Debre Berhan University

College of Natural and Computational Sciences

Department of Statistics

CurriculumProposal for the Master of Science in Biostatistics

Debre Berhan, Ethiopia

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1. BACKGROUND

1.1. Brief History of Debre Berhan University

Debre Berhan University (DBU) is a Public Higher Educational Institution established in October, 1999 E.C. Additionally, DBU is one of the leading new established Universities and it is located in Amhara National Regional State (ANRS), North Shoa Zone specifically at Debre Berhan Town, which is located at 130 KM North East of Addis Ababa. It holds an area of 102 Hectares.

DBU is one of Ethiopia's innovative community oriented education institution of higher learning. The university adopted by the Towns name for logically because of sound reasons.Firstly, Debre Berhan is one of the oldest Towns in Ethiopia noted for its cold weather condition and sheep production. Secondly, it was the seat of ancient kings of Ethiopia during the former province of Shoa, named AsteZeraYakob around 14^{th} century and latter during the period of Emperor Minilik in 1880 E.C.

The University is situated in Kebele nine near Beressa River. Debre Berhan town is known among other things for its year around cold weather condition and sheep production as mentioned above. Currently, Aqua- Safe spring water factory, Debre Berhan Blanket factory, and the new emerging Habesha Beer Factory are located in the Town.

People in Debre Berhan and its surrounding are naturally, friendly and more so for they are interested for being the Debre Berhan University community (Staff and students). One can easily walk out to the nearest community and get an enthusiastic welcome.

For about a half of a century, Addis Ababa University was the only Higher Education Institution (HEI) responsible for Statistics education in the country. Currently, with intensive expansion of HEIs several young universities have initiated Bachelor of Science (B.Sc.) programs in Statistics to meet the need for qualified statisticians in the growing socio-economic development of the country at large. Only few graduates programs are available.

Vision, Mission and Values of DBU

DBU is one of the youngest Universities in Ethiopia with having the following Vision, Mission and Values.

Vision of DBU

Seeing DBU being one of the known Universities among the middle income countries in term of higher education, research and community service it offers.

Mission of DBU

- Creating competent citizens by giving qualitative and research based higher education.
- Solving problems of the society by giving, rending community serviced and under taking researches based on the interest of stakeholders.
- Based on researches, expanding educational programmers that are market oriented and considering timely tangible circumstances.
- Contributing its role for the democracy and good governance to be hold in the country
- Contributing its role for the success of the country's Millennium goals
- Addressing gender issue and disabled peoples.

Values of DBU

- ❖ Providing quality education is our identification.
- ❖ Democracy and good governance is our manifestation.
- ❖ We believe in gender, religion, culture, and ethnic diversity and equalities.
- ❖ We strongly do for the success of our mutual vision.
- ❖ We can be identified by giving student centered services.

Starting history of DBU

- Debre Berhan University (DBU) is one of the 13 newly ~~established~~emerging Universities which were established in 1999 E.C by the Ethiopian government.
- The foundation of the University was lead down in May, 1997 E.C its first face building was started in May, 1998 E.C and has been going on a good since then.
- DBU started teaching and learning process on January 28, 1999 E.C (2007) with enrollment of 725 students in the Faculty of Education with two streams, namely Business Education and Natural Science teaching.
- In the academic year of 2000 E.C additional three Faculties (Business and Economics, Health Science and Agriculture Faculties) have been opened. This made the total number of students in the university to a reach 2483.
- Furthermore, the university broadened its program and enrolled 393 summer students and 500 extension /evening students in 1999 and 2000 E.C.
- In case of Statistics program since there is a shortage of qualified and experience teachers in the department it's launching was delayed. Nowadays 56% of the problem~~s~~is solved and the road is paved to open the department help for encouraging in problem solving by

conducting research, advising on different project and giving different statistical software's training when needed.

1.2. Brief History of the Department of Statistics

The Department of Statistics at DebreBerhan was founded in 2013 with four lecturers, and one graduate assistance, prior to this, Statistics and mathematics staffs were under the Department of Mathematics. The growth in demand for statisticians in the country created an opportunity to start a separate department for Statistics. Following the establishment of the new department in 2013, sixty students were admitted to the department. It was followed by a more than a twofold increase of student enrollment in 2014.

Statistics department is one of the fast growing departments of the university with the objectives of providing statistical software trainings, research and consultancy services. The department is highly motivated to links and cooperation's with various national (i.e. University of Gondar, Jimma University, Bahir dar University,and Mekelle University), and international Universities (i.e. Hasslet University, Belgium). Recently in March 2015, the department of statistics had a meeting with those national and international sister universities concerning the collaboration, and it was successful.

Since its establishment in the year 2013, the department has had primary responsibility for teaching undergraduate statistics courses for the students in the department of statistics and other service courses within the College of Science and other Colleges, Faculties, Schools and Institutes of Debre Berhan University. The department offers computer oriented practical courses using its fully equipped separate computer laboratory having 40 personal computers.

Nowadays statistics plays a vitalrole in supporting and advancing development efforts at national and global levels and this is well recognized by Debre Berhan University. Consequently, the department of Statistics at DBU proposes designing and adopting a curriculum to launch a Master of Sciencein Biostatistics in collaboration with Hasselt University, Belgium. This program is proposed to satisfy the growing demand for statistics professionals with knowledge and training in data science and quantitative analysis.

1.3 Justification for the need of launching Masters Degree in Statistics

A growing number of administrative, planning, and statistical agencies at all levels ofgovernmental organizations, educational and research institutions, and private industriesare showing a demand for highly qualified statisticians. In addition, an increasing number of students have shown an interest in acquiring specialized training in statistics. Inresponse to these trends, the statistics department has designed a curriculum to launch agraduate program in statistics (i.e. biostatistics, and applied statistics) that prepares graduates for employment in varietyof governmental and non-governmental organizations.

Demand for statistics' professionals with strong quantitative analytical skill is not new,but recent changes in education, in health, in agriculture, and the growing reliance of thenational business and economics on data have created uneven greater need forstatisticians. Moreover, technological developments in the information age have demanded methodology for the efficient extraction of reliable statistics from the complexdatabases.

The proposed M.Sc. program will help to meet these needs by providing workingprofessionals the means to obtain postgraduate-level in statistics. This programwill similarly meet the current and projected demand for professionals with theoreticaland applied skills in statistics.

The graduate program in statistics provides opportunities for graduate study and thesisdirection in various areas of statistics, both theoretical and applied. A variety ofconsulting and collaborative opportunities allow both department and graduate studentsto conduct comprehensive and interdisciplinary research.

In general, The Master of Science in Biostatistics is designed to providestudents a broad knowledge of applied statistical methods and computational tools, and experience sharing with foreign universities.Graduates may find employment involving diverse statistics-related activities in researchinstitutions, consultant companies, banks, industry, health, agriculture, education,engineering, computer science and software development, and teaching statistics atuniversity etc. Graduates will possess a good foundation to pursue further advancedstudies and research in statistical sciences and allied disciplines.

1.3. Vision of the Department of Statistics

The vision of the Statistics department at Debre BerhanUniversity is to be a leader in the statistical sciences in Ethiopia in the coming few years thereby providing high-quality education and statistical consultancy and research services. The program endeavors for excellence in statistical theory, methodology and its applications.

1.4. Mission of the Department

The mission of the Department of Statistics is to contribute to the overall objectives of Debre Berhan University and the nation at large thereby providing high quality statistical training both at graduate as well as undergraduate levels and in support of other degree programs. The goal for the graduate and undergraduate programs of the department is to provide an opportunity for students to enhance their ability of applying statistics in a wide range of fields of application in line with the needs of the universityand the labor market requirements of the country. It also aims to give consultancy services and need based short and long term training in statistical methodology and statistical data analysis using different statistical software packages to the university community and other governmental and nongovernmental organizations in the region and in the country at large.

1.5. Values of the Department

The core values of the department in line with the values of the university are:

- Commitment to excellence and innovation,
- Commitment to professional and scientific methodologies,
- Focus on the requirements of data users,
- Promotion of team work,
- Integrity.

2. RATIONALE OF THE PROGRAM

Debre Berhan University has the vision to become one of the best universities in 2020, and its mission is to contribute substantially for the nation and beyond through high quality education, research and community service. It is evident that research is the central point in the mission and vision of the university. The fact that the university has established different research centers and research groups and launching different postgraduate programs at the masters' level is a clear indication of its move towards its vision and accomplishing its mission. It is also evident that a clear understanding of statistical methodologies is a prerequisite to scientific research. The launching of a graduate program in statistics will strengthen the capacity of faculty members in the department thereby helping the university and the outside community for collaborative research and get training and assistance in statistical methodologies and data analysis techniques.

Statistical procedures and methodology are becoming widely used in government and non-government agencies, research institutions and the private sector. The need for well-trained statisticians at the masters' level is continuing to grow. The main reason for this on the side of practitioners of statistics is the need for advanced level courses in statistics that will help them in the analysis of data of different nature and on the side of employers is the need for middle level trained statisticians who can independently manage the high level statistical tasks of their company.

The fact that the data analysis and research interests in the university and the outside community are diversified justifies the need for identifying main focus areas and offering specialized elective courses. The Bio-stat MSc curriculum is intended to equip students with the advanced theories of statistics, general application courses and some from selected application areas which are designed mainly to satisfy the needs of government sectors/ higher learning institutions, private and non-governmental institutions.

2 PROFESSIONAL PROFILE

MSc. degree graduate in Biostatistics would:

- Have a thorough knowledge of the familiar methods of statistical analysis used in scientific research, social and health sectors.

- Contribute to the development of the field thereby conducting theoretical and applied research on biostatistics and epidemiology.
- Have a thorough knowledge of study designs and data collection in a wide range of fields of application.
- Be actively involved in research groups in the university and the community at large in the design, collection and analysis of statistical data.
- Independently take responsibility for his or hers own professional development and specialization.

3 GRADUATE PROFILE

M.Sc. degree graduate in Biostatistics would:

- Have a thorough knowledge of study designs for data collection in a wide range of fields of application,
- Be able to formulate problems in statistical terms, plan studies (study design, data collection, analysis and interpretation) and apply both simple and advanced methods of statistical analysis using a wide variety of techniques,
- Use various computer packages for data entry and statistical analysis, and be able to interpret the results,
- Write clear reports, research papers, etc. based on statistical analyses,
- Be able to conduct and publish outstanding research in the field,
- Be able to develop attitudes and confidence to acquire new statistical knowledge and expertise in a subsequent career.

4 OBJECTIVES OF THE PROGRAM

The main goal of the M.Sc., program is to advance the mission of the department through achieving excellence in our three core functions: teaching and learning, research and innovation, and providing service to the wider community. The foremost aim is to train middle level statisticians in order to meet the demands of the socioeconomic, business and development sectors in the country. Specifically,

- To prepare graduates in the field of biostatistics who will lead statistical services in the public and private sectors,

- To train university and college instructors who are prepared for subsequent doctoral training in statistics,
- To enhance the research capacity of the department and the university,
- To contribute to the theoretical development of the field through scholarly research in core areas of statistics.
- To contribute to the advancement of science and technology through interdisciplinary research, jointly with scientists at Debre Berhan University and at other research institutions,
- To promote statistical reasoning and the use of statistical principles at the University and in society at large.
- Prepare graduates in the field of biostatistics who will lead statistical services in the public and private sectors,
- To train university and college instructors who are prepared for subsequent doctoral training in statistics,
- To enhance the research capacity of the department and the university,
- To contribute to the theoretical development of the field through scholarly research in core areas of statistics.
- To contribute to the advancement of science and technology through interdisciplinary research, jointly with scientists at Debre Berhan University and at other research institutions,

5 PROGRAMREQUIREMENTS

6.1 General admission requirements

Full admission is solely based upon the academic record and fulfillment of the required prerequisites with a minimum of pass grade. All applicants for admission to the graduate program in Biostatistics must have Grade point Average (GPA) above 2.5 in their bachelor degree. In addition to this students should score above 50% in their entrance exam.

Students who have statistics background, and students come from other discipline who took more than three courses related with statistics can be admitted conditional upon their entrance exam result.

6.2 Admission with prerequisite in statistical courses

When necessary, applicants may be requested to take pre-requisite courses in basic statistics as specified by the DGC (Department Graduate Committee) and entrance examinations are those applicants with first degree in:

- Mathematics
- Public Health, Medicine and related disciplines,
- Biology, Agriculture, Vet Medicine and related disciples

Pre-requisite courses

- Basic statistics
- Introduction to probability theory
- Sampling theory
- Design and analysis of experiment

6.3 Duration of the study

Duration of the study will be:

- Two years for full-time students
- Three years for part-time students
- Students who have statistics background will finish the program within two years
- Students who joined the program from other disciplines such as public health, mathematics, biology and other related departments will take a one year pre-request course from under graduate students.

The maximum duration of stay for full-time students is three years and for part-time students five years. However an extension of one year may be possible by the graduate council committee decision.

6.4 Graduation Requirements

The M.Sc. degree in Biostatistics is awarded to a candidate who:

- Has fulfilled the general graduation requirements of the School of Graduate Studies (SGS) of Debre Berhan University,

- Attain the minimum grade point average for graduation (i.e. CGPA must be greater than or equal to 3.00), in which the maximum allowable number of C grade is two.
- Successfully completed and defended his/her master thesis/project work.
- The students cannot repeat the course more than two times.

6.5 Name of Program and Nomenclature

Master of Science in Biostatistics

Degree Nomenclature:

English: **Master of Science (M.Sc.) in Biostatistics**

Amharic: **የሳይንስ ማስተርስ ዲግሪ በባዮስታቲስቲክስ**

6.5 Course Requirements

6.5.1 Core Courses

Course Title	Credit hr
Regression Analysis	3
Design and Analysis of Clinical Trials	3
Basic epidemiology	2
Concepts of Probability and Statistics	2
Statistical Software and Seminars	1
Survival Data Analysis	3
Statistical inference	2
Linear Statistical models	2
Discrete Data Analysis	3
Infectious Disease Modeling	2
Concepts of Bayesian inference	3
Longitudinal Data Analysis	3
Current Topics in Biostatistics	1

6.5.2 Elective Course

Course Title	Credit hr
Spatial Data Analysis	3
Data management in statistics	3
Survey methodology	3
Non-parametric statistics	3
Concepts of Bioinformatics and Big data Analysis	3
Multivariate and Correlated Data Analysis	3

6.5.3 Course distribution by semester and year

Year-I, Semester-I

Course No.	Title	Credit
Stat 521	Basic epidemiology	2
Stat 541	Design and Analysis of Clinical Trials	3
Stat 561	Regression Analysis	3
Stat 571	Concepts of Probability and Statistics	2
Stat 581	Statistical Software and Seminars	1
	Total	**11**

Year-I, Semester-II

Course No.	Title	Credit hr
Stat 552	Survival Data Analysis	3
Stat 562	Statistical inference	2
Stat 572	Linear Statistical models	2
Stat 582	Discrete Data Analysis	3
	Total	**10**

Year-II, Semester-I

Course No.	**Title**	**Credit**
Stat 641	Infectious Disease Modeling	2
Stat 651	Concepts of Bayesian inference	3
Stat 661	Longitudinal Data Analysis	3
Stat 681	Current Topics in Biostatistics	1
	Total	**9**

Year-II, Semester-II

With master thesis only

Course No.	**Title**	**Credit hr**
SRP	Master Thesis	6
	Total	**6**

Without master thesis

Course No.	**Title**			**Credit hr**
SRP 682	Project work			3
Stat 6X2	Elective	Stat 622	Data management in statistics	3
Stat 6X2		Stat 632	Survey methodology	3
		Stat 642	Concepts of Bioinformatics	3
		Stat 652	Non-parametric statistics	3
		Stat 662	Multivariate and Correlated Data Analysis	3
		Stat 672	Spatial Data Analysis	3
			Total	**9**

Overall Total:

Year	Semester (No. Courses)	Credit hr load
One	**I (5-courses)**	**11**
One	**II (4-courses)**	**10**
Two	**I (4-courses)**	**9**
Two	**II (thesis only)**	**6**
Two	**II (2-ourse+project work)**	**9**
	Over all Total	**30 + (6 (Thesis) or 9(Project and courses))**

6.6 Course number coding scheme

Stat	**Statistics**
1st digit	**Year of study**
	5 refers first year graduate course
	6 refers second year graduate course
2nd digit	**Discipline**
	2refers Biostatistics: basic
	3-6 refers Biostatistics: Methodological
	7refers Statistics: theory and methodological
	8 refers Statistics: Application/method course of specialization
	9 Application
3rd digit	**Semester**
	1 refers first Semester Course
	2 refers second Semester Course

6.7 Medium of Instruction

The medium of Instruction will be English

7 TEACHING AND LEARNING METHODS

Most of the courses in this program involve both theoretical, distance and applied aspects. The basic theories will be introduced and explained to the students by the course coordinator and guest professors from Belgium, and students will be required to ensure that they understand the theories. Students will be provided with different self-test exercises to be done individually or in groups. These tutorial sessions may be covered by the course assistant instructor. These exercises may be submitted to the instructor or students may be required to present in seminars. Applications of the theories will also be demonstrated using different statistical software.

Specific teaching-Learning methods for each course will be presented in the respective course guide books.

8 ASSESSMENT METHODS

8.1 Course Assessment

Course assessment consists of continuous and final assessment; the students will be assessed using a variety of assessment methods, ranging from presentations, theory tests, quizzes and project work and seminar preparation. The combination of methods will assess whether the students gained the competencies required in the labor market. Assessments' results for each course shall be graded independently using the Ethiopian Credit Transfer System (EtCTS) grading system, in accordance with Debre Birhan University policy, mentioned as follows:

Mark Interval 100%	**Fixed No. Grade**	**Letter Grade**	**Description**
90≤X≤100	4.0	A^+	Excellent
85≤X<90	4.0	A	
80≤X<85	3.75	A^-	
75≤X<80	3.5	B^+	Very Good
70≤X<75	3.0	B	
65≤X<70	2.75	B^-	Good
60≤X<65	2.5	C^+	
50≤X<60	2	C	Satisfactory
<50	0	F	Fail

8.2 Thesis assessment

Students are required to conduct a research work in their study areas. Research proposals should be presented on an open defense session and should be endorsed by the department before conducting the research. Conducting researches in any of the thematic areas identified by any of the research centers established in the university is encouraged. This research may be an analysis of some practical statistical project, or may involve a more theoretical or methodological investigation. M.Sc. thesis work starts during the first semester of the second year and will be supervised by senior academic staff member(s) assigned by the department. The thesis will be evaluated in an open defense administered by appointed thesis examination board and the categorical grades "Excellent", "Very Good", "Good", "Satisfactory" or "Fail" will be given based on the points given by the board of examiners as per the rules of the university. The board consists of internal and external examiner and the chairman. There is also an option for students who wants graduate with project work.

9 RESOURCES

9.1 Staff Profile

No.	**Title**		**No. of Staff**	**Remark**
1.	Professor		4	Adjunct Professor
2.	PhD		1	Foreign
3.	MSc	Biostatistics	5	
		Applied Statistics	9	
4.	Lab Assistants		1	
		Total	**17(+3)**	

9.1 Facilities

The department has a fully equipped computer laboratory with different statistical packages installed on each PC and text and reference books.

10. Course Description

Course title: Basic Epidemiology

Course code: Stat 521

Credit hours: 2

Contact hours: Lecture 2hours and lab 2 hours per week

Description:

At the end the lecture, students should be able to get adequate knowledge regarding the following topics:

- Introduction to epidemiology (definitions concepts)
- Measurement of disease occurrence and burden
- Descriptive epidemiology-describe a health event in terms of person, place and time
- Descriptive study designs (survey, cross sectional, ecological, qualitative methods)
- Analytical study designs (cohort, case-control, experimental)
- Sampling methods (probability sampling, non-probability sampling)
- Measurement of association and impact
- Other topics (Causation, demography, census, vital statistics (death rates & ratios, measures of fertility & morbidity), life table analysis, population projections)

Course title: Design and Analysis of Clinical Trials

Course code: Stat 541

Credit hours: 3

Contact hours: Lecture 3 hours and lab 2 hours per week

Description:

This course covers the principles of therapeutic research design, including design of study, and design of data analysis. Specifically, the course covers the following topics

- Understand some frequently used terms in clinical trials

- Identify and classify different types of trial designs when reading a clinical trial report
- Understand the essential design issues of randomized clinical trials
- Appreciate three possible sources of errors that could lead to erroneous trial results
- Understand the basic statistical principles, concepts, and methods for clinical data analysis and reporting
- Justify the use of Stratification, Blocking, and Blinding in clinical trials
- Understand how to write protocols for clinical trial
- Principles of drug risk assessment in the context of therapeutic research
- Understand the basic of Meta- Analysis in Clinical trial
- Differentiate Bias, Random error and Confounding
- Power and sample size determination
- Survival data Analysis and Repeated measures

Course title: Regression Analysis

Course Code: Stat 561

Credit hours: 3

Contact hours: Lecture 3 hours and lab/tutor 2 hours per week

Description

At the end the lecture, students should be able to get adequate knowledge regarding the following topics:

- Simple Linear Regression with One Independent Variable (Functional Relation versus Statistical Relation, Formal Statement of the Model, Estimation of Regression Parameters)
- Inferences in Regression Analysis (Inference for regression parameters, Analysis of Variance, Predicting New Observations, General Linear Model Test)
- Diagnostics and Remedial Measures (Departures from the Model, Residual Analysis, Lack-of-Fit Test, Transformations, Regression Through the Origin, Errors in the Predictor Variable)

- Multiple Linear Regression (Remedial Measures, General Linear Regression Model, Matrix Formulation, Inference About the Regression Parameters, Inference About Mean Response, Predictions, Diagnostics and Remedial Measures, Extra Sum of Squares, Coefficient of Partial Determination, Standardized Multiple Regression, Multicollinearity)
- Model Building Process and Diagnostics (Model Building Process, Procedures for Variable Reduction, Automatic Search Procedures for Variable Reduction, Diagnostic Methods, Multicollinearity Diagnostics)

Course title: Concepts of Probability and Statistics

Course code: Stat 571

Credit hours: 2

Contact hours: Lecture 2 hours and tutorial 2 hour per week

Description

This course is an introduction to the concepts of probability and statistics which is a base for other statistical courses such as linear statistical models, Regression, discrete data analysis, Bayesian data analysis and others. At the end the lecture, students should be able to get adequate knowledge regarding the following topics:

- Introduction to probability, random variables, discrete and continuous distributions, and the use of calculus to obtain expressions for parameters of these distributions such as the mean and variance
- Important univariate distributions with their peculiar properties are introduced to model various situations of the real world
- Joint distributions for multiple random variables are introduced together with the important concepts of independence, correlation and covariance, marginal and conditional distributions
- Techniques for determining distributions of functions of random variables, techniques cumulative distribution function, techniques of moment generating function and transformation techniques

- The concept of the sampling distribution and standard error of an estimator of a parameter together with key properties of estimators
- Large sample results concerning the properties of estimators with emphasis on the central role of the Normal distribution in these results
- Theorems ofconvergences such as convergence in probability, convergence in distribution together with weak law of large numbers are introduced
- Order statistics and its distribution at the two extreme points, such as the distribution of minimum and the distribution of maximum are also considered

Course title: Statistical Software and Seminars

Course Code: Stat 581

Credit hours: 1

Contact hours: Lecture 1 hours and Seminars 1 hours per week

Selected topics on statistical methodology or applications prepare seminars, practices and family with different statistical software; apply application of different statistical software

Course title: Survival Data Analysis

Course code: Stat 641

Credit hours: 3

Contact hours: Lecture 3 hours and tutorial 2 hours per week

Description

This course presents the theory and applications of survival (time-to-event) data analysis. At the end the course, students should be able to get adequate knowledge regarding the following topics:

- Introduction **(**Special features of survival data**,** Censoring & truncation**,** Survivor and hazard functions)
- Non parametric method **(**Estimating the survivor function, Confidence interval estimation of the survival estimation, Estimating the hazard and cumulative hazard functions, Point and interval estimation the median and percentiles of the survivor function)
- Comparison of Survival data (Comparisons of two groups of survivor functions, Comparisons of more than two groups of survivor functions, The log-rank and Wilcoxon Tests, Stratified tests, Log rank tests for trend)
- Semi-parametric Proportional Hazards Regression with fixed covariate **(**Modeling the hazard function **,** The linear comment of the proportional hazards model**,** Fitting the proportional hazards model**,** Confidence intervals and hypothesis tests for the β's**,** Interpretation of model parameters**,** Estimation of the hazard and survivor functions)
- Model checking in the Cox Regression Model (Residuals for the Cox regression model**,** Assessment Model fit**,** Identification of influential observations**,** Treatment of influential observations**,** Testing the assumption of proportional hazards)
- Parametric proportional hazards model **(**Models for the Hazard function**,** Assessing the suitability of a parametric model**,** Fitting a Parametric model**,** The Weibullgompertz Proportional Hazards Model**,** The Gompertz Proportional Hazards model)
- Accelerated Failure time (AFT) Models **(**The log-Logistic Distribution, weibulldistribution,The lognormal Distribution**,** Exploratory analysis**,** The AFT Model for comparing two groups**,** The general AFT Model**,** Log-Linear from of AFT Models**,** Parametric AFT Models)
- Model checking in parametric Models **(**Residuals for Parametric models (Standardized, Cox-Snell, Martingale, Deviance, Score)andResiduals for Particular Parametric models.)

Textbooks

- Collett, D., Modeling Survival Data in Medical Research, 2nd edition, Chapman and Hall 2004.
- Cox, D. R., and Oakes, D. (1984). Analysis of Survival Data. Chapman & Hall, New York.
- Hosmer, D. W., and Lemeshow, S. (1999). Applied Survival Analysis, 2nd ed. Wiley, New York.
- Klein, J. P. and Moeschberger, M. L., Survival Analysis, 2nd edition, Springer 2003.

Course title: Statistical inference

Course code: Stat 562

Credit hours: 2

Contact hours: Lecture 2 hours and tutorial 2 hours per week

Description

This course deals with **p**rinciples of statistical inference in both small- and large-sample cases. The topics include: In the cases of small-samples - sufficiency principle, the likelihood principle; equivariance principle; methods of finding estimators (maximum likelihood (ML), Bayes method, the EM algorithm); methods of evaluating estimators (mean squared error, best unbiased estimators, sufficiency and unbiasedness; loss function optimality; methods of finding tests (likelihood ratio (LR), Bayesian, union-intersection and intersection-union tests); methods of evaluating tests (error probabilities and the power function, most powerful tests, sizes of tests) loss function optimality; methods of finding interval estimators (inverting a test statistic, pivotal quantities, pivoting the CDF, Bayesian intervals); methods of evaluating interval estimators (size and coverage probability, test-related optimality, Bayesian optimality, loss function optimality). Large-samples point estimation (consistency, efficiency, bootstrap standard errors); robustness (mean and median, M-estimators); hypothesis testing (asymptotic distribution of LR-tests, other large-sample tests); interval estimation (approximate ML intervals, other large-sample intervals).

Objectives

- To provide students with the Theory of Statistical Inference: Point and Interval Estimation, Tests of Hypotheses, and Applications.
- To introduce estimation and hypothesis testing methods based on likelihood and other methods
- To introduce students to the principles of efficient estimation and hypothesis testing and acquaint them with best methods of estimation and construction of test procedures

The course has the following topics:

- Parametric Point Estimation **(**Introduction, Methods of Finding Estimation and Methods of Evaluating Estimators)
- Hypothesis Testing (Introduction, Methods of Evaluating Tests and Methods of Finding Tests)
- Interval Estimation (Introduction: notion of interval estimation, Methods of Finding Interval Estimation and Methods of Evaluating Interval Estimation)
- Asymptotic Evaluation (Point Estimation, Robustness, Hypothesis Testing and Interval Estimation)

Course title: Linear Statistical Models

Course code: Stat 572

Credit hours: 2

Contact hours: Lecture 2 hours and lab/tutorial 2 hours per week

Description

This course aims to provide a general introduction about linear statistical models using matrix algebra and distributions of quadratic forms to develop the general linear model for multi-factor data. Hence, at the end the course, students should be able to get adequate knowledge regarding the following topics:

- Regression using Matrix Algebra (Simple regression and correlation, multiple regression, analysis of covariance and analysis of variance)
- Estimation and hypothesis testing in the full rank model
- Statistical inference in the less than full rank model
- Tests of the general linear hypothesis
- Ridge, polynomial and weighted regression
- Model building: Fitting strategies, residual analysis, leverage and influence, collinearity diagnostics, estimability, multiple comparisons

Course title: Discrete Data Analysis

Course title:Discrete Data Analysis

Course Code: Stat 582

Credit hours: 3

Contact hours: Lecture 3hours and tutor 2 hours per week

Description

Focuses on the use of statistical models for analyzing count data, emphasizing both practical applications and theory; Topics include the analysis of contingency tables, chi-square and exact tests, measures of association, generalized linear models, logistic regression and basic log-linear analyses.

At the end the course, students should be able to get adequate knowledge regarding the following topics:

- Introduction: Distributions and Inference for Categorical Data
- Describing Contingency Tables and Inference for Contingency Tables (two ways and three ways contingency table)
- Introduction to Generalized Linear Models (GLM for Binary Data, GLM for Count Data)
- Simple Logistic Regression, proportional odd model
- Multiple Logistic Regression
- Relationship between odd ratio and relative risk
- Building and Applying Logistic Regression Models
- Logit Models for Multinomial Responses
- LoglinearModels for Contingency Tables

Course title: Infectious Disease Modeling

Course Code: Stat 641

Credit hours: 2

Contact hours: Lecture 2 hours and tutor 2 hours per week

Description

The main of objective this course is to introduce students on basicprocedures in the modeling of diseases to use a compartmental model, in which the population is divided into different groups. The Susceptible-Infected-Recovered (SIR) SIR Model is used in epidemiology to compute the amount of susceptible, infected, and recovered people in a population. It is also used to explain the change in the number of people needing medical attention during an epidemic.

At the end the course, students should be able to get adequate knowledge regarding the following topics:

- Basic introduction to modeling infectious disease
- Static and Dynamic aspects of Susceptible-Infected-Recovered (SIR) model
- Transmission models and their relation to the data (Incidence data, Outbreak data and Serological data)
- Connecting Statistical and mathematical models to study infectious disease
- Estimating the force of infection
- Estimation of the basic reproductive number from the initial outbreak
- Estimation of the force of infection from current status data
- Estimation of the force of infection using fractional polynomials
- Non Parametric models for the force of infection
- A priori and a posteriori models for closed population and SIR model in time homogeneity setting

Text Books:

1. Modeling Infectious disease parameters based on serological and social contact data
2. Infectious diseases of humans

Course title: Concepts of Bayesian Inference

Course code: Stat 651

Credit hours: 3

Contact hours: Lecture 3 hours and tutorial 2 hours per week

Description

The aim of this course is to achieve an understanding of the logic of Bayesian statistical inference, i.e. how Bayesian method is used for parameter estimations, and acquires skills to perform practical Bayesian analysis relating to biomedical research problems. At the end the course, students should be able to get adequate knowledge and skills regarding the following topics:

- Introduction (Statistical problems and statistical models, Prior and posterior distributions, Likelihood Principle and Sufficiency Principle, The Bayesian paradigm as a duality principle , Proper prior and conjugate prior and Improper prior distributions)
- Bayesian Model Choice, Comparison and Checking (The Bayesian choice, Introduction: the formal approach to Bayes model choice and averaging, Analytic marginal likelihood approximations and the Bayes information criterion, Approximating Bayes factors or model probabilities and Marginal likelihood approximations from the MCMC output)
- Bayesian inference (Bayesian point estimation (analytic and numeric), Credible regions, Asymptotic properties of estimators and posterior distributions, Bayesian hypothesis testing and MCMC techiqunes)
- Bayesian regression(Bayesian estimation for regression parameters, MCMC simulations, Bayesian variable and model selection, outlier detection and error form, Conjugate, Improper and reference prior)
- Bayesian Decision Theory (Bayes estimators, Conjugate priors, Loss function and Two optimalities: minimaxity and admissibility)

These courses will emphasis on the R, Win-BUGS and SAS open source package as a practical tool

Course title: Longitudinal Data Analysis

Course code: Stat 661

Credit hours: 3

Contact hours: Lecture 3 hours and tutorial/lab 2 hours per week

Description:

This course covers both the applied aspects and recent methods and developments in longitudinal data analysis. Specifically, the course covers the following topics:

- Basic methods in longitudinal data analysis, such as exploratory data analysis, two-stage analysis and mixed-effects models
- Linear mixed-effects models: restricted maximum likelihood estimation, estimation and inference for fixed and random effects and models for serial correlations
- Generalized Estimating Equations (GEE) models
- Nonlinear mixed-effects models, and generalized linear mixed-effects models
- Nonparametric longitudinal models, functional mixed-effects models
- Joint modeling of longitudinal data and the dropout mechanism

Course title: Current Topics in Statistics

Course Code: Stat 681

Credit hours: 1

Contact hours: Lecture 1 hours and Seminars 1 hours per week

This is similar course so that the students present seminars on current topics of research in statistics and Biostatistics based on literature review …

Course title: Master Thesis

Course code: Stat 692

Credit hours: 6

Description

In consultation with advisor(s) the student should able to select and apply the theories and methodologies from across the various topics taught in the Master program in Biostatistics, So as to conduct research and write thesis.

Student able to participate, in a real working environment, in work of a predominantly statistical nature and she/he is able to report in written and oral form. The written report takes the form of a scientific report, following the state of the art from the scholarly literature, in terms of structure, organization, etc. The oral communication is such that the candidate can appeal to a broad professional, interdisciplinary audience.

Course title: Non-parametric Method

Course code: Stat 684

Credit hours: 3

Contact hours: Lecture 3 hours and tutorial/lab 2 hours per week

Description

The empirical distribution function, statistical properties, distributions of the median and range, exact moments of order statistics and their large-sample approximations to the moments of order statistics, asymptotic distribution

Tests of Randomness; tests of goodness of fit; the Chi-Square goodness-of-fit test, the Kolmogorov-Smirnov one-sample statistic, lilliefors's tests for normality, and the exponential distribution, visual analysis of goodness of fit, One-sample and paired-sample procedures, confidence interval for a population quantile, hypothesis testing for a population quantile, the sign test and confidence interval for the median, rank-order statistics, treatment of ties in rank tests, the wilcoxon signed-rank test and confidence interval

Linear rank tests for the location problem, linear rank tests for the scale problem, tests of the equality of k independent samples; extension of the median test, extension of the control median test. The Kruskal-Wallis one-way ANOVA test and multiple comparisons, the Chi-Square test for k proportions

The objectives are:

- To broaden students knowladge in terms of thinking about data and inferencesfree of distribution.
- To introduce useful nonparametric methods that you can apply while analyzing data
- To familiarize them with important topics in nonparametric statistics that they may wish to research
- To bring them up to speed concerning terminology and concepts in nonparametric statistics so that they can more easily read research articles of the field and they can apply for their research work.

The course covers the following topics:

- Introduction and Fundamentals **(**Basic Introduction to the course, Fundamental Statistical Concepts**)**
- Order Statistics, Quantiles, and Coverages **(**Introduction, The Quantile Function and The Empirical Distribution Function**)**
- Tests of Randomness and Tests of Goodness of Fit (Introduction,Tests Based on the Total Number of Runs
- One-Sample and Paired-Sample Procedures (Introduction,Confidence Interval for a Population Quantile, Hypothesis Testing for a Population Quantile, The Sign Test and Confidence Interval for the Median, Rank-Order Statistics, Treatment of Ties in Rank Testsand The Wilcoxon Signed-Rank Test and Confidence Interval)
- The General Two-Sample Problem(Introduction, The Wald-Wolfowitz Runs Test, The Kolmogorov-Smirnov Two-Sample Test, The Median Test, The Control Median Test and The Mann-Whitney U Test)
- Linear Rank Statistics for Two-Sample Problem, for the Location Problem and for the Scale Problem (Introduction and Definition of Linear Rank Statistics, DistributionProperties of Linear Rank Statistics, Introduction for Linear Rank Tests

for the Location Problem, The Wilcoxon Rank-Sum Test, Other Location Tests, Introduction for Linear Rank Tests for the Scale Problem, The Mood Test,The Freund-Ansari-Bradley-David-Barton Tests and The Siegel-Tukey Test)

- Tests of the Equality of k Independent Samples (Introduction, Extension of the Median Test, Extension of the Control Median Test, The Kruskal-Wallis One-Way ANOVA Test and Multiple Comparisons, Other Rank-Test Statistics, Tests against Ordered Alternatives, Comparisons with a Control and The Chi-Square Test for k Proportions)

Course title: Concepts of Bioinformatics

Course code: Stat 642

Credit hours: 3

Contact hours: Lecture 3 hours and tutorial/lab 2 hours per week

Description

The course provides fundamental concepts in bioinformatics and related big data analysis both theoretically and practically; mathematical and algorithmic models underlying bioinformatics. Topics include gene prediction, data mining, sequence analysis, data base search, cell simulation and computing, molecular structure comparison and predication, model the structure of proteins and also to identify functional and structural domains in DNA sequences and analysis of gene expression.

Course title: Multivariate and Correlated Data Analysis

Course code: Stat 662

Credit hours: 3

Contact hours: Lecture 3 hours and tutorial/lab 2 hours per week

Description:

- The multivariate normal distribution and its properties; marginal and conditional distributions; multiple and partial correlation
- Samples from the multivariate normal distribution: estimation of parameters, partial correlation, multiple correlation, and regression coefficients

- Hypothesis tests and confidence interval estimation for the multinormal mean vector based on the Hotelling T-squared statistic
- Repeated-sample cases, and Profile analysis
- Power and sample size determination
- Multivariate analysis of variance and the multivariate general linear model
- Linear discrimination and classification for two and several groups using canonical correlation, principal components, and factor analysis.
- Introduction to correlated data Analysis...