engaged groups, along with a ninth group of less engaged Bystanders. The assignment of individuals to one of the eight core typology groups is based primarily on their position on nine scales of social and political values—each of which is determined by responses to two or three survey questions—as well as their party identification. The typology groups were created using cluster analysis to generate scores on all nine scales and sort them into relatively homogeneous groups.

The following "types" were identified and a short description is presented for each:

The Divided Right

- Enterprisers (12% of adult population): Affluent, well-educated, and predominantly white. This classic Republican group is mainly characterized as pro-business, anti-government, anti-social welfare.
- Moralists (15%): Middle-aged, middle-income, predominantly white, religious (more than half are Evangelicals). This core Republican group is also socially intolerant and anti-social welfare, militaristic, anti-big business and anti-big government. Former Democrats drawn to the GOP's religious and cultural conservatism have increased its size substantially since 1987.
- Libertarians (7%): Highly-educated, affluent, predominately white male. This group has Republican lineage but is uncomfortable with today's GOP, particularly its religious right. Pro-business, anti-government, anti-social welfare but highly tolerant, very low on religious faith, cynical about politicians.

The Detached Center

- New Economy Independents (14%): Average income, young to middle aged, mostly female. This group is unanchored in either party. It has many conflicting values: strongly environmentalist but not believers in government regulation; pro-social welfare but not very sympathetic to blacks; inclined to fundamental religious beliefs (highest white Catholic group) but highly tolerant of homosexuals.
- Bystanders (10%): Very young, poorly educated, with low income. This group opts out of the political process or are not eligible to vote (highest Hispanic concentration). Slightly more female than male, its only claimed commitment is to environmentalism.
- The Embittered (6%): Low income, low education, middle-aged. One in five of this group are black, one in three have children under 18. Old ties to Democrats have eroded but the Embittered feel unwelcome in the GOP. They distrust government, politicians, corporations. They are

religious and socially intolerant. They strongly blame discrimination for lack of black progress, but are not strongly in favor of social welfare programs.

The "Not So" Left

- Seculars (7%): Highly educated, sophisticated, affluent, mostly white baby boomers and Generation X. The most socially tolerant group, driven by social issues, it is the only one to embrace the "liberal" label. Very low in religious faith. Highly pro-environment, pro-government, distrusting of business.
- New Democrats (12%): Mostly female, below average income and average education, includes a high proportion of white Catholics (30%) but also many white Evangelical Protestants (19%). Religious but not intolerant, more pro-business than other Democratic groups, they reject discrimination as a major barrier to black progress, are pro-government and environmentalist.
- New Dealers (8%): One of the oldest groups in the typology (three in ten over 65), below average education and low income. Once part of FDR's coalition, beneficiary of government programs, this group is now turned off by politics. Strongly conservative on race and social welfare, strong on religion, moderate on social tolerance, pro-America, distrustful of politicians and business.
- Partisan Poor (9%): Very poor (26% with household income under $20,000 a year), disadvantaged, about one in three in the South. Rooted in New Deal coalition, this group believes more government spending on the poor is needed. More than one-third are non-whites. Very religious and socially conservative.

Source: Pew Charitable Trust (2017).

Demographers are interested in political behavior because of the role that demographics plays in people's actions within the political sphere. From displaying a mild interest in politics to actually participating in the process, one's demographic affiliations influences every step of the way. Demographics can be used to predict who will register to vote, who will actually vote, and what party they will vote for. For this reason proponents of various political factions have relatively clear-cut demographic attributes.

A general profile of the population would provide clues to its political orientation. A population that is top heavy with seniors could be expected to have a different political orientation from a very young population. A racially homogenous population can be expected to have a different political perspective from a population that is diverse in terms of its racial and/or ethnic characteristics. A predominantly urban population can be expected to have a different political orientation from a suburban or rural population. The well-educated can be expected to display different characteristics from the poorly educated.

Ultimately, there are few demographic attributes that do not have implications for political behavior. Behavior in this sphere is influenced by age, sex, race and ethnicity among the biosocial characteristics. Political actors are also influenced by income and educational levels, region of the country and even religious affiliation.

There are a variety of reasons one may want to generate a profile of the electorate. If one is considering running for office or assisting someone who is, or wants to determine the leaning of the electorate on a particular issue, or is trying to anticipate the outcome of an upcoming election, a profile of the electorate might be worthwhile. Case Study 12.1 presents an example of profiling the electorate.

Case Study 12.1: Profiling the Electorate

An ambitious individual felt called to serve in politics and was encouraged by his peers to run as a candidate in an upcoming election in his hometown. The potential candidate was a 50-year-old white male with a college education and a white-collar job. Before agreeing to run for office he determined that he needed to profile the electorate residing within his district. Given the fact that he was relatively outspoken in his opinions, he felt that he had to be on the same page with the electorate in order to be a viable candidate.

For starters, the would-be candidate would probably want to profile the population of the district in terms of its demographic characteristics. He would want to determine the age distribution, the sex distribution, the racial and ethnic mix of the population, the income and educational levels and the marital status and household structure of the district's population. In many cases, it might be important to determine the religious affiliation of residents.

The profile generated by the campaign's exploratory committee indicated that the district contained a relatively heterogeneous population. It included mostly working-age residents with fewer than average children and seniors. These findings suggested that family issues were not likely to be as important as support for seniors and working-age people. The population was also heterogenous in terms of race and ethnicity, with a significant proportion of African-Americans (although lower than the city average) and an inordinate number of immigrants and refugees. This information was considered very important in that it suggested the presence of some politically active groups (e.g., seniors and working-age people) and some others that were less likely to participate in the electoral process. African-Americans tended to be underrepresented among the voting population, and many immigrants and refugees were not eligible to vote.

Having developed a reasonably complete demographic profile of the district's residents, the potential candidate may actually make a determination that he/she is or is not a good fit for the district. More than one potential candidate has profiled the residents of a district and decided that they would be unlikely to be electable there. While the demographic profile suggested some challenges in terms of generating agreement as to the issues, there was nothing in the profile that suggested a 50-year-old white male would necessarily meet resistance.

Since the demographic profiles didn't raise any red flags, the potential candidate felt justified in acquiring some other information to inform his/her decision. Only a portion of the area's population is going to be registered to vote and, if this is like most districts, the characteristics of those registered to vote are likely to be different from those who are not registered. Information is available on the rates of registration for different demographic categories, and this information might be used to inform the deliberations concerning this district. In this case, the level of registration for members of various demographic groups generally mirrored their proportion within the population. Not surprisingly, older white residents were somewhat over-represented among registered voters, and younger African-American residents were under-represented.

Other types of information that are typically available from public records are the voting history of residents of the district and their political preferences. The latter might be determined by party registration in states that require that or by the voting history of individual voters. Both of these pieces of information are important—the former due to the fact that those who vote may exhibit a different profile from those who are registered and, for the latter, due to the fact that certain voters may be predisposed to vote for a candidate of a given party regardless of the merits of those running for office. Since this jurisdiction did not require party registration, the research had to rely on the records that tracked voting patterns. In this case, it turned out that political party "preference" as indicated by past voting history did not favor either major party. The would-be candidate concluded that running as a Democrat or as a Republican would not represent an advantage or disadvantage.

Having obtained these data the would-be candidate is in a position to make an informed decision on the prospects of a successful campaign. Additional information might be required and it is likely to necessitate some primary research. For example, the data so far are not likely to indicate voter satisfaction with the incumbent politician, their political philosophy or their stand on various issues that may be relevant to the campaign. Should the potential candidate decide to go down this path it will be necessary to structure any sample used for data collection to reflect the characteristics of registered voters and, even better, those of likely voters. There was little in the information collected to date that might deter the candidate's quest for office so, in this case, it was deemed that no other research was necessary.

In addition to determining the characteristics of the electorate, it is important to identify the patterns of political behavior that characterize a population. A basic question to be answered relates to the level of voting registration for that population. Americans are notorious for not registering to vote, and the number registered is typically only a fraction of the total number of residents. The registration rate provides a clue to the level of political participation characterizing a population. If the district in question is typical, one would find that the level of voter registration differs for the various demographic groups residing in the area. Members of some groups invariably register at higher rates than others, and these differences generally fall along demographic lines.

Similar patterns can be observed for the level of actual participation (i.e., voting) among those who are registered. As demonstrated elsewhere in this chapter, the level of registration may or may not be predictive of voting patterns. There is invariably a drop-off from the number registered to the number actually voting, with the drop-off reflective of a number of factors. One constant, however, is that the attrition rate between registering and voting is greater for some demographic categories than others. While one should not rush to over-generalize, certain patterns have been found to persist over time and space. A number of different factors, of course, influence the attrition rate—from the type of election to the "hot" issues of the day to the attributes of the candidates.

To a certain extent, voter registration and even voting behavior represent "passive" forms of political participation. There are many other forms of political participation that can be tracked. Active participation in the political process might include campaigning for a particular candidate or lobbying for a particular cause. Support for a candidate may simply include a donation or more active participation through campaign support such as canvassing door to door, making phone calls or placing yard signs. As with the other aspects of political participation being discussed, the differences in the level of participation exhibit an association with demographic traits.

One final aspect of participation to be discussed here is policy making, the end result of the political process. This topic is discussed in more detail in the second half of this chapter, but some mention should be made here. Elections have consequences—and some of those consequences involve demographic attributes and processes. The result of elections determines not only who holds political office but the types of policies and programs that are enacted. The question that could be asked concerning the outcome of any election (but particularly those with national implications) is "Who benefits?" While we think of public programs as helping or hurting individuals, they ultimately impact *groups* within the population. Federal programs in particular focus on certain demographic segments of the population—seniors (Medicare, Social Security), school-age children (No Child Left Behind), minority groups (affirmative action initiatives), or poor people (Medicaid, food stamps) among others.

The difference between the two major political parties can be increasingly defined in terms of the demographic attributes of their supporters.

It is not likely that anyone would dispute the fact that Democrats and Republicans today represent quite different approaches to extant social issues. This is important to this discussion in that the constituents for the two parties at the national level are quite different demographically. It is no surprise, then, that Republican policies generally favor white, affluent males at the expense of other groups in society. Democratic policies, on the other hand, are more likely to address the needs to the less affluent and those in various racial and ethnic minority groups. Here one must be careful not to over-generalize since many different factors come into play to influence the nature of legislation that is enacted.

12.3 Demographic Correlates of Political Behavior

In examining the relationship between demographics and political behavior there are two different equally valid approaches that could be taken. On the one hand, one might examine the demographics of a political category. For example, with regard to the two major political parties, an analyst might be interested in how they break down in terms of their demographic characteristics. Conventional wisdom suggests that Democrats and Republicans differ in terms of their demographic attributes, and the facts clearly bear this out.

On the other hand, one might analyze the political attributes of various demographic groups within the population. Considering the different age categories for example, how does political orientation or political participation vary for people of different ages? Do males and females exhibit different preferences and behaviors? What differences are found among various racial and ethnic groups with regard to their political philosophies and voting behavior? Do the better educated display different political preferences than the poorly educated? How does one's income level affect one's political orientation? Many of these questions can be answered, in fact, with the data provided in Exhibits 12.2 and 12.3.

Historically, voters have become more conservative as they aged espousing different social and economic concerns than younger voters. Males and females have different perspectives and different concerns—hence the major gender split in recent presidential elections. Members of different racial and ethnic groups may have different concerns depending on their position within the social structure. Cuban-Americans for example have tended to be relatively conservative and supporters of the Republican party driven to a certain extent by the issue of our relationship with Cuba. Mexican-Americans on the other hand have tended to be more socially liberal and have tended to vote for Democratic candidates.

Those with differing income levels have historically exhibited different levels of participation and differing perspectives. The least affluent are the least likely to participate in the political process while political participation increases with income. The more affluent tend to be more conservative and have historically supported the Republican party, while more downscale citizens are likely to be less conservative and have historically supported the Democratic party. The relationship between educational level is not as clear-cut as it is for income, although the better educated tend to be more politically active than the poorly educated.

The U.S. has become increasingly divided geographically into "red" states and "blue" states that exhibit distinct demographic characteristics.

The region of the country remains a remarkably important factor in political behavior. The parts of the country that are predominantly "red" (Republican) or particularly "blue" (Democratic) are clearly different geographically. The northeast and the west coast have been consistently Democratic in their orientation for decades while the Midwest and the South tend to be primarily conservative and Republican in their orientation. The "solid South" is, of course, not as "solid" as in the past but for the most part has represented a consistently Republican voting bloc for some time.

One additional relationship to be considered is religious affiliation and participation. While there are some religious groups (e.g., Catholics) that reflect a cross-section of the population, most of the religious groups in the U.S. are stratified along various demographic dimensions. Religious groups that are more progressive in terms of their religious doctrine tend to be more liberal in their political perspectives. On the other hand, religious groups that tend to be more fundamentalist in their orientation are more likely to be more conservative in terms of their political perspective.

Of course, if one is analyzing the political character of a population the total population is not the main concern. The focus is on those that matter—the subset of the population that is registered to vote, likely to vote or actually does vote. Interestingly, the demographic profile may change significantly as one shifts from one category to another. Similarly, there may be differences when other groups are considered—campaign supporters, donors and political activists.

As an example, we might consider the characteristics of registered voters compared to those who actually vote. Exhibit 12.2 presents some basic demographics for these two categories of political participants for the 2014 mid-term election.

Exhibit 12.2: Demographics of Registered Voters and Actual Voters 2014 Mid-Term Election

Attribute	Registered (%)	Voted (%)
Total		
Adults	64.6	43.9
Sex		
Males	62.8	40.8
Females	66.3	43.0
Race/Ethnicity		
Non-Hispanic whites	68.1	45.0
African-Americans	63.4	37.3
Asian-Americans	48.8	19.1
Hispanics	51.3	18.4
Age		
18–24 years	42.2	17.1
25–44 years	60.5	32.5
45–64 years	70.4	49.6
65–74 years	76.3	61.2
75 + years	74.1	56.9
Marital status		
Married	72.1	50.9
Never married	50.8	25.9
Divorced	64.3	40.4
Widowed	69.9	47.7
Income		
<$10,000	51.7	24.5
$10,000–19,999	56.0	30.5
$20,000–39,999	63.0	37.8
$40,000–74,999	70.0	46.1
$75,000+	78.0	54.0

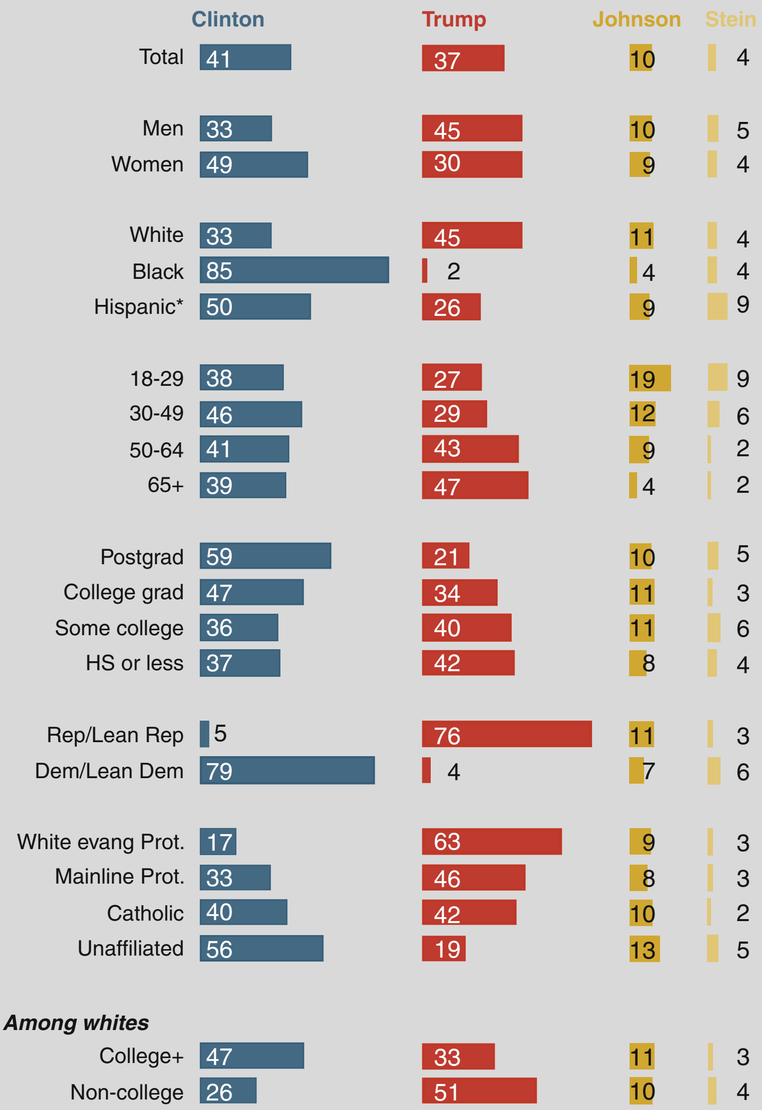
As can be seen less than two-thirds of American adults are even registered to vote. When the demographics of registered voters are considered, we find that women are more likely to be registered than men and that whites are more likely to be registered than any other racial or ethnic group. These figures indicate that registration generally increases with age up until the oldest cohort (75+ years). Less than half of the youngest cohort (18–24 years) was registered in 2014 while all other cohorts reported registration rates of 60% or more. When it comes to marital status the married are most likely to be registered while the never married are the least likely. In terms of income, we find there is a steady increase in the rate of registration from the lowest income group (<$10,000) to the highest income group ($75,000+).

While it is instructive to analyze the association between demographic attributes and voter registration rates, a review of those who actually voted is even more instructive. There was a significant drop-off from the proportions registered to the proportion actually voting, a pattern that was exhibited across the board. However, there were some major disparities in terms of rates between those registered and those voting. As can be seen in Exhibit 12.2 the greatest attrition was found for non-white voters, very young voters, single voters and the least affluent voters. On the other hand, inordinately represented among those who did vote were non-Hispanic whites, those 45 and older, married citizens and those in the highest income bracket.

Although it is not shown in the table, there were some interesting developments related to those who were registered to vote in 2014. The proportion registered exhibited considerable growth among racial and ethnic minorities over previous elections, particularly with the significant increase in Hispanic registration. There was also an increase in young (and of necessity first-time voters) in 2014. There were more female voters registered over the previous period and, although seniors were already registered to vote at a high rate, that proportion grew as well.

While a comparative analysis of registration and voting patterns is worthwhile, an even more interesting picture is generated when the distribution of votes by demographic traits is examined. Exhibit 12.3 display the results from the 2016 presidential election in terms of the demographic patterns associated with voting. As can be seen, Clinton actually received the majority of the votes from each demographic category but one—older white men. While Trump was able to win the election by virtue of the electoral college, the likely future voting patterns are revealed when one examines the breakdown of voting by demographic category.

Exhibit 12.3: 2016 Election Results by Demographic Category



*Small sample size: N=116.
Notes: Based on registered voters. Whites and blacks include only those who are not Hispanic; Hispanics are of any race. Other/Don't know responses not shown. Q13/13a.
Source: Survey conducted August 9-16, 2016.

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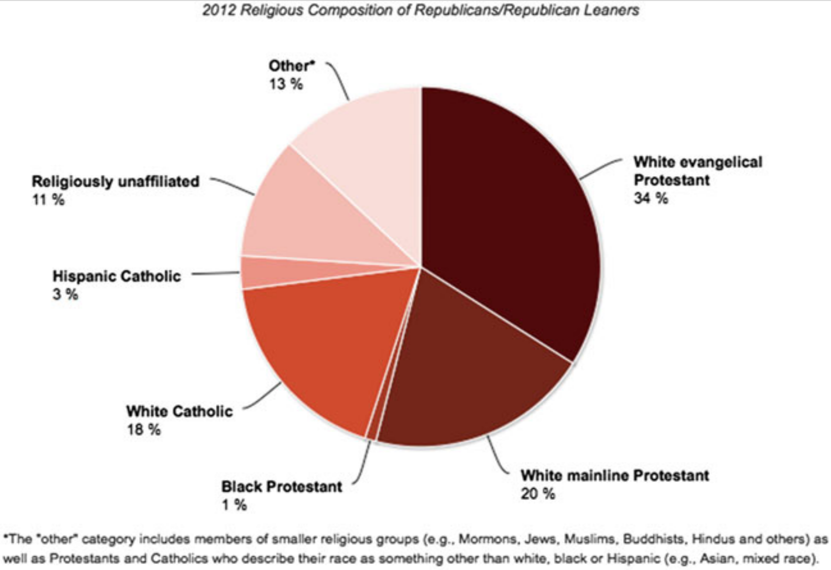
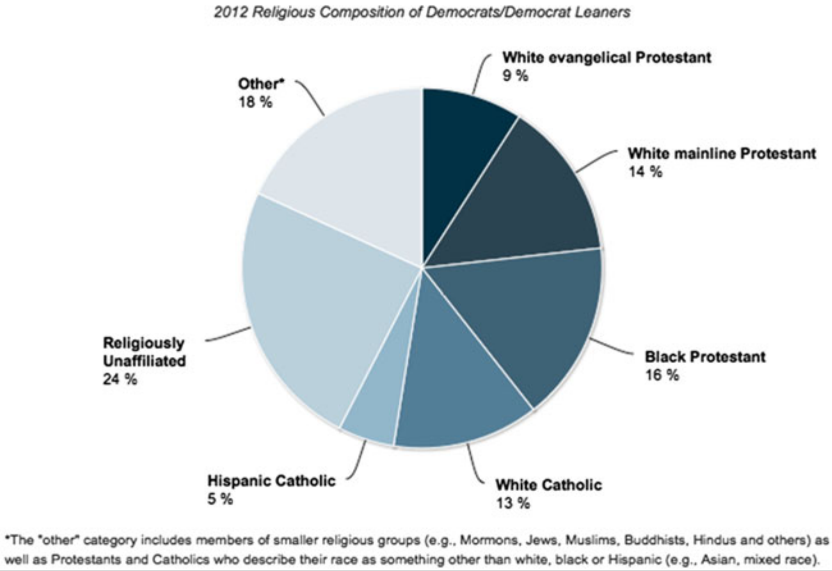
Religious affiliation remains an important consideration when it comes to political behavior in the U.S. as demonstrated by the 2016 presidential election. There is a clear association between demographic attributes and both the level of religiosity and denominational affiliation. Traditionally, the more "religious" segments of society and members of fundamentalist denominations have been more conservative and, hence, more likely to be affiliated with the Republican party. Conversely, the less "religious" and those affiliated with less fundamentalist denominations have tended to be more liberal and more likely to support the Democratic party. This distinction was evident during the 2016 election when white evangelical Christians were among Donald Trump's most ardent supporters. Exhibit 12.4 illustrates the distribution of Republicans and Democrats based on their religious affiliation.

Exhibit 12.4: Religious Affiliation of Republicans/Republican Leaners and Democrats/Democrat Leaners





Source: Pew Research Center

12.4 Demographic Trends and Political Change

It is possible that no other sphere of American society is being as influenced by demographic change as the political arena. While the history of politics in the U.S. is to a certain extent a history of demographic change, it could be argued that the developments of recent years have served to escalate this process. Certainly, over the past 20 years the impact of demographic trends on the voting behavior of Americans has been substantial as the U.S. has experienced an unprecedented level of immigration accompanied by the escalating diversity of the U.S. population, a restructuring of American families and households, and shifting economic fortunes.

Perhaps the most dramatic development that the U.S. continues to experience is the emergence of minority voters. As the older, white population (particularly the baby boomers) continues to dwindle, its stranglehold on the political process has begun to wane. The size of the minority electorate is rapidly increasing and escalated in the run-up to the 2016 presidential election. Minority voter political participation is growing even faster than the population. Indeed, minorities accounted for 15% of the voters in 1988 and 28% in 2012. While participation levels by African-Americans have remained stable, participation on the part of Hispanics has skyrocketed. The proportion of the votes accounted for by Hispanics increased from less than 2% in 1998 to 11% of the total in 2012. While it may appear that the small size of the minority population means it is overwhelmed by the majority at the polls, the concentration of minority group members in certain areas offsets their numerical disadvantage. Exhibit 12.5 describes the potential impact of demographic change on political preferences.

Exhibit 12.5: Does Demographic Change Mean the End of the Republican Party?

It is often said that "demographics is destiny", and that may be the case with American politics if the implications for current trends are examined. Voters who support different parties or exhibit different political orientations (e.g., conservative, liberal, libertarian) have historically exhibited different demographic characteristics. Although there have been major shifts in political orientation by demographic groups (e.g., the shift of Southern white voters from Democrat to Republican after civil rights legislation was passed), the demographic characteristics exhibited by voters that fall along party and philosophical lines have remained consistent over time. In fact, since 2000 these lines have become increasingly rigid as both major political parties (and the Republican Party in particular) have discouraged any dissension from the "party line". Thus, Republican Party supporters have become more rigidly entrenched as have Democratic Party supporters, although to a less extreme level.

Given the demographic profiles of those supporting different political parties and/or political orientations, it might be worthwhile to examine current demographic trends and their implications for the future electorate. Over the past 15 or 20 years a clear pattern has emerged with regard to voting activity. The Republican Party has become the party of old, white men for all practical purposes. This was the only group that broke heavily for Romney in the 2012 presidential election and Trump in the 2016 election. This support came primarily from working-class whites, those with *some* college education, and upper-income groups (although support here appeared to have eroded).

On the other hand, those supporting the Democratic party in recent years tended to exhibit much more diverse demographic traits. These supporters include women (particularly single women), younger voters, and the well-educated. However, the most significant trend is the increasingly one-sided support for Democrats on the part of racial and ethnic minority groups.

African-Americans were totally in for the Democratic candidate in 2012 and 2016 with near 100% support. Hispanics, the largest non-white racial or ethnic group, voted overwhelmingly for Obama as did Asian-Americans. Jewish voters, usually reliably Democrat in their orientation, continued to provide heavy support.

The segments of the population that now support the Republican Party are declining in number while the groups that are increasingly throwing their support behind the Democrats are increasing in number. Non-Hispanic whites are declining as a proportion of the population, now representing only 63% of the total. By 2050 it is projected that this group will constitute a numerical minority of the population. On the other hand, the African-American population continues to grow, maintaining its 12% share of the population. The Hispanic population is experiencing major growth, now surpassing 15% of the population. Asian-Americans, although small in numbers, are also growing at a relatively high rate. The high proportion of the electorate that was something other than non-Hispanic white in 2012 reflected these demographic trends.

In speculating about the implications of demographic trends for the future political process certain assumptions must be made. First, it is assumed that the native-born non-Hispanic white population will be stable and continue to decline as a proportion of the population. This is a relatively safe assumption; there is little that could happen that could change this. It is also assumed that virtually all racial and ethnic groups (other than non-Hispanic whites) will continue to increase in number and proportion for the foreseeable future. Admittedly, it is not likely that the current rate of immigration can continue indefinitely into the future. In fact, the U.S. has already experienced a reversal of immigration trends as a result of the recent economic downturn. All things being equal, however, a certain amount of immigration is inevitable, the only question being the volume. It is also assumed that non-white racial and ethnic minority groups will continue to reproduce at a higher rate than the non-Hispanic white population. Fertility rates are lower for non-Hispanic whites than any other racial/ethnic group, and even the existing rate is not likely to add to the population of that group as non-Hispanic white women of childbearing age continue to age out of their fertile years.

Assuming that the current projections hold, it could be argued that the constituency for the Republican Party will steadily decline. The proportion of the population that is white and/or male is expected to decrease with little hope of being replenished. The very wealthy, who have historically supported the more conservative party, while perhaps continuing to increase their wealth, have become a smaller and smaller proportion of the electorate. On the other hand, the typical voter of the future is likely to be black, Hispanic or Asian, young and with increasingly progressive perspectives. Females will continue to grow as a proportion of the population and even older females are less likely to support the Republican Party than their male counterparts. Even seniors appear to be deserting the Republican Party, based on current surveys, as a result of the attacks on Social Security and Medicare by Republican politicians and activists.

In conclusion, it could be argued that, even under the most conservative assumptions, the proportion of the electorate supporting the Republican Party will steadily decline, while the proportion of the electorate supporting the Democratic Party will steadily increase. Democrats are expected to benefit from growing numbers (and proportions) of the groups that are solidly in their camp, increasing voter registration and turnout of Democratic-supporting groups, and the more progressive outlook that is associated with the groups in U.S. society that are currently growing.

A number of other groups have emerged to form some semblance of voting blocs over the past few years. White college graduates have coalesced into a small but influential voting bloc in recent years. The college-educated as a proportion of the electorate is up from previous years. A similar pattern has been observed for unmarried, educated working women. In fact, all three components of this group have been growing—unmarried women, educated women and working women. The proportion of college-age women increased from 8% of the voters in 1970 to 28% in 2003. Both the white college graduates and the emerging bloc of unmarried, educated working women were strong supporters of Hillary Clinton in the 2016 presidential election.

“Millennials” represent an emerging generation that promises to be larger than the baby boom. The term is presented in quotation marks since some argue that the cohort does not really qualify as a distinct social segment. The number of voting age individuals among this group is expected to increase from 55 million in 2003 to 103 million in 2020. Although young Millennials tend to be among the least likely to participate in the political process, their numbers alone suggest substantial potential impact on future political contests.

In contrast to these growing segments of the electorate, there are a number of groups that are shrinking in importance as a proportion of the electorate. Although one couldn't tell it from the 2016 presidential election, the number of working class white voters is steadily diminishing. The number of white working-class voters is declining in every state, with the share of the vote attributed to working class whites shrinking by at least 17 percentage points in several states. A similar pattern is seen for "faith" voters, voters whose political leanings and voting behavior are influenced by their religious beliefs. There have been declines in membership for all of the major denominations. At the same time, there has been an increase in the proportion of religiously unaffiliated Americans.

The implications of these trends could be significant although speculating on the future impact of demographic changes is fraught with danger. As Exhibit 12.5 indicates, the increasing diversity of the population could spell the end of the Republican party. Yet, the 2016 presidential election results suggest that non-Hispanic whites still continue to dominate the electoral process. In this case, the voter turnout rate for different demographic groups was a critical factor along with the peculiarities of the electoral college. The 2016 election aside, the segments of the population that appear to be growing are more likely to lean Democrat in their political orientation. On the other hand, the segments that tend to be shrinking (especially older non-Hispanic whites) tend to lean Republican.

12.5 Sources of Data for Political Demography

The data available to political demographers is not as plentiful as it is for some other areas of demographic application. Data on the characteristics of the general population, of course, are readily available from the Census Bureau and other federal sources and from state data centers. The Census Bureau collects political data during election years via the Current Population Survey. Data are collected on registration and voting activity based on demographic attributes. Data on voting patterns is not as plentiful, and at the national level the primary source of such data is the Federal Election Commission (FEC). However, FEC data is limited in its usefulness for many purposes in that it focuses on campaign expenditures, political donations and regulatory issues rather than election results.

For other levels of government, state election commissions may be a source of data, but the available information and level of access varies from state to state. Local election commissions typically have some responsibility for providing election results and for maintaining information on registered voters. Typically, the type of information available at the local level would be name, address, age, race, voting history, political party's primary voted in, and, in state's that require it, the political party of record.

A variety of organizations—public and private—collect data on political affiliation and activity. News organizations typically conduct opinion polls, monitor voter sentiment and often conduct exit interviews at the time of elections to provide immediate feedback on voting patterns. Research institutes associated with universities may compile political data from various sources and often conduct primary research. The Pew Research Center monitors political orientation and voters' perspectives on various topics. A variety of political action groups and advocacy organizations also compile political data and sometimes conduct primary research.

Case Study 12.2: Conducting a Political Poll

The social science research center at a local university wanted to conduct a poll of candidate preferences among the local population leading up to the 2016 presidential election. The intent was to determine local sentiment with regard to the two candidates three months prior to election day. The center had not conducted opinion polls before so was required to start from scratch in developing a polling capability.

The process began by collecting voting information on the local population. Data were acquired from the local election commission that provided insights into the nature of the electorate. Information was available on registration and voting history, allowing the analysts to develop a picture of politically active citizens. Additional information was extracted on the age, sex and race of registered voters. Finally, information on past voting history was compiled, including frequency of voting and the party primary most recently voted in. Party registration was not required so information on formal political party affiliation was not available.

While it would be more effective to directly contact those to be interviewed, telephone numbers were not available for registered voters so it was determined that mail-out survey would be employed. This is admittedly not the most efficient or most effective way to collect data of this type but given the circumstances a mail-out survey was considered the best option.

With a mail-out survey instrument particular care must be taken when developing the survey items since no one will be available to clarify any questions included in the survey. Survey items that have been validated and utilized in previous surveys were used when available. As with any survey instrument care was taken to limit the number and complexity of items to the extent possible.

Survey items were developed that elicited information on political party affiliation, political orientation, likelihood of voting, and the preferred candidate. Five questions were also included related to the respondent's stance on various issues. Standard questions were included to collect basic demographic data. The instrument was pre-tested among center staff and students and then field pre-tested with a focus group of community residents. Necessary changes were made in the wording of the survey form, the instrument finalized, and survey forms printed.

The final step preparatory to survey administration was the identification of households to which the survey would be mailed. It had been determined based on past experience with such surveys that 1500 surveys should be mailed out with the expectation that 500 surveys would be returned. The sample was drawn from the compiled list of registered voters and stratified to reflect the demographic makeup of the electorate. It was felt that given the size and characteristics of the electorate a response of this size would yield statistically valid results. In order to encourage completion of the survey a dollar bill was included along with a stamped, self-addressed envelope.

The surveys were mailed out and the researchers determined that one month would be the timeframe in which responses would be accepted. Within a month of the mail-out 435 completed surveys had been returned and these provided the basis for data analysis. As anticipated the characteristics of those responding to the survey were somewhat different from the sample that had been carefully designed. Women and senior citizens were over-represented among the respondents, and the data had to be statistically adjusted to assure appropriate representation of various demographic groups.

Once the data were weighted to account for anomalies in the characteristics of respondents the center was able to process the data and analyze the results. The analysis determined that the respondents were more or less evenly split with regard to candidate preference. This split occurred essentially along party lines. There were differences in perspectives on the five issues presented and these too reflected party leaning. Based on the size of the sample, a margin of error of + or − 5% was indicated. The center was able to disseminate the findings from the study with a fairly high level of confidence that the findings were accurate.

12.6 Demography and Public Policy

The interface between demography and public policy is exhibited in myriad ways. In fact, it is difficult to separate population policies and policies related to other areas of society due the impact they have upon each other. The enactment of policies in the healthcare, education, criminal justice and economic arenas, among others, will inevitably have implications for the demographic processes of the society, affecting fertility levels (e.g., through abortion policies), morbidity patterns (e.g., through health insurance coverage), and mortality (e.g., through research funding priorities). Some policies may have a direct impact on demographic processes, as in the case of now-abolished policies prohibiting the immigration of people infected by AIDS; or they may be more indirect, as in the case of the impact of efforts to allow illegal immigrants in the U.S. access to educational opportunities.

Before focusing on the factors that are influencing population policy, it would be helpful to define the concepts that are being used. A "policy" is may be thought of as a high-level overall plan embracing the general goals and acceptable procedures especially of a governmental body.

A useful definition of public policy has been provided by Longest (2010):

> Public policies are authoritative decisions that are made in the legislative, executive or judicial branches of government. These decisions are intended to direct or influence the actions, behaviors or decisions of others.

This definition, however, is fairly broad and it is helpful to consider the various types of policies that could be enacted. These include:

- **Macro policies**—overarching policies affecting many areas of public policy (usually on part of federal government)
- **Public policies**—policy approaches focusing on a particular issue (usually on the part of government)
- **Organizational policies**—policies affecting behavior within an organization
- **Professional policies**—policies guiding professional behavior

In the U.S., macro-level policies related to any issue are essentially non-existent, and anything that comes close to a population policy is more often than not a derivative of a policy promulgated in healthcare or some other societal arena. Most broad "policies" that are introduced by various levels of government should be considered in the "public policy" category. There are organizational-level and professional-level policies promulgated throughout U.S. society, but these policies more often than not represent a "trickle down" effect from broader public policies.

As an example, the 2012 executive ruling by the Obama administration that health insurance plans must include coverage for contraceptives represents a national "policy" in support of reproductive management. However, the primary impact will not be at the national level but is reflected in the implications this policy has for the organizational and professional policies of organizations that provide health services. Thus, health insurance companies were required to cover the cost of contraceptive services as part of their insurance plans. Further, companies that offer health insurance to their employees were required to include such coverage as a benefit. In both cases, it should be noted, provisions were made for those parties whose religious beliefs prohibit the use of birth control.

Obviously, the U.S. is faced with a number of issues in a variety of arenas. However, only some of these issues rise to the level where they become matters of public policy. Most problems start out as "private" problems, affecting only the individuals involved. However, there are situations when a problem becomes widespread and begins to have societal implications. Thus, the decision on how many children to have is a personal decision made by individuals and couples and, as such, should not have implications for public policy. However, if these individual decisions result in consequences for society, they may rise to the level of public interest. If, for example, members of a population are having too few babies to replace the population, this becomes a matter of public concern (as it has in many European countries today). On the other hand, if members of the population are having too many babies resulting in an unmanageable population explosion, this too becomes a matter of public concern (as in the case of China and India).

The emergence of society-wide problems that require the enactment of public policies are more often than not driven by demographic trends.

Similar situations can be found with regard to health policies. Referring back to the acquisition of health insurance by individuals in the U.S., this has historically been a personal matter mediated in some cases through the role of employers or government-sponsored health plans. Since the 1980s, however, individuals have faced increasing barriers to the acquisition of health insurance at a time when healthcare costs are skyrocketing. By the end of the twentieth century, tens of millions of Americans were not covered by health insurance. Non-coverage has subsequently been found to be a major contributor to the soaring bankruptcy rate in the U.S. as a result of overwhelming medical bills. Further, tens of thousands of Americans were dying unnecessarily every year simply because they did not have a means to pay for their healthcare. Thus, what was once considered a personal issue had risen to the point of a public policy issue and led to the incorporation of numerous provisions in the Patient Protection and Affordable Care Act of 2010. In the case of both population and healthcare issues, a problem moves from the private sphere to the public when it entails a substantial social or individual difficulty that cannot easily be addressed by the affected parties and cannot be ignored by society.

There are a variety of reasons why effective policy setting does not occur at the national level in the United States. It has already been noted that there is no formal mechanism in place for setting national goals and priorities. In addition, the federalist arrangement under which the U.S. political system operates mitigates against a strong influence on the part of the central government. In fact, about the only option available to the federal government in terms of influencing policy is through the control of federal expenditures. In addition, strong vested interests make it difficult to establish consensus on the acceptable degree of government involvement in various sectors (e.g., education, healthcare), much less on the nature of that involvement.

Population policies, where they exist, tend to be more straightforward and direct with regard to the activities that are to be regulated. These policies typically relate to demographic processes such as fertility and mortality (and their implications for population growth and change) and immigration. There are no U.S. agencies, however, charged with monitoring and/or controlling population growth, although the U.S. Department of Justice has overall responsibility for immigration policy.

12.7 Examples of Policy Applications

12.7.1 Immigration

The management of immigration is a federal responsibility (although in recent years some states have passed laws that attempted to take some immigration matters into state hands). Laws and regulations within the Department of Justice determine governmental actions with regard to immigration and emigration. Policy aspects of these statutes relate to immigration quotas for various countries, visa requirements, allowed activities by foreign visitors, and so forth. The U.S. immigration laws (and thus the underlying policies) have not been thoroughly revised since the 1980s. Comprehensive immigration reform remains a controversial issue within contemporary politics.

Immigration is an issue that is directly driven by demographics, and significant controversy surrounds the immigration issue. The backlash with regard to immigration (particularly illegal immigration) on the part of certain politicians has created an environment of uncertainty, and demands on the part of some for a wall between the U.S. and Mexico have served to increase the controversy. This is clearly an issue within the province of government policy makers and an updating of federal immigration policies is clearly required.

12.7.2 Fertility

The U.S. has not promulgated any formal policies with regard to fertility, and there is no federal agency charged with addressing issues related to reproduction. Any "policies" that exist that have implications for fertility have an indirect impact. One specific regulation is the allowance of deductions for "dependents" against personal income taxes. And cynics may argue that welfare payments, as meager as they may be, similarly encourage child bearing. In actuality, it could better be argued that existing policies discourage rather than encourage fertility. Thus, limited family leave options, poorly developed early childhood opportunities, and a general weak "safety net" for families could be considered deterrents to child bearing.

The level of fertility, of course, reflects the characteristics of the population at a point in time, and in the U.S. at least policy-makers have been reluctant to legislate fertility. However, there are growing concerns about the population's ability to reproduce itself, an already existing issue in many countries. Currently, the non-Hispanic white population is exhibiting the lowest fertility rates of any racial or ethnic group. Relatively high fertility rates for other racial and ethnic groups assures that the non-Hispanic white population will be decline proportionately. Trends in the fertility patterns of other racial and ethnic groups should be monitored to determine the extent to which the U.S. population can replace itself in the future.

12.7.3 Healthcare

Perhaps the most clear-cut example of federal influence on healthcare policy is the impact that the introduction of the Medicare and Medicaid programs has had on the nature of the healthcare delivery system. By controlling the financing mechanism, and virtually no other aspect of the process, the federal government has set "policy" with regard to the provision of care. By determining the healthcare procedures that would be covered under the Medicare program, for example, the federal government went a long way toward specifying the types of services that would be provided, since unreimbursed services were less likely to be offered by healthcare providers. Medicare regulations had the spillover effect of influencing the level of reimbursement offered by private health insurers.

Another example of federal efforts to influence the direction of the healthcare system has been the formulation of goals for health promotion developed by the U. S. Public Health Service within the Department of Health and Human Services during the 1980s. The HealthyPeople initiative identified goals for many different aspects of healthcare, from reducing the burden of diseases, improving access to care, and creating a more informed patient population. While there was no mechanism for enforcing the pursuit of the goals outlined in the HealthyPeople program, all federal agencies and any entity receiving funds from the DHHS had to indicate the ways in which they would pursue those goals. The most recent attempt at a major public policy initiative is embodied by the Patient Protection and Affordable Care Act (PPACA) of 2010. The implications of demographic trends for the Medicare program are discussed in Exhibit 12.6.

12.7.4 Education

In the U.S. education has generally been a function carried out at the local level, with policies set by individual school districts. Over time, however, state governments became increasingly involved in education, supporting state institutions of higher education as well as certain secondary school programs at the local level. In general, educational standards and graduation requirements are set at the state level and, recently, we have seen examples of state legislatures seeking to actually influence the content of courses taught in public schools.

The U.S. Department of Education has also played an increasingly important role in public education. Federal monies are transferred to the respective states (and then to the local school districts) for general support as well as for support of specific programs. In the first decade of the 21st century the No Child Left Behind initiative was established at the federal level and imposed upon the various states. This represented an attempt (although considered misguided by some) to promulgate a national policy related to academic standards. This policy at the federal level was in response to the growing concern over lagging academic achievement within U.S. public schools.

A number of demographically driven issues are affecting the situation with regard to education in the U.S. today. There is ample evidence that U.S. public schools have become resegregated over time. This *de facto* segregation reflects the on-going residential segregation that characterizes many communities along with the migration of more affluent students to private schools. Another demographically related factor driving the process is the increase in the proportion of school children who are members of racial or ethnic minorities. There are already more minority school children than majority students with the proportion of non-Hispanic white students expected to continue to decline. Both resurgent segregation and increasing minority participation in public schools require attention from policy setters within the political sphere.

12.7.5 Criminal Justice

Policing has historically been a local function in the U.S., and the founding fathers discouraged the establishment of a national police force. Indeed, except in unusual circumstances, the military cannot be deployed within the U.S. At the same time, the federal government has over time become much more involved at the state and local levels. Criminal justice “policies” have been promulgated primarily through the allocation of federal funds through the U.S. Department of Justice. There are a variety of programs that support police staffing, training and equipping. After the attacks on the World Trade Center on 9/11 the Department of Homeland Security was established, and this agency has aggressively funded equipment for local police agencies.

The “policies” in place with regard to criminal justice can be determined by the focus of enforcement activities. A prime example of this is the so-called “war on drugs” initiated under President Ronald Reagan in the 1980s. In response to a perceived increase in illegal drug use, the Drug Enforcement Agency was established to prosecute drug suppliers and drug users. Despite the mind-boggling amount of money and resources devoted to the war on drugs, most experts agree that the war has been lost. Indeed, this is probably a case study in the emergence of unintended consequences, in that rather than reducing the volume of illegal drug use in the U.S., these efforts have contributed to continued high use by making the drug “industry” so lucrative. It has further been argued that the war on drugs was a smokescreen for a “war on minorities” since it was believed, rightly or wrongly, that minorities were more likely to be drug users than whites and that this represented a way to counter the civil rights legislation of the 1960s and 1970s. In this regard, the policy has been effective in that our prisons are filled with African-Americans and Hispanics who have been convicted of minor drug crimes.

12.7.6 Housing and Community Development

Housing and community development are functions generally carried out at the local level and, for the most part, by private sector organizations. The U.S. Department of Housing and Urban Development does play a role in initiating federal programs to be administered at the local level and in the allocation of funds for specific needs (e.g., housing for the homeless or people living with AIDS). The federal government has also historically played a role in the development of public housing or subsidized housing. By providing funding to localities, HUD has supported the establishment of public housing projects and subsidized the cost of so-called "Section 8" housing for the indigent. The availability of affordable housing continues to be a national issue as does the rise in homelessness, and the resolution of this issue has been left primarily to local government which has to depend on private sector entities to address these issues. HUD has become increasingly involved in neighborhood redevelopment and provides funds to localities for this purpose, the "policy" here suggesting the importance of preserving existing communities rather than abandoning them.

12.7.7 Transportation

It could be argued that the predominant types of communities, and the distribution of the U.S. population today is a reflection of yesterday's policy decisions, however implicit, with regard to transportation. In the 19th century, long-distance travel in the U.S. was primarily by passenger train. However, in the 20th century air travel became possible but, more importantly, the automobile came to be within the reach of most families. Decisions were made, primarily at the federal level, with regard to allocation of funds for infrastructure development. These decisions directed federal funding away from railroads and toward airports and highways. This process was highlighted by the development of the interstate highways system initiated in the 1950s. This nationwide system of superhighways was justified on the basis of national security in that it allowed the rapid deployment of resources in the case of a military attack. These policies resulted in the U.S. becoming an automobile-centric society, to the detriment of other forms of transportation.

A major consequence of these policy decisions was the emergence of "urban sprawl" as it was now possible to locate residences at some distance from the urban core. By the 1990s, the U.S. had become a suburban society with more people living in suburbs than urban cores, small towns or rural areas. While the U.S. population continued its prolonged rural-to-urban migration, the bulk of these migrants eventually ended up in suburbs, thanks to transportation policies put in place a half-century earlier.

12.7.8 Economic Development

The economy is the most important sector of U.S. society, and an inordinate amount of energy and resources at the federal level are devoted to monitoring economic trends, encouraging economic development, and regulating interstate commerce. Federal policies have long encouraged private sector development, and the amount of "corporate welfare" that exists continues to be a controversial topic. The U.S. Department of Commerce uses monetary policy to attempt to steer the economy in the right direction, encouraging growth and discouraging inflationary practices. Numerous agencies like the Small Business Administration have been established to support business development, and job training and workforce development are activities supported by the federal government through grants to states and localities.

Of historical significance is the "war on poverty" initiated in the 1960s when it was realized that a shocking proportion of Americans lived in poverty situations that were generally invisible to the rest of an increasingly affluent society. Policies were promulgated related to poverty amelioration including an expanded welfare program and the introduction of "food stamps" to provide an adequate diet for those living below the poverty level. The Medicaid program was introduced to help address the healthcare issues of impoverished Americans. These policies, accompanied by economic growth, served to moderate the level of poverty in the U.S. for two or three decades. However, in the 1980s the U.S. experienced an upward trend in the number of Americans living in poverty, and this peaked at historic levels during the economic downtown beginning in 2008. Current policies, it could be argued, are not adequate to address the growing number of impoverished Americans and, indeed, it is suggested that the current generation of young Americans will be worse off economically than previous generations.

12.8 Direct and Indirect Policies

Policies can be divided into direct and indirect components as well. Direct policies refer to those legislative efforts designed purposefully to affect, for example, the delivery and quality of health care. Examples would include the funding and research agenda for the National Institutes of Health and the Centers for Disease Control and Prevention. Indirect policies related to healthcare, say, are those whose basic intent is to affect an outcome within a certain sphere, although in the process the *provision* of healthcare is affected. For example, federal tax reform regulations related to health insurance coverage ostensibly address revenue collection. However, by affecting tax-related issues for employers and individuals these regulations affect patterns of health insurance coverage and ultimately patterns of care. Numerous provisions in the Affordable Care Act have both direct and indirect dimensions. Requirements meant to assure that not-for-profit hospitals are providing adequate community benefits affect not only the not-for-profit hospitals themselves but the communities in which these hospitals operate.

The interaction between policy and demographics can be illustrated through a number of examples. As the U.S. population continues to age (demographic determinant), the prevalence of chronic conditions and incidence of deaths due to heart disease and cancer increase. Policies are in place to ameliorate the conditions and reduce deaths attributable to these causes (health consequence). To the extent that the policies are effective, an increase in life expectancy and a further aging of the population (demographic consequences) are likely to come about. Moreover, policy changes would be required to address the conditions of the new population composition. Programs that focus on lowering the number of unwanted pregnancies (healthcare determinant) can help bring about a reduction in the birth rate and a decline in the total number of births (demographic consequence). The 2012 regulation promulgated by the Obama administration mandating that insurance companies provide contraception coverage as part of their plans is an example of the potential indirect effects of legislation. Again, the consequences of the policy are likely to lead to a refocusing of policy.

12.9 Factors Influencing Policy

12.9.1 Demographic Trends

As noted throughout this book, the United States is currently undergoing unprecedented demographic changes, and these changes have numerous implications for public policy. Demographic change also has implications for population policy which in turn have implications for the needs of the population. Population growth has slowed, and without continued immigration, the population of the nation will decline. At the same time, the population is aging, generating more deaths and producing an age structure that will soon be dominated by those over age 40. The fact that the older age cohorts, particularly the oldest old, are among the fastest growing groups in the U.S. has significant implications for the life circumstances of the population and, by extension, its service needs. Even as the first baby boomers enter retirement, the burden of chronic disease is increasing and placing growing pressure on the Medicare program. (See Exhibit 12.6 for a discussion of the implications of an aging population for Medicare.)

Demographic trends that might engender public policies include the changing age structure of the U.S. population, its increasing racial and ethnic diversity, changing marital status and household characteristics, and evolving healthcare challenges.

The growth rates of racial and ethnic minorities in the United States, particularly those for blacks and Hispanics, far exceed that of the white population. The increasing contribution of immigrants and racial/ethnic minorities to population growth implies that the United States is again becoming a land of diverse cultures and languages. Health behaviors in these populations are different as well. As discussed in Chap. 8, this compositional shift is generating a different demand structure for health services. As noted previously, by the first third decade of the twenty-first century, fully one-third of the population of the United States is expected to be part of a racial or ethnic minority group.

Along with marked changes in the racial/ethnic composition of this country, there have been major shifts in the income structure. The income discrepancy between what can be labeled the "haves" and "have nots" is widening with an increasing proportion of national wealth concentrated at the very top while incomes for the middle and working classes stagnate. Since 1970, the number of persons at or below poverty level has increased substantially, and the economic downtown beginning in 2008 has resulted in record modern poverty levels. There are significant demographic differences between impoverished individuals and the more affluent.

This is particularly true with regard to health status, with the poverty-level population suffering from a higher level of health problems than the non-poverty population. This situation is exacerbated by the lack of health insurance among the poor. The health of children has been somewhat addressed through federal policies encouraging the establishment of children's healthcare programs. Nevertheless, much of the low-income population suffers from a lack of health insurance for other members of the household, exacerbating the challenges they face in obtaining necessary care.

The regional redistribution of the population also has implications for policy setting. Although rates of internal migration have fallen in recent years, the American population remains relatively mobile, with one in six persons moving each year. This mobility rate has an impact on the distribution of population which, in turn, affects the distribution of resources. Each of these flows can have important implications for policy setting. In-migrant, out-migrant, and net migration data with respect to rural to urban, city to suburb, and region-to-region flows are seen as major contributors to changing service needs in areas that are either net exporters or net importers of people.

For example, a migration stream from the Midwest to central Florida may bring not only a large population with demographic characteristics different from the receiving area (e.g., older or younger), but one with a different set of tastes and preferences. It is often the case that receiving communities do not have the resources required to meet the needs of a growing population, while communities of origination are faced with a "surplus" of resources. This may be the case with rural hospitals, for example, that are faced with a declining patient base but are placed under a lot of pressure to remain open.

Exhibit 12.6: Demographic Implications for the Future of Medicare

The aging of the baby boom generation in the United States is placing strains on the financial sustainability of the Medicare program, the government-funded program that ensures care for those 65 and older. Between 2010 and 2020 the number of Americans over 65 will increase by 14.5 million. Although the senior population is healthier than previous generation, the senior years tend to be characterized by expensive-to-manage chronic disease and the inordinate medical expense involved in treatment during the last months of life. Medicare funding cannot match cost growth as the number of Medicare beneficiaries is increasing much more rapidly than the number of workers. Today, there are 3.9 workers for every beneficiary; by 2030, there will only be about 2.4 workers for every beneficiary. There are concerns that, unless the system is drastically changed, in less than ten years the funds supporting the Medicare program will no longer support the demand for services.

Although obtaining health services, even for seniors, can be considered a personal concern, the establishment of the Medicare program in 1965 moved healthcare for seniors into the policy arena. For decades, however, the program has operated smoothly and stayed under the public policy radar. Today, the growing pressure being placed on Medicare has made the program's viability an increasingly public issue, and policy makers are struggling with the prospect of the program's inability to sustain itself into the future.

Medicare's core program (Part A Hospital Insurance) is funded by the hundreds of millions of employees who will subsequently receive benefits during retirement. When they turn 65, eligible citizens are automatically enrolled in Part A, which pays for inpatient services, continued treatment or rehabilitation in a skilled-nursing facility, and hospice care for the terminally ill. The money paid by employees to the Hospital Insurance Trust Fund is not directly saved for their own personal future health expenses but covers the medical bills of the people who are currently enrolled in Medicare.

Medicare's costs are projected to rise initially because the number of people receiving benefits increases rapidly as the large baby boom generation retires. However, once society has absorbed the retirements of the baby boom generation, Medicare's costs are projected to continue to rise. This growth is fueled by expected increases in the utilization and cost of healthcare, and the more recent addition of Medicare Part D which covers the use of prescription drugs. In particular, the continued development of new technology is expected to cause per capita healthcare expenditures to continue to grow faster than the economy as a whole. So, while long-term projections of Medicare's costs are subject to demographic and economic uncertainties, they are also subject to an additional layer of uncertainty caused by increases in general healthcare costs and additional benefits.

The ultimate question is: Are burgeoning Medicare costs the result of demographic trends or the function of some other development? While conservative politicians interested in limiting the role of the federal government point to the rapidly increasing senior population as the culprit, thus suggesting no hope for the future solvency of the program, demographic trends may, in fact, not be the explanation. Clearly, there are more seniors today and their numbers will continue to grow. However, today's seniors are relatively healthy and are not expected to consume more health services per capita than previous generations. In reality, the long-term costs of Medicare are primarily driven by the same factors that have caused skyrocketing healthcare costs: increases in the number and intensity of the services provided for health conditions and the increasing costs of these services.

As with many policy-related issues, the apparent explanation for the problem may not be the real explanation. Medicare policies that rely primarily on shifting more costs onto seniors, who are mostly lower-income, are misdirected and, in any case, not sustainable over the long term. Arguably, the source of the problem does not arise from demographics but from failings in the healthcare system that affect all segments of the population. Seniors are simply more visible because of the government-funded aspect of the Medicare program. The Medicare "problem" will be addressed, it is argued, only when the burgeoning costs of healthcare are addressed.

Sources: National Committee to Preserve Social Security and Medicare (2009), Nielson (2009).

12.10 Intended and Unintended Consequences

Regardless of the type of policy implemented or its origin, every policy has both intended and unintended consequences. Intended consequences are obviously those that the policy was meant to bring about. Unintended consequences are circumstances that arise from the implementation of a policy that were unanticipated or anticipated but emerged with different characteristics from those anticipated. Up until the last 20 years, the cancer research policies of the National Institutes of Health, for example, focused almost exclusively on finding a cure for cancer in its various forms. Virtually no resources were devoted to the prevention of cancer or an understanding of the social and cultural factors that contributed to cancer morbidity. As intended, progress was made in the treatment of known cases of cancer and many lives were ultimately saved or prolonged. At the same time, however, the number of cancer cases within the U.S. population continued to rise and cancer remained the second most common cause of death. Thus, an unintended consequence was the steady rise in the number of cases of cancer due to a lack of aggressive prevention.

An excellent example of the consequences of a policy—both intended and unintended—is embodied by China's one-child policy described in Case Study 12.3.

Case Study 12.3: Unintended Consequences of China's One-Child Policy

The Communist government established in China in the 1950s was faced with the problem of excessive fertility and resulting overpopulation. China's one-child policy was established by Chinese leader Deng Xiaoping in 1979 to limit communist China's population growth. Although intended as a temporary measure, it remained in place for over 30 years. The policy limited couples to one child, and couples that became pregnant with a subsequent child face fines, pressure to abort, and even forced sterilization. The rule was not universally applied, with citizens living in rural areas and minorities living in China not subject to the law. IUDs, sterilization, and abortion are China's most popular forms of birth control, although the government has begun providing more education and support for alternative birth control methods.

The one-child policy has been successful at reducing population growth in China, with its current population of 1.3 billion reflecting the preclusion of over 300 million births since the policy's enactment. However, the strict enforcement of this policy has had implications for both population characteristics and health status. The one-child policy has led to a preference for male infants, high levels of abortion, child neglect and abandonment, and even female infanticide. The result of such draconian family planning has resulted in the disparate ratio of 114 males for every 100 females among babies from birth through children four years of age. Normally, 105 males are naturally born for every 100 females. Today, there are an estimated 30 million "excess" males in China with as many as 50 million unattached males expected by 2030.

The fact that tens of millions of males do not have partners has led to an epidemic of prostitution in the country. This, in turn, has led to an upsurge in sexually transmitted infections and especially HIV/AIDS. There are predictions that China will have more AIDS cases in a few years than any other region of the world. In 2007, there were reports that in the southwestern Guangxi Autonomous Region of China, officials were forcing pregnant women without permission to give birth to have abortions and levying steep fines on families violating the law. As a result, riots broke out and some may have been killed, including population control officials.

Now that millions of sibling-less people in China are young adults in or nearing their child-bearing years, a special provision allows millions of couples to have two children legally. If a couple is composed of two people without siblings, then they may have two children of their own, thus preventing too dramatic of a population decrease. Because of the unintended, consequences (and also the relative success of the initiative in reducing population growth) the Chinese government has begun relaxing its restrictions on family size.

Exercise 12.1: Determining Political Orientation

The Pew Research Center, part of the Pew Charitable Trusts, conducts on-going research on political orientation. The data collected by the Center has been used to create a typology of political leanings. They Center continues to collect data by offering an on-line survey that allows individuals to determine where they stand within the typology.

For this exercise, students will access the Center's website (http://www.people-press.org/quiz/political-party-quiz/) in order to complete the survey and determine the category in which they fall with regard to political orientation.

Once students have completed the quiz and been informed of their category, the instructor can compile the results for the class. Note that some students may be reluctant to provide their results and their wishes should be honored in this regard.

Once the results have been compiled the students should be led in discussion of the results. The observed breakdown among the different political orientations will drive much of the discussion but some sample questions include:

- Is there a dominant category or categories of political orientation that characterize the class?
- How does the distribution of students among the various categories compare to the national breakdown and how can the differences be explained?
- What accounts for the differences observed between members of the class when it comes to political orientation?

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Chapter 13
Other Applications of Demographic Concepts, Techniques and Data

Abstract The final chapter summarizes activities in other contexts where applications of demographic principles and techniques are useful. Applications in such areas as education, criminal justice, disaster planning, and community development illustrate the breadth of usefulness of demographic methods and materials.

13.1 Educational Demography

Educational demography (or the demography of education) involves the application of demographic concepts, techniques and data to issues within the educational arena. The problems that might be addressed by demographers in this sphere include: planning for school construction; determining teacher requirements; determining English-language training requirements; estimating the demand for pre-school programs; and monitoring the racial mix for a school system, among others.

The educational level of a population has implications for other demographic attributes with education often interacting with other variables. A population's level of education is a determining factor in the types of occupations that are filled and, to a lesser degree, the relative importance of different industrial sectors. The educational level interacts with income, making each a relatively effective predictor of the other. On the other hand, there are additional factors that influence the level of education. Income not only interacts with education but one's family's income level is a predictor of the individual's level of education (an issue discussed later in this section).

The educational level also determines the type of job one is likely to hold. Education has an impact on various demographic processes; the fertility rate is a function of educational level in the U.S. and exhibits an association with mortality as well. The level of morbidity and the type of health problem (physical and mental) are also reflections of the educational level. Exhibit 13.1 illustrates the relationship between education and income.

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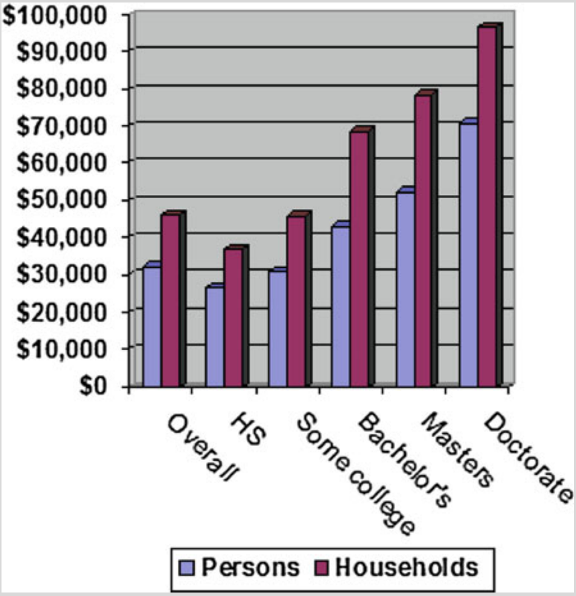
Exhibit 13.1: Educational Attainment and Income 2000



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Demographers are often called upon to generate estimates of the demand for educational services. They may be asked for figures on the number of children expected to enter kindergarten at some point in the future, or the number of expected to enter high school or college. A useful technique for generating such estimates is cohort analysis, a method that allows demographers to take advantage of existing information. For projections of this type, demographers have a built-in advantage in that the information they need is already available. A table that shows the number of people found in each age cohort provides the basis for projecting into the future as described earlier. If x number of one-year-olds are found in the population this year, there should be x number of six-year-olds in the population five years from now. This assumes, of course, that there no attrition due to death and that there was no impact of migration. This method can be used to project the demand for educational services several years into the future.

Other planning-type activities that demographers may be involved in include drawing school district boundaries, estimating teacher requirements and monitoring racial equality programs. The latter may include expert testimony related to school discrimination and funding activities. Case Study 13.1 describes the application of demographic techniques to school planning.

Another area in which demographers may be employed is in workforce development. With a constantly changing economic environment the educational requirements for the workforce will continue to evolve. Educational demographers (for example at the Bureau of Labor Statistics) may calculate the education requirements necessary for future workers in the light of anticipated industrial activity. There is already thought to be a mismatch between the educational status of the U.S. workforce and the requirements of the industries that are expanding. This situation has already reached dire levels in some European countries (Coomans, 2005).

Case Study 13.1: Enrollment Effects of Opening a New School: Build It and They Will Come!

A public school district hired a demographic consultant to investigate whether the recent growth in school enrollment was likely to continue into the future. Overall enrollments, especially in kindergarten, had increased unexpectedly. Officials of the Belmont-Redwood Shores School District, located about 20 miles south of San Francisco, California, needed a demographic analysis of recent trends and their causes in order to make assumptions about future enrollment patterns.

During the investigation, it was found that some of the enrollment increase was associated with the opening of a new K-3 elementary school in an area separated from the rest of the district by a busy freeway, U.S. Highway 101. This area, a set of recently-built housing developments called Redwood Shores, is located on the edge of San Francisco Bay. Until the new school opened (Sandpiper Elementary), there was no neighborhood public school, and children living in Redwood Shores had to cross the freeway to attend public schools in the western part of the district. Before Sandpiper opened some parents had chosen options other than enrolling their children in the district's schools on the other side of the freeway.

The first thing the consultant did was to obtain student address data in order to geocode the records and identify the location of the children living in Redwood Shores who had attended District schools. The District was able to supply only two years of student address data, but it was possible to identify how many children lived in Redwood Shores the year before the school opened and the year that it opened.

The consultants found that the number of the school district's kindergartners who lived in Redwood Shores and attended a district school *nearly doubled* after Sandpiper School opened in the fall of 1997 (from 44 students in fall 1996 to 84 the following year, see Fig. 13.1). Clearly, before the school opened, some parents did not enroll their kindergartners in the district's other public schools. Instead, they must have enrolled their children in private schools or public schools close to their workplaces outside the school district, and chose the new, neighborhood public school in Redwood Shores as soon as it opened.

The consultants also studied how enrollments in other grades changed after Sandpiper opened. They measured "grade progressions," which quantify changes in the size of a student cohort as the children move to the next higher grade and found that the number of Redwood Shores kindergartners already enrolled in district schools before Sandpiper opened grew by 22 as the cohort moved to first grade the year it opened (Fig. 13.2). Some increase usually occurs as parents transfer children from private day care and preschool to public schools for first grade, but the size of this increase was surprising.

Although opening Sandpiper evidently increased kindergarten and first grade enrollments, there was not much change in the number of Redwood Shores children who switched from other schools in the district to enroll in second and third grades at Sandpiper. We believe that parents may have been reluctant to switch young children who were already established in another school. They found that the older the child, the less likely the new school was to attract them.

Postscript: The number of BRSSD kindergartners living in Redwood Shores rose to 120 in 2007 and 149 in fall 2016, and a second elementary school (Redwood Shores) was opened in that part of the district. This resulted largely from housing growth after 1997, but it is believed that some of the increase is explained by more families purchasing homes in Redwood Shores because it now had neighborhood schools.

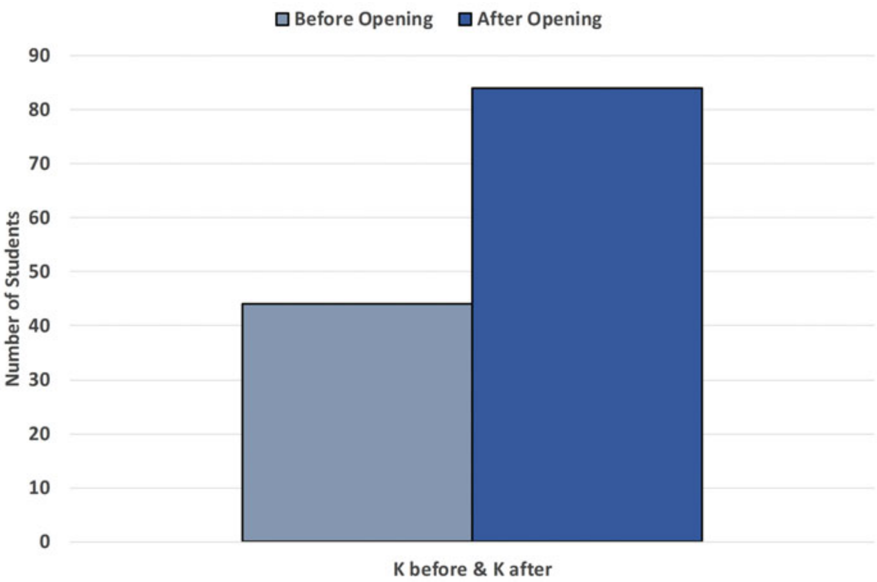


Fig. 13.1 Number of BRSSD kindergartners living in redwood shores before and after sandpiper school opened

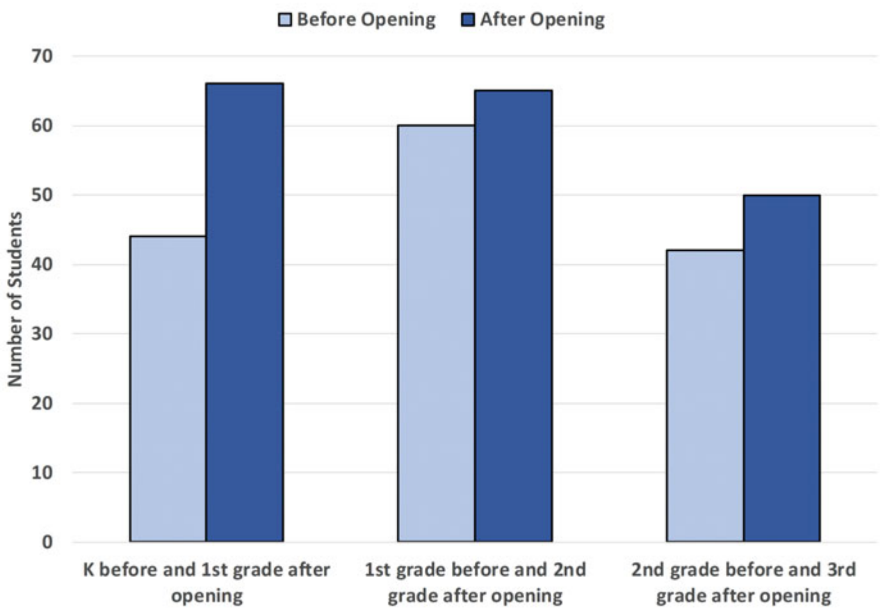


Fig. 13.2 Primary grade progressions before and after sandpiper school opened. *Source* Lapkoff and Gobalet (2017) Demographic Research, Inc., www.demographers.com

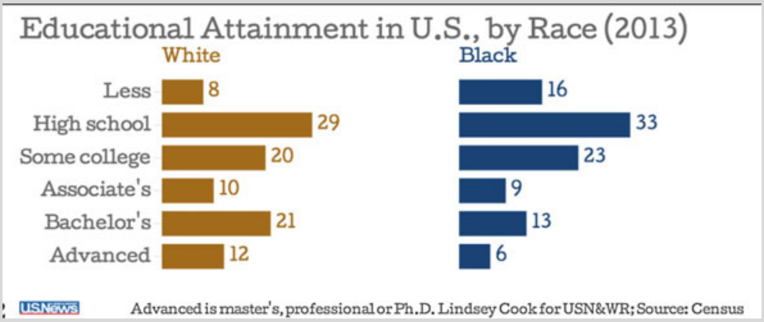
13.2 Educational Demography and Educational Policy

There are a variety of issues of interest to educational demographers that have implications for educational policy. The dangers of neglecting the demographic dimension in formulating educational policy can be clearly seen, as the effectiveness of the U.S. educational system is increasingly called into question.

An issue that is impossible to ignore is the continued bifurcation of educational attainment along racial and socioeconomic lines, with racial disparities in educational attainment being particularly stark. These disparities were highlighted in a recent study that quantified the differences in the educational experience for whites and blacks in the U.S. today (Cook, 2015a, b). Although in 2010, the U.S. spent much more per full-time student than comparable countries, this does not translate into better educational outcomes. Among problems facing the U.S. educational system is glaring differences between white students and students of color. Indeed, more than 60 years after Brown vs. Board of Education, school systems in the United States remain separate and unequal, and the trend is toward more disparities as the proportion of minority students continues to increase. Exhibit 13.2 illustrates differences in educational attainment by race.

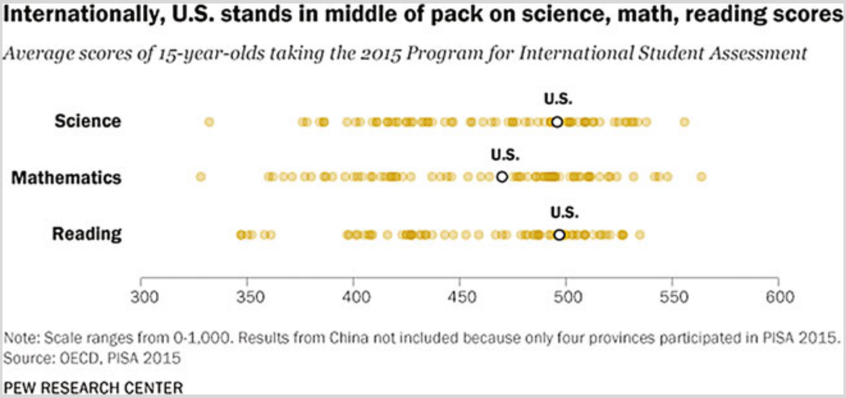
As the percentage of white students in our education system shrinks and the percentage of students of color grows, the U.S. will be left with an education system that does not serve the majority of its children properly. Lower wealth, lower health, lower parental education levels, more involvement with the justice system and other circumstances create a perfect storm that leaves blacks without the same educational opportunities as whites (Cook, 2015a, b). Black parents, most of whom are less educated than their white counterparts, do not expect their children to attain as much education as white parents expect. Lower expectations become self-fulfilling prophecies, contributing to less motivated students, less-positive attitudes toward school, fewer out-of-school learning opportunities and less parent-child communication about school.

Exhibit 13.2



At the same time that disparities in educational attainment are increasing, the level of education of Americans is slipping relative to citizens of comparable countries. Recently released data from international math and science assessments indicate that U.S. students continue to rank around the middle of the pack, and behind many other advanced industrial nations. On the major cross-national tests the U.S. ranked 38th out of 71 countries in math and 24th in science. Among the 35 members of the Organization for Economic Cooperation and Development the U.S. ranked 30th in math and 19th in science. In the most recent tests, from 2015, 10 countries (out of 48 total) had statistically higher average fourth-grade math scores than the U.S., while seven countries had higher average science scores. In the eighth-grade tests, seven out of 37 countries had statistically higher average math scores than the U.S., and seven recorded higher science scores. Exhibit 13.3 indicates how the U.S. stacks up against comparable countries.

Exhibit 13.3



As with other sectors of society, the U.S. does not have a clear national policy for education. Despite the efforts of the U.S. Department of Education and its various programs, little in the way of policy guidance for the U.S. educational system exists. In addition to the resistance shown in the U.S. to any type of centralized control, the fact is that the responsibility for education rests with the individual states and, ultimately, with local school systems. One attempt that was made during the Bush administration was the enactment of the "No Child Left Behind" initiative. No Child Left Behind was first introduced as House Resolution 1 during the 107th Congress in March of 2001. The Act aimed to ensure that all students, regardless of race or socioeconomic status, had an opportunity for a solid education (Chen, 2015).

There has been plenty of controversy surrounding No Child Left Behind. Teachers, schools, educational organizations and even entire states have come forth and declared No Child Left Behind to be "flawed" and "ineffective" for various reasons. As reform of the law moves forward, debates about how to make NCLB more effective continue within Congress and among different schools and districts.

The No Child Left Behind policy was given impetus by the seeming failure of many public schools to reach an adequate level of achievement for their students. Ultimately, the differences observed among schools were in effect demographic differences as minority-heavy schools and schools in poorer neighborhoods demonstrated lower achievement on the standard measures.

Exercise 13.1: Projecting the Demand for Educational Services
Demographers are often called upon to generate estimates of the demand for educational services. They may be asked for figures on the number of children expected to enter kindergarten at some point in the future, or the number expected to enter high school or college. A useful technique for generating such estimates is cohort analysis, a method that allows demographers to take advantage of existing information. Based on the table showing the youth population below, students should project the number of children who will enter the first grade (age 6) in five years, the number of teens who will enter high school (age 15) in eight years, and the number of students who will be eligible for college (age 18) in ten years.

Age	Number
1 year	1174
2 years	910
3 years	766
4 years	886
5 years	2515
6 years	2659
7 years	2300
8 years	1629
9 years	1581
10 years	1413
11 years	1557
12 years	1988
13 years	1605
14 years	1149
15 years	1671
16 years	1479
17 years	1359
18 years	1311

Provide the following figures:
Number entering the first grade in 5 years: ____
Number entering high school in 8 years: ____
Number eligible for college in 10 years: ____

13.3 Criminal Justice

Demographers have long been involved in studying the U.S. criminal justice system and applying demographic concepts, techniques and data to real-world problems. A number of areas of inquiry can be highlighted that reflect the relationship between demography and crime and criminal justice, along with the study of the operation of the system, the characteristics of criminals and victims, disparities in law enforcement and a variety of other issues. There is also interest in the relationship between various demographic attributes and criminal activity.

There are two different interfaces between demography and criminal justice that are particularly salient. One of these is the disparities that exist in the operation of the criminal justice system—disparities that exist primarily along demographic dimensions. African-Americans, Latinos and poor people are disproportionately represented on every indicator of criminality. All other things being equal, members of these groups record more encounters with the law, more arrests, more convictions and harsher sentences. Members of these groups are disproportionately represented among the prison population.

The second area where demography is particularly relevant is in the examination of the roots of crime in U.S. society. As with other factors, it could be argued that one's ZIP code of residence is the best predictor of involvement with the criminal justice system. The roots of America's mass-incarceration policies are tangled in history, politics, social conflict and inequality. These "roots" include poverty, unemployment, lack of education, and poor health (often including disability). This is not to mention chronic exposure to discrimination and the stress that entails. This type of environment is clearly not conducive to good relationships with the criminal justice system.

13.4 Contemporary Issues of Relevance to Demography

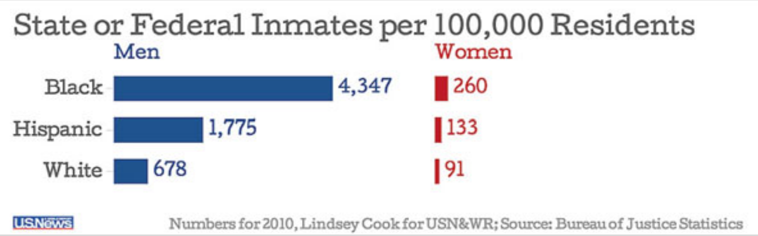
There are a number of issues currently facing the criminal justice system for which demography has significance. It is hard to deny that the U.S. criminal justice system is not effectively or efficiently achieving its stated goals. There is no measure on which the system can be considered effective at this point.

A major consideration is the "mass incarceration" among the U.S. population. The U.S. has by far the largest prison population among comparable countries. Some analysts call that sky-high incarceration rate this era's civil rights issue, and argue that the justice system warehouses inmates, damages families and hollows out communities. About two-thirds of African-American men with low levels of schooling will go to prison during their lifetimes, and most inmates are minority men under age 40. Case Study 13.2 describes some of the inequities that exist in the U.S. criminal justice system.

Case Study 13.2: Criminal Justice is Not Colorblind

The recent protests and controversy surrounding the Black Lives Matter movement show that the United States is in no way post-racial. While the debate continues over whether the criminal justice system is colorblind or not, the answer lies with the data. First, the U.S. is extremely accomplished at throwing its citizens in jail. With only 5% of the world's population, we house 25% of all prisoners, making the U.S. the world's biggest jailer. The prison population has increased by 700% since 1970, to the point that one in every 31 adults is under some sort of correctional management. The U.S.'s love of throwing people behind bars is also expensive—the annual cost per inmate is $21,006 for minimum security and $33,930 for high security.

The prison population is far from equally distributed. Black Americans are imprisoned at a much higher rate than white Americans, prompting critics to refer to our criminal justice system as "the new Jim Crow." While people of color represent a minority of the country's overall population, they represents a majority in U.S. prisons.



Many of the factors contributing to this inequality can be attributed to the system instead of to different behavior between blacks and whites. Nothing illustrates the difference between justice for the races than the "war on drugs," Whites and blacks use drugs at roughly the same rate, but black people are arrested for drug use at a much higher rate. At the disparities' peak in the late 1980s and early 1990s, blacks were five times more likely to be arrested for drugs than whites were. Recent figures reflect the same pattern: The national arrests rates for marijuana possession were 716 arrests per 100,000 black residents in 2010 compared to 192 arrests per 100,000 white residents.

The events in Ferguson, Missouri, raised our consciousness with regard to disparities in policing but that was not an anomaly. In Boston, blacks represent less than 1 in 4 residents but from 2007 to 2010 accounted for more than 3 of 5 field interrogations, observations, frisks and/or searches. The ACLU found that even after controlling for potential confounding factors such as neighborhood crime rates, past arrest records and alleged gang affiliation, racial differences persisted in encounters with the Boston police. New York's Stop-and-Frisk policy consistently led to police stopping more blacks and Latinos, even when the area's population was less than ¼ black and Latino. The difference between police killings for white and black teenagers is stark. Black teenage men are 21 times as likely to be the victim of a reported police killing as white teenage men.

The disparities do not stop after encounters with police. At every level of the justice system, data show that not everyone whose case goes in front of a jury is evaluated equally, not everyone who stands in front of a judge is sentenced equally, and not everyone's case is prosecuted equally.

The majority of people serving life sentences at the federal level are black, and almost half of those serving life sentences nationally are black. In some states, the percentage is even higher: In Maryland, 77% of inmates serving life sentences are black, in Georgia and Mississippi it's 72% The ACLU also found authorization to seek the death penalty was more likely when there was at least one white victim in the case. Overall, the sentences for black male offenders are almost 20% longer than sentences for white male offenders.

Black Americans have a different relationship with police and with the criminal justice system than white Americans do, which influences how blacks think about the system itself. Blacks believe less in the "perceived honesty and ethics" of police officers. Black Americans also have less confidence in the criminal justice system, less confidence in police, and are more likely to say the unequal rates of incarceration between blacks and whites are due to racism.

Racial differences between the citizens or defendants and those dispensing justice may also contribute to distrust and unequal punishments. In many U.S. counties, Ferguson included, police officers serving the citizens are mostly white, while residents of the county are mostly people of color.

Source Cook (2015a).

Exercise 13.2: Projecting Incarceration Rates

Demographics often drive crime rates—a growing number of young males in the population, for example, often leads to higher crime rates. This exercise describes what is known about future demographic trends and examines how planners can use this knowledge as an advance-warning tool to craft effective policies and prevention programs and reduce crime in the future. For this exercise, students are to project the rate of incarceration for 2025. The two factors to consider are the racial/ethnic mix of the population and its age structure, since these are the two factors that have the most influence on incarceration rates.

Race of inmates	Age of inmates
White—59%	<25 years—6%
Black—38%	25–34 years—28%
Native American—2%	35–44 years—34%
Asian—2%	45–54 years—13%
Hispanic—34%	55+ years—10%

Projected change by 2025:

Race of population	Age of population
White—−8%	<25 years—−6%
Black—+2%	25–34 years—-2%
Native American—+1%	35–44 years—+2%
Asian—+2%	45–54 years—+5%
Hispanic—+15%	55+ years—+10%

Given the current distribution of the incarcerated population, consider the following:

1. What are the likely implications of the changing racial and ethnic mix of the population for incarceration rates in 2025?
2. What are the likely implications of the changing age structure of the population for incarceration rates in 2025?

13.5 Urban Planning and Community Development

There is a long history of demographic input into urban planning and community development activities. Since the commencement of the planning "movement" in the 1960s, demographers and demographic data have served an important function in advancing planning activities. The input of demographers into private sector endeavors was highlighted in the chapter on business demography. Planners in the public sector use demographic information and analysis to assist with a number of planning decisions as indicated below (Measure Evaluation, 2017).

- Planners use population information to determine the demand for services among different segments of the population. Demand is determined by the composition of the population and how it is changing over time in terms of age-sex distribution, marital status, household types, occupation distribution, spatial distribution of the population, educational levels and income levels.

- Planners study the present and future composition of the population and its spatial distribution to identify the best locations to provide services to meet local needs.
- Planners examine population characteristics to determine the feasibility for new programs. Community residents may ask the government for a new school. Planners assess the age-sex distribution at present and in the future to determine whether or not it is feasible to construct a new facility.
- Planners are concerned about the impact of new plans on population change. A new plan to promote rural industries can lead to population growth as new families move into the community for job opportunities. Housing and educational plans may need to be revised to meet the needs of new households that may move into the area.
- Planners are concerned about the impact of population growth on the ability to implement existing plans. Planners are interested in how changes in size, spatial distribution and composition will affect efforts to implement various types of plans—housing, social services, and infrastructure such as roads, water supply and electricity.

Demographic analysis is needed in all stages of the planning process. Population analysis is needed to identify problems and community needs, establish goals and objectives, assess alternative courses of action, allocate resources for plan implementation, and evaluate the ability of the plan to achieve its goals and objectives.

An example of how demographic analysis can be used in the planning process is presented in Exhibit 13.5. In this example, a health planner is asked to design a plan for expanding primary healthcare within the district. The planner may use the following demographic analysis and information to develop the plan (Measure Evaluation, 2017).

Exhibit 13.5: Demographic Analysis in the Planning Process: Healthcare Example

Planning process	Demographic analysis
Identify problems and needs	• Study trends in mortality rates and causes of death among different segments of the population • Study trends in fertility to plan for maternal and child health care • Project total population size by age-sex structure since it provides insights on the different health needs among different age groups
Goals and objectives	Collect information to establish objectives on: • Population size • Population composition • Geographic distribution • Population projections

(continued)

(continued)

Generating alternative strategies	Collect information on the size, location and composition of the target population to develop alternative strategies to achieve stated goals and objectives
Select and implement a plan of action	Collect demographic data to determine: • Demand for services • Resource needs including the number of facilities, staff, medicine, and money • Locations for new facilities
Monitoring and evaluation	Use of demographic indicators to measure the achievement of the objectives. This could include • Infant mortality rates • Age specific fertility rates • Age specific death rates • Morbidity statistics

13.6 Focus Areas for Demographers Involved in Planning and Development

A major responsibility of demographers in planning and development activities is the production of population statistics. While population estimates and projections may be available from the Census Bureau, state data centers, commercial data vendors or other sources, the demographer has the responsibility for verifying these statistics. The smaller the geographic area under consideration, the more important this process is, and government agencies seldom generate data below the county level. While more granular data (e.g., ZIP code, census tract) may be available from commercial data vendors, it should be realized that these estimates and projections are generated using computer models for 3000 counties and 30,000 census tracts. That means that any peculiarities of a particular community are not likely to be taken into consideration.

For example, if the population of an area, even a county, is rapidly increasing or rapidly decreasing, most standard projection techniques are not likely to account for this development. Or, on the other hand, if it is a short-term although substantial gain or loss, the global projection model may overstate the changes into the future. In any case, the demographer must be able to verify any externally generated data and be prepared to adjust it as necessary.

In the absence of data from an external source for a project or in cases where a non-standard population or geographical area is involved, the demographer may be required to independently generate data. In that case, the techniques for generating estimates and projections discussed in Chap. 9 come into play. The importance of these population statistics cannot be overstated since they provide the foundation for virtually all other activities related to planning and development.

Demographers involved in these activities will typically require more than a population count for purposes of planning and development. Size matters, of course, but it is also necessary to determine the distribution of the population within the affected area and the characteristics of that population. Some attributes that are likely to be particularly important within a planning/development context are age distribution, household structure, length of residence, commuting patterns and home ownership along with other relevant variables. Unlike some analyses the relationship between people and the environment is of particular importance within a planning/development context.

A major function that requires demographic input is land use planning. Most municipalities have zoning ordinances in place to guide the development process. Rather than allowing development to occur in a haphazard fashion local governments typically generate land use plans as a basis for decisions related to future development. The formulation of these plans typically starts with an understanding of the size, location and characteristics of the affected population discussed above.

An important component of land use planning involves the consideration of housing options. Even in the absence of a formal land use plan, most communities must address the issue of adequate housing for their residents. Demographers involved in these activities are responsible for generating data on the available housing, its occupancy level, state of adequacy, affordability and so forth. Questions must be addressed related to the adequacy of the housing stock today but, more important, into the future. (Again, the population projections generated earlier come into play.) The need for public housing is an issue that is likely to arise, including the issue of homelessness and the extent this is a problem that needs to be addressed within the planning/development context.

Demographers involved in these activities may also provide input into transportation planning. As urban development has accelerated transportation planning has become an increasingly important issue, especially with the growth of urban sprawl. With urban congestion public transportation has resurfaced as an issue facing urban planners. Today's city centers are being choked with traffic and growing numbers of residents do not have adequate access to transportation. A record number of "millennials" do not have cars, and they are flocking to city centers and need transportation.

Today, the impact of transportation decisions has become recognized because of the variety of other aspects of urban life they impact. Transportation routes have become an increasingly important contributor to urban development and serve to drive economic activity. In addition, transportation decisions affect many other aspects of human life—the physical and social environments, access to services, even the health of the population. Even outside of urban areas the impact of development on transportation is being debated as witnessed by recent controversies over the impact of new "big box" stores on transportation patterns and, subsequently, on the quality of life for nearby residents.

Urban planning efforts are increasingly incorporating health planning into their initiatives on the assumption that the health of the population is inextricably intertwined with the physical environment. Planning for health facilities is increasingly carried out within the larger framework of community development and, conversely, most major planning decisions take health consequences into consideration. Health impact assessments (HIAs) have become a regular contributor to planning decisions as the health implications of decisions have come to be recognized. HIAs are a spin-off from the environmental impact assessments described in Exhibit 13.6. Case Study 13.3 describes the implementation of a health impact assessment.

Exhibit 13.6: Environmental Impact Assessment

Demographers involved in planning and development often provide input into environmental impact assessments. An Environmental Impact Statement (EIS) is a document prepared to describe the effects of proposed activities on the environment. "Environment," in this case, is defined as the natural and physical environment and the relationship of people with that environment. This means that the "environment" considered in an EIS includes land, water, air, structures, living organisms, environmental values at the site, and the social, cultural, and economic aspects. An "impact" is a change in consequence that results from an activity. Impacts can be positive or negative or both. An EIS describes impacts, as well as ways to "mitigate" impacts. To "mitigate" means to lessen or remove negative impacts. Ultimately, an environmental impact statement describes the impacts on the environment as a result of a proposed action. It also describes impacts of alternatives as well as plans to mitigate the impacts.

Federal laws and regulations require the federal government to evaluate the effects of its actions on the environment and to consider alternative courses of action. The National Environmental Policy Act of 1969 (NEPA) specifies when an environmental impact statement (EIS) must be prepared. NEPA regulations require, among other things, federal agencies to include discussion of a proposed action and the range of reasonable alternatives in an EIS. Sufficient information must be included in the EIS for reviewers to evaluate the relative merits of each alternative.

An EIS must take into consideration the impact of any development on human activity on the condition of the humans involved. The demographer can play a role here through examining the impact of a decision on an affected population. In the past decisions made, for example, related to the placement of a toxic dump without regard to its impact on nearly residents. The demographer can play a role in identifying the ways in which residents will be affected and are likely to be sensitive to factors that non-demographers would not take into consideration.

Case Study 13.3: Atlanta's Beltline

Atlanta is notorious for its traffic—sometimes called the worst in the southeast United States. Local officials envisioned creating a more pedestrian-friendly urban area and a light-rail system as part of the solution to the region's jammed roadways. Known as the Atlanta BeltLine, the intent of the project was to create a light-rail system and major redevelopment along a corridor of abandoned railways encircling the city's core. The officials involved also saw this as an opportunity to incorporate multi-use trails, parks and affordable housing. However, concern over the potential impact of the project on surrounding areas led to calls for the implementation of a health impact assessment (HIA). The HIA was a collaborative effort of the Center for Quality Growth and Regional Development (CQGRD), a research center of the Georgia Institute of Technology's College of Architecture, and staff at the Centers for Disease Control and Prevention.

To better understand how the project would affect Atlanta communities and to help protect the health of the 200,000 people living within the area, local planners evaluated the project via one of the United States' first HIAs. Led by Professor Catherine Ross at the Georgia Institute of Technology, the HIA provided information on how the BeltLine proposal might affect neighboring communities and, most important, provided practical recommendations for enhancements that would maximize the health benefits of the project.

Used as a reference by community members and decision makers, the HIA report determined that the project would have a largely favorable impact on community health, through improving the availability of green spaces and healthy food, creating opportunities for physical activity, reconnecting people and places previously separated by the rail corridor, and increasing transportation options. The HIA revealed how developers could strategically place parks, residential areas, schools, transit routes and grocery stores to increase residents' health and decrease potential health problems.

As a result of the HIA, construction of green space became a top priority and project and funding decisions took health into account. New partnerships between community groups, health experts and government agencies helped ensure that project plans continued to take into account health-related concerns. Acknowledging the HIA's overarching conclusion that the Beltline project would offer important health benefits for Atlanta residents, the U.S. Environmental Protection Agency (EPA) awarded a $1 million dollar grant to clean up abandoned industrial sites along the corridor, and speed the development process.

This HIA demonstrates that when decision makers at all levels understand the health implications of a project, more effective policies can be advanced that improve health and help project dollars go further.

Exercise 13.3: Planning for Urban Development
Your class of fledging applied demographers has just been given an assignment with the city's planning department. The planning staff is concerned about the impact of the city's changing population on its ability to implement the existing urban land use plan. You have been asked to write a population analysis report that studies the impact of past, present, and future demographic trends on planning activities. (Refer to Case Study 8.1 for some of the data you need for the analysis.)

a. What types of population information would you collect to assess the ability of the plan to meet its stated goals and objectives?
b. What types of statements and/or recommendations will the population information allow you to make about the comprehensive plan?
c. What types of analysis will you need to conduct to discuss the impact of population trends on the plan?

13.7 Emergency Preparedness

Demographers and demographic concepts, techniques and data are increasingly being used to address issues related to disaster preparedness. The term "disaster preparedness" is used here to cover not only preparedness but disaster response. In order to make effective preparedness plans, key methods in demography need to be systematically integrated into the discipline of disaster preparedness (Allen & Katz, 2010). The responsibility for disaster preparedness planning is shared by a myriad of state and federal entities. The breadth and depth of government entities involved in disaster preparedness is substantial and particularly in recent years, disaster preparedness has been recognized as fundamental and closely related to the nation's security.

Because effective preparedness plans require the understanding of population characteristics, demographic methods and data underlie preparedness planning (Allen & Katz, 2010). Responding to a public health emergency, such as the intentional release of a biological agent, will require a certain level of infrastructure (transportation, hospital beds) and medical countermeasures (vaccines and other pharmaceuticals). A rapid response requires that plans take into account the likely surge of individuals into hospitals and other medical care centers and the uncertainties regarding the magnitude and duration of such a surge. In order to effectively approximate the level of infrastructure required and the amount of medical countermeasures needed, disaster preparedness practitioners must have sufficient and reasonably accurate information about a given population. Demographic data and calculations, such as age of a population, sex ratio, SES, and geographical dispersion are essential for formulating empirically-based preparedness plans. More specifically, employing certain population projections and non-emergent morbidity rates in the creation of policy can help to ensure that there are sufficient drugs, devices, hospital beds, transport, and care providers for a given population in the case of a public health emergency.

Population-level data can be used to evaluate the costs and benefits of preparedness policies and the development of particular levels and types of countermeasures and infrastructure (Zohrabian et al. 2004). Many pharmaceutical countermeasures are not appropriate for all ages or all individuals. In order to ensure that appropriate logistical considerations are in place, disaster preparedness practitioners need to turn to demographers for information. Analyzing the age structure of a population, for example, should help to dictate the type and respective number of goods and services required in response to a disaster.

There also needs to be some consideration of the mobility of various groups within the population. Before, during and after a disaster, an appreciation of the ability of the total population and, more importantly, of vulnerable portions of the population to move themselves out of harm's way is necessary. This was an important lesson learned after Hurricane Katrina (although no doubt experienced in many other places as well). It became clear that certain segments of the population did not have the ability to escape the initial impact of the natural disaster nor the consequences that followed in its wake. The failure to recognize issues related to mobility were reflected in the tragedies that occurred long after the dissipation of Hurricane Katrina.

In order to protect a population from disease outbreaks, disaster preparedness planners must estimate the number of individuals that need to be inoculated to provide the population with protection from contagion. To do so without substantial demographic information is arduous. For example, some vaccines [such as Pertussis (whooping cough)] are administered to children but traditionally not re-administered to the general population later in life, even though protection from this particular vaccination is known to diminish over time. Preparedness experts need to carefully analyze population age distributions to determine how the sub-population has "aged out" of the protective level of a vaccine.

Pandemics often impact particular age groups more significantly than others, and different types of public health emergencies are likely to affect different populations and various segments within those populations to differing degrees. For example, the H1N1 virus of 1918 targeted the healthiest individuals, which typically was the working-age and military populations. Other flu strains—such as seasonal flu—disproportionately affect the very young and the very old. Other types of public health emergencies such as chemical or radiation emergencies are likely to impact individuals who are more susceptible to infection, such as the elderly, the very young, and those already in poor health (perhaps indicated by SES). An effective disaster preparedness plan must recognize which groups are likely to be most severely impacted so that the public health community can respond efficiently. Demographic data are required to understand how large these sub-populations are and where they are located. Furthermore, in public health emergencies where resources are scarce, demographic information may inform disaster preparedness "triage", and help practitioners to identify where and to whom resources should be focused.

Preparedness plans should also address the possibility of emergencies that last for extended periods of time. Calculations such as dependency ratios can be used to illuminate important social and economic consequences. For example, demographers can help to estimate the number of working professionals in the labor force and the number of dependent (young or old) family members. Information about the labor force can help planners better formulate preparedness policies to take into account the impact of forced social distancing, such as school closures.

This type of planning also involves consideration of the conditions related to surviving populations. This was an important lesson learned in the wake of Hurricane Katrina. While the death toll in the immediate aftermath of the disaster was noteworthy, the conditions of life for the survivors—both those remaining at "ground zero" and those who had been displaced—extended the effects of the disaster weeks, months and even years into the future. Over ten years later, there are victims of the disaster who still exhibit symptoms of post-traumatic stress disorder.

Demographic data can also be used to identify the populations most vulnerable to the effects of a disaster. Some populations are particularly susceptible to impacts of disaster and are disproportionately affected by public health emergencies. Demographic studies that identify differing SES status and minority communities as well as the location of these communities need to be employed by disaster preparedness planners to identify these vulnerable groups. Morbidity measures are another tool that can indicate where scarce health resources are already stretched by existing health priorities and where a public health emergency is likely to have a greater impact.

The U.S. Census Bureau is an important source of data for emergency preparedness and tools for analyzing the data (U.S. Census Bureau, 2017). "OnTheMap for Emergency Management" is a web-based resource that provides a live view of selected emergencies and weather events in the U.S., 24 hours a day, 7 days a week. It automatically incorporates real-time updates from federal sources so you can view the potential effects of hurricanes (and other disasters) on America's population and workforce. The Census Bureau and the National Oceanic and Atmospheric Administration have jointly developed this application for disseminating real-time data.

This tool uses local socio-economic and demographic statistics from the American Community Survey and other Census Bureau data sources to provide a detailed look at affected areas. It gives you information on the number of people potentially affected by a storm, as well as some of their characteristics down to the neighborhood level–for example, the percentage of residents age 65 or older or local employment patterns. The Census Bureau provides vital economic and demographic data to federal and local emergency management agencies, which can use this information to better assess the impact hurricanes have on coastal populations. For example, following Super Storm Sandy, New Jersey officials used this application to estimate the volume of traffic in affected areas.

In addition, Census Bureau data from the economic census, County Business Patterns, , Survey of Business Owners and Non-employer Statistics to supplement OnTheMap for Emergency Management.

There are limitations to the contribution demographers and demographic data can make to disaster preparedness and response. First, data about populations are rarely available in real-time. Therefore, using demographic data in disaster preparedness requires serious considerations about the accuracy and reliability of estimates; policy makers need to be aware of the sensitivity of preparedness plans to changes in figures and rates. In addition, more localized geographical data may be needed in preparedness than are gathered by traditional demographic surveys or instruments. Demographers can help preparedness experts develop appropriate surveys about populations that may potentially confront emergency situations. The disaster preparedness community must exercise informed discretion in data use and acknowledge that perfect information about a population does not exist.

Case Study 13.4: Assessing the Impact of a Disaster

In the aftermath of the destruction caused by Hurricane Katrina in the New Orleans area, a demographer was engaged to assist an insurance company in determining the extent to which it was liable for damages incurred by a New Orleans-area hospital. The hurricane and subsequent flooding had caused extensive damage throughout the area, and many of the city's health facilities had been evacuated and remained closed.

The hospital that was the subject of the analysis was some distance from "ground zero" and had sustained little physical damage. Its physician office building had suffered some superficial damage but had only been closed for a couple of days. Other than some minor damage to a parking lot, there was little else that could be attributed to the hurricane and its aftermath. The hospital never closed and, in fact, was operating at capacity due to the lack of other facilities in the area.

Despite operating at capacity, the hospital had experienced a significant drop in revenue in the months following the hurricane. In the wake of the storm the payer mix among the hospital's patient changed dramatically. While prior to the storm, the hospital's clientele was mostly well-insured suburban residents, and, although the hospital was not operating at capacity, it was generating a healthy cash flow from paying patients. After the hurricane, its patient mix changed fairly dramatically. Patients who had previously patronized inner-city hospitals using Medicaid insurance or paying out of pocket were now forced to use this suburban hospital. Despite the increase in volume the hospital's revenue declined.

The hospital presented a "bill" to the insurance company indicating that its "damage" as a result of the natural disaster was in the range of $12–20 million dollars. This is the amount they claimed to have lost as a result of the storm. However, the insurance policy clearly stated that its liability extended only to losses incurred as a result of *physical* damage to the facility. It specifically excluded losses incurred as a result of changes in the demographics of the patient population or any other change reflecting population shifts.

The demographer engaged by the insurance company was charged with determining the extent to which the losses incurred were a result of physical damage as opposed to damage due to changes in the makeup of the patient population. This was not a difficult call for the demographic consultant. There was no damage to the property that resulted in any change in terms of utilization of the facility. On the other hand, the patient mix had changed dramatically as a result of people being displaced by the storm and the closure of several medical facilities. The most obvious finding from a review of patient data was the shift in source of payment from private insurance to Medicaid and self-pay (i.e., essentially no-pay). Further, when patient origin was examined it was found that patients were originating from areas much further away from the facility than pre-hurricane and that the racial and ethnic mix was now much different, with a much higher proportion of African-Americans and Hispanics among the patients.

Based on the information available the demographer concluded that virtually none of the losses incurred by the facility were related to physical damage. In fact, essentially 100% of the revenue decline was due to the shift in the demographics of the patients utilizing the facility. The findings from this analysis provided the information required by the insurance company to negotiate a settlement with the hospital based on factual data.

Exercise 13.5: Disaster Preparedness Planning

You have been assigned to the task force responsible for preparing response plans should a disaster occur. There are some general measures to be taken for any disaster, but specific types of disasters are likely to require different types of responses. For the type of disaster specified below, answer each of the questions posed to the task force.

Group 1: Disaster type: Flood

Will all or part of the geographic area be directly affected? Explain your answer.

Will all or part of the area population be directly affected? Explain your answer.

Will all types of housing be affected or will some be affected more than others? Explain your answer.

What, if any, demographic categories will be affected more than others and why?

What are the characteristics of the population(s) most vulnerable to the impact of this type of disaster?

What groups are going to be least able to recover from the effects of the disaster?

What type of health consequences can be expected from this type of disaster?

Which groups will suffer the greatest health consequences from this type of disaster?

What policies should be put into place to protect the total population from such a disaster? The most vulnerable population(s)?

You have been assigned to the task force responsible for preparing response plans should a disaster occur. There are some general measures to be taken for any disaster but specific types of disasters are likely to require different types of responses. For the type of disaster specified below, answer each of the questions posed to the task force.

Group 2: Disaster type: H1N1 Outbreak

Will all or part of the geographic area be directly affected? Explain your answer.

Will all or part of the area population be directly affected? Explain your answer.

Will all types of housing be affected or will some be affected more than others? Explain your answer.

What, if any, demographic categories will be affected more than others and why?

What are the characteristics of the population(s) most vulnerable to the impact of this type of disaster?

What groups are going to be least able to recover from the effects of the disaster?

What type of health consequences can be expected from this type of disaster?

Which groups will suffer the greatest health consequences from this type of disaster?

What policies should be put into place to protect the total population from such a disaster? The most vulnerable population(s)?

You have been assigned to the task force responsible for preparing response plans should a disaster occur. There are some general measures to be taken for any disaster but specific types of disasters are likely to require different types of responses. For the type of disaster specified below, answer each of the questions posed to the task force.

Group 3: Disaster type: Earthquake

Will all or part of the geographic area be directly affected? Explain your answer.

Will all or part of the area population be directly affected? Explain your answer.

Will all types of housing be affected or will some be affected more than others? Explain your answer.

What, if any, demographic categories will be affected more than others and why?

What are the characteristics of the population(s) most vulnerable to the impact of this type of disaster?

What groups are going to be least able to recover from the effects of the disaster?

What type of health consequences can be expected from this type of disaster?

Which groups will suffer the greatest health consequences from this type of disaster?

What policies should be put into place to protect the total population from such a disaster? The most vulnerable population(s)?

You have been assigned to the task force responsible for preparing response plans should a disaster occur. There are some general measures to be taken for any disaster but specific types of disasters are likely to require different types of responses. For the type of disaster specified below, answer each of the questions posed to the task force.

Group 4: Disaster type: Chemical Plant Explosion

Will all or part of the geographic area be directly affected? Explain your answer.

Will all or part of the area population be directly affected? Explain your answer.

Will all types of housing be affected or will some be affected more than others? Explain your answer.

What, if any, demographic categories will be affected more than others and why?

What are the characteristics of the population(s) most vulnerable to the impact of this type of disaster?

What groups are going to be least able to recover from the effects of the disaster?

What type of health consequences can be expected from this type of disaster?

Which groups will suffer the greatest health consequences from this type of disaster?

What policies should be put into place to protect the total population from such a disaster? The most vulnerable population(s)?

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Glossary

Acute disease A health condition characterized by rapid onset, short duration and definite disposition (cure or death).

Administrative record A registration system for the transactions involving members or enrollees of a registry.

Area of dominant influence (ADI) The geographic territory covered by a particular form of media.

Age-dependency ratio The ratio of persons in the ages defined as dependent (under 15 years and over 64 years) to persons in the ages defined as economically productive (15–64 years) in a population.

Age-sex structure The composition of a population as determined by the number or proportion of males and females in each age category.

Age-specific rate Rate associated with a specific age group (e.g., age-specific fertility rate, death rate).

Aging of population A process in which the proportions of adults and elderly increase in a population, while the proportions of children and adolescents decrease.

Baby Boom A dramatic increase in fertility rates and in the absolute number of births in the United States, generally those born between 1946 and 1964.

Baby Bust A rapid decline in U.S. fertility rates to record-low levels during the period immediately after the baby boom.

Balancing equation A basic demographic formula used to estimate total population change between two points in time—or to estimate any unknown component of population change, provided that the other components are known.

Biosocial variables Demographic attributes reflecting biological traits that have a significant social dimension (e.g., age, sex and race).

Carrying capacity The maximum sustainable size of a resident population in a given ecosystem.

R. K. Thomas, *Concepts, Methods and Practical Applications in Applied Demography*, https://doi.org/10.1007/978-3-319-65439-3

Case fatality rate The proportion of persons contracting a disease who die from it during a specified time period.

Case rate The number of reported cases of a specific disease per 100,000 population in a given year.

Census A complete count of the people residing in a specific place at a specific time.

Census block The smallest statistical unit for which the Census Bureau collects population data representing a physical block ideally circumscribed by four sides.

Census block group An aggregation of census blocks that can be combined with other census block groups to create a census tract.

Census tract A statistical unit established by the Census Bureau for data collection purposes ideally with a population of 2000–4000 residents.

Centers for Disease Control and Prevention (CDC) The federal agency charged with monitoring morbidity and mortality in the United States.

Central city The core city of a metropolitan statistical area, typically with a minimum of 50,000 residents.

Central county The core county within a metropolitan statistical area, typically including the central city.

Child bearing years The reproductive age span of women, assumed for statistical purposes to be 15–44 or 15–49 years of age.

Child-woman ratio The number of children under age 5 per 1000 women ages 15–44 or 15–49 in a population in a given year.

Chronic disease A health condition that involves gradual onset and a permanent state that can only be managed and not cured.

Closed population A population with no migratory flow either in or out, so that changes in population size occur only through births and deaths.

Cohort A group of people sharing a common temporal demographic experience who are observed through time.

Cohort analysis Observation of a cohort's demographic behavior over time.

Cohort change ratio technique A technique for estimating or projecting population statistics that involves advancing an existing age cohort over time and using a child-women ratio to supplement the advancing cohorts.

Completed fertility rate The number of children born per woman to a cohort of women by the end of their childbearing years.

Concentration The extent to which population is distributed within a geographic area typically measured in terms of density.

Crude rate Rate of any demographic event computed for an entire population.

Data standardization A technique by which rates are recalculated using a "standard" population in order to adjust for an abnormal age structure or other anomaly in demographic traits.

Death rate (or crude death rate) The number of deaths per 1000 population in a given year.

Demographic transition The historical shift of birth and death rates from high to low levels in a population. The decline of mortality usually precedes the decline in fertility, thus resulting in rapid population growth during the transition period.

Demography The scientific study of human populations, including their sizes, compositions, distributions, densities, growth, and other characteristics, as well as the causes and consequences of changes in these factors.

Dependency Ratio The ratio of the economically dependent part of the population to the productive part; that is, the ratio of the elderly (ages 65 and older) and the young (under age 15) to the working age population (ages 15–64).

Depopulation The state of population decline.

Descriptive research Research that describes (but does not explain) the characteristics of a community or population.

Diagnostic and Statistical Manual (DSM) The coding system used to classify behavioral health problems.

Divorcerate The number of divorces per 1000 population in a given year.

Emigration The process of leaving one country to take up permanent or semipermanent residence in another.

Emigration rate The number of emigrants departing an area of origin per 1000 population in that area of origin in a given year.

Epidemiologic transition A change in a population's epidemiologic profile—from acute to chronic health problems—as a result of aging and changing demographic characteristics.

Estimate The calculation of a figure for a current or past period using a statistical method.

Ethnicity A common racial, national, tribal, religious, linguistic, or cultural trait or background of members of a population.

Extrapolation A technique for generating population projections that involves extending past trends represented by two or more data points to some point in the future.

Exurb A residential community that exists outside the boundaries of a metropolitan statistical area but with important social or economic connections.

Exploratory research Research that discerns the general nature of a problem or an opportunity to identify factors of importance.

Family Usually two or more persons living together and related by birth, marriage, or adoption.

Fecundity The physiological capacity of a woman to produce a child.

Fertility The actual reproductive performance of an individual, a couple, a group, or a population.

Forecast A form of projection that incorporates likely future developments into the calculations.

Gender The social dimension of sex that involves sex roles that exist independent of the physical attributes of the two sexes.

General fertility rate The number of live births per 1000 women ages 15–44 or 15–49 years in a given year.

Geographic information system (GIS) A computer application that collects, analyzes, and organizes data geographically for the purpose of spatial analysis and map generation.

Geographic segmentation A method of dividing a target audience on the basis of geographic location.

Geographic unit A physical area demarcated by defined boundaries and used as a basis for demographic analysis.

Globalization The worldwide expansion and interconnectedness of organizations and their associated economies and influence.

Gross reproduction rate (GRR) The average number of daughters that would be born alive to a woman (or group of women) during her lifetime if she passed through her childbearing years conforming to the age-specific fertility rates of a given year.

Growth rate The number of people added to (or subtracted from) a population in a year due to natural increase and net migration expressed as a percentage of the population at the beginning of the time period.

Health Traditionally, a state reflecting the absence of biological pathology; today, a state of overall physical, social, and psychological well-being.

Health behavior Any action aimed at restoring, preserving, and enhancing an individual's health status.

Health/health care system A multifacility healthcare organization; also may refer to the overall healthcare system.

Health status The degree to which an individual or population is characterized by health problems; the level of ill-health within a population.

Health care Any informal or formal activity intended to restore, maintain or enhance the health status of individuals or populations.

Illegal alien (sometimes called undocumented alien) A foreigner who has entered a country without proper documents or has violated the terms of legal admission to the country.

Immigration The process of entering one country from another to take up permanent or semi-permanent residence.

Immigration rate The number of immigrants arriving at a destination per 1000 population at that destination in a given year.

Incidence rate The number of persons contracting a disease per 1000 population at risk, for a given period of time.

Infant mortality rate The number of deaths of infants under age 1 per 1000 live births in a given year.

In-migration The process of entering one administrative subdivision of a country (such as a province or state) from another subdivision to take up residence.

Inpatient care Medical care provided by a hospital to patients who are admitted for at least one night.

Interpolation A technique for generating population estimates that involves calculating a figure between two population data points.

Household One or more persons occupying a housing unit.

Less Developed Countries Following United Nations' definitions, the term "less developed countries" (or regions) refers to countries in Africa, Asia (except Japan), Latin America and the Caribbean, and Oceania (except Australia and New Zealand).

Life expectancy The average number of additional years a person could expect to live if current mortality trends were to continue for the rest of that person's life.

Life cycle The maturation of a population, a product, or an industry from birth to death.

Life Span The maximum age that human beings could reach under optimum conditions.

Lifestyle The entirety of attitudes, preferences, and behaviors of an individual, a group, or a culture.

Life table A tabular display of life expectancy and the probability of dying at each age (or age group) for a given population, according to the age-specific death rates prevailing at that time.

Market area The actual or desired area from which organizations draw or intend to draw customers; also known as *service area*.

Market segmentation A process for grouping individuals or households who share similar characteristics for the purpose of target marketing.

Marriage rate (or crude marriage rate) The number of marriages per 1000 population in a given year.

Maternal mortality The number of women who die as a result of pregnancy and childbirth complications per 1000 live births in a given year.

Mass marketing An approach that targets the total population—typically through network TV or newspapers—as if it were one undifferentiated conglomeration of consumers.

Mean age The mathematical average age of all the members of a population.

Median age The age that divides a population into two numerically equal groups; that is, half the people are younger than this age and half are older.

Median family income The level of income that divides familyhouseholds into two numerically equal groups, with half the households above this income level and half below.

Median household income The level of income that divides households into two numerically equal groups, with half the households above this income level and half below.

Mortality The number and rate of deaths characterizing a population, along with the characteristics of those dying.

Micromarketing An approach that breaks the market down to the household or even the individual level to target those most likely to consume a product.

Migration The process whereby individuals or groups move from one geographic area to another with the purpose of permanent residence.

Migration stream A process where a large number of migrants or immigrants move as a group from one geographic area to another.

Morbidity The level of ill-health characterizing a population. Sometimes synonymous with health status.

National Center for Health Statistics (NCHS) The federal agency charged with collecting health data in the United States.

Natural region A geographical area that is characterized by homogenous social, economic and political attributes (e.g., the Mississippi "delta").

Niche A segment of a market that can be carved out because of the uniqueness of the target population, the geographic area, or the product being promoted.

Not-for-profit An organization granted tax-exempt status by the Internal Revenue Service due to the fact that it does not generate a profit for its "owners".

Observation A data collection technique whereby the actions and/or attributes of those being studied are recorded either by an individual or a mechanical device.

Out-migration The process of leaving one subdivision of a country to take up residence in another.

Outcome In healthcare, the consequences of a clinical episode; in marketing, the results of a promotional campaign.

Outpatient care Medical care provided outside a hospital or an inpatient facility; also known as *ambulatory care*.

Parity The number of children previously born alive to a woman at the time of the current birth.

Patient An individual who has been officially diagnosed with a health condition and is receiving formal medical care.

Patient Protection and Affordable Care Act (ACA) 2010 legislation that aims to expand health insurance coverage and improve healthcare delivery and quality. Also referred to as "Obamacare".

Policy Authoritative decisions made in the legislative, executive or judicial branches of government (public policies) intended to direct or influence the actions, behaviors or decisions of others. Policies are also set within organizations (e.g,, policies and procedures).

Political or administrative unit A bounded geographic area formally defined for administrative purposes, such as a state, county, municipality, or school district.

Population health An approach to improving the health status and health behavior of groups rather than individuals.

Population density Population per unit of land area; for example, people per square mile or people per square kilometer of arable land.

Population distribution The patterns of settlement and dispersal of a population.

Population increase The total population increase resulting from the interaction of births, deaths, and migration in a population in a given period of time.

Population momentum The tendency for population growth to continue beyond the time that replacement-level fertility has been achieved because of the relatively high concentration of people in the childbearing years.

Population policy Explicit or implicit measures instituted by a government to influence population size, growth, distribution, or composition.

Population pyramid A bar chart, arranged vertically, that shows the distribution of a population by age and sex. By convention, the younger ages are at the bottom, with males on the left and females on the right.

Population register A government data collection system in which the demographic and socioeconomic characteristics of all or part of the population are continuously recorded.

Predictive model A statistical method for identifying and quantifying the likely future need for health services on the basis of known utilization patterns for a defined population.

Predictive research Research that forecasts future characteristics or actions on the basis of known and present characteristics.

Prevalence The total number of cases of a disease, disability, or other health-related condition at a particular point in time; used to calculate a prevalence rate.

Primary data Data generated directly through surveys, focus groups, observational methods, and other research techniques.

Primary research The direct collection of data for a specific use.

Projection The use of a statistical technique to calculate a figure (e.g., population) for a future period of time.

Provider A health professional or an organization that provides direct patient care or related support services.

Psychographics The lifestyle characteristics of a population.

Psychographic (or lifestyle) segmentation The process of subdividing a population into groups of like individuals on the basis of their psychographic designation.

"Push-Pull" hypothesis A migration theory that suggests that circumstances at the place of origin repel or push people out of that place to other places that exert a positive attraction or pull.

Rate of natural increase (or decrease) The rate at which a population is increasing (or decreasing) in a given year due to a surplus (or deficit) of births over deaths, expressed as a percentage of the base population.

Reality-based population estimates A technique for estimating the size of a population by utilizing proxy or symptomatic data as a basis for calculating an estimate.

Registration system A mechanism for systematically compiling, recording, and reporting a range of events, institutions, or individuals.

Reimbursement In healthcare, compensation paid by a third-party payer to a provider or customer for the cost of services rendered/received.

Replacement-level fertility The level of fertility at which women produce enough births for the population to replace itself—generally 2.1 births per woman.

Sample survey The administration of a questionnaire to a segment of a target population that has been systematically selected.

Secondary data Data collected through primary data collection and used for some other purpose, such as market research.

Secondary research The analysis of data originally collected during primary research and for some other purpose.

Segment A component of a population or market defined on the basis of some characteristic relevant to analysts.

Segmentation The process of dividing a population into meaningful segments for purposes of analysis and planning.

Sex ratio The number of males per 100 females in a population.

Social mobility A change in social status typically referring to movement up or down a society's social hierarchy.

Sociocultural variable Demographic attributes that reflect one's position in the social structure such as marital status, income, education and occupation.

Spatial analysis A technique that utilizes geographic information systems to analyze the relationship between phenomena and their environment or geographic setting.

Stable population A population with an unchanging rate of growth and an unchanging age composition as a result of age-specific birth and death rates that have remained constant over a sufficient period of time.

Statistical unit A bounded geographic area formally defined for data collection purposes, such as the geographic units developed by the Census Bureau.

Suburb A residential area within an urban area located on the outskirts of a central city.

Survey A data collection technique that involves the use of a questionnaire administered in any number of ways.

Survival rate The proportion of persons in a specified group (age, sex, or health status) alive at the beginning of an interval (such as a five-year period) who survive to the end of the interval.

Synthetic data Data generated in the form of estimates, projections or forecasts in the absence of actual data.

Total fertility rate The average number of children that would be born to a woman (or group of women) during her lifetime if she were to pass through her childbearing years conforming to the age-specific fertility rates of a given year.

Urban In the U.S. community or settlement with a population of 2000 or more with a certain density is considered urban.

Urbanization Growth in the proportion of a population living in urban areas.

Vital statistics Demographic data on births, deaths, fetal deaths, marriages and divorces.

ZIP code Operational unit established by the U.S. Postal Service as a basis for delivering male. The Census Bureau has replicated the USPS ZIP code with its ZIP code tabulation area.

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