

School of Civil and Environmental Engineering

Engineering Economics (CEng 5211)

Chapter 5: Depreciation

Contents

Depreciation

- Introduction
- Rules of depreciation
- Methods of asset depreciation

5.1 Introduction

- How will an investment affect the financial position of an organization?
 - **Long run effect:** the investment may present an opportunity of creating greater wealth for the organization:- increasing productivity, product quality, cutting down time consumed by the process.
 - **Short run effect:** the initial cost will negatively impact the organization's bottom line, which will only gradually be rewarded by the benefits from the investment.
- **How long** this system remains advantageous?
- **When** will the competitive advantage the firm has just acquired become a competitive disadvantage, due to obsolescence?
- The asset will inevitably wear out over time, and even if its productive service extends over many years, the **cost of maintaining** its high level of functioning will **increase** as the individual pieces of hardware wear out and need to be replaced.
- Fact that organizations must deal with and take account for is that **assets lose their value** even as they continue to function and contribute to the engineering projects that use them. This loss of value, called **depreciation**, can involve **deterioration** and **obsolescence**.

5.1 Introduction

- Business costs are generally either **expensed** or **written off over time**.
- **Expensed** items, such as labor, utilities, materials, and insurance, are part of regular business operations and are “**consumed**” over short periods of time. These costs **do not** represent capital assets that loss value gradually over time.
- Business costs due to **capital assets** are **written off over time through depreciation**.

PRUFROCK CORPORATION 2009 Income Statement (\$ in millions)	
Sales	\$2,311
Cost of goods sold	1,344
Depreciation	<u>276</u>
Earning before interest and taxes	\$ 691
Interest paid	<u>141</u>
Taxable income	\$ 550
Taxes (34%)	<u>187</u>
Net income	<u>\$ 363</u>
Dividends	\$ 121
Addition to retained earnings	242

5.1 Introduction

Definition

- **“Decrease in value of an asset over time or with usage.”**
- **“Allocating the asset’s cost over its depreciable life or recovery period.”**
- **Depreciation or capital allowances**
 - are a **noncash** cost
 - Don’t require exchange of money from one hand to another. Companies do not write check to someone to pay these expenses.
 - are business expenses that are allowed by the government to **offset the loss in value of business assets.**
- It is simply a way to write off the “business expense” , paid for the asset upfront, faced when acquiring an asset over time. Contingent mechanism for recovering the capital invested.
- **Principal reasons for developing the concept of depreciation** is to allow:
 - a reasonably **accurate report** to the owners of a business regarding its value at any given point in time.
 - reasonable estimates to be made concerning the **cost of doing business.** Prices need to be set at levels that will recapture investments made in depreciable properties.

5.1 Introduction

→ Why do we need to understand the concept of asset depreciation?

- In order to determine the effects of income taxes on project cash flows, we need to understand **how a company calculates the profit** (or net income) from undertaking a project, where depreciation expenses play a very critical role.
- The main function of depreciation accounting is to **account for the cost of fixed assets in a pattern that matches their decline in value over time**. The cost of the asset will be allocated over several years in the firm's financial statement so that its pattern of costs roughly matches its pattern of service.
- Depreciation accounting enables the firm to **stabilize the statement of financial position** that it distributes to stock holders and the outside world.
- **Treating depreciation as expenses allows one to incorporate such charges in the cost of production and ensure that the prices are sufficient to recover invested capital.**
- On a project level, engineers must be able to assess how the practice of depreciating fixed assets **influences the investment value** of a given project.
- To make this assessment, they need to estimate the **allocation of capital costs over the life of the project**, which requires an understanding of the conventions and techniques that accountants use to depreciate assets.

5.2 Rules of Asset Depreciation

- The acquisition of fixed assets is an important activity for a business organization (whether the organization is **starting up** or is acquiring **new assets** to remain competitive).
- Like other disbursements, the costs of these fixed assets must be recorded as expenses on a firm's **balance sheet** and **income statement**. However, unlike costs such as maintenance, material, and labor, the costs of fixed assets are ***not treated simply as expenses to be accounted for in the year that they are acquired.***

→ What constitutes a depreciable asset?

For an asset to be considered as depreciable it must:

1. Be used in business or held for the production of income.
2. Have a definite service life, which must be longer than one year.
3. Be something that wears out, decays, gets used up, becomes obsolete or loses value from natural causes.

5.2 Rules of Asset Depreciation

→ What constitutes a depreciable asset?

For an asset to be considered as depreciable it must

I. Be used in business or held for the production of income.

- To claim depreciation on property, you **must use** it in your business or income-producing activity. If you use property to produce income (investment use), the income must be **taxable**. You cannot depreciate property that you use solely for **personal activities**.
- **Inventories** are **not** depreciable property, because they are held primarily for sale to customers in the ordinary course of business. Because inventory gets consumed or sold during the normal course of business (within one-year) it cannot get depreciated on a company's books. For tax purpose they are subtracted from the business revenue **when they occur**.

5.2 Rules of Asset Depreciation

→ What constitutes a depreciable asset?

For an asset to be considered as depreciable it must

2. Have a definite service life, which must be longer than one year.

- The asset must have a useful life that can be determined.
- If an asset has no definite service life, the asset cannot be depreciated. For example, we can never depreciate land.

3. Be something that wears out, decays, gets used up, becomes obsolete or loses value from natural causes.

- The property must be an asset that decays, gets used up, wears out, becomes obsolete or loses value **to the owner** from natural causes.

5.2 Rules of Asset Depreciation

Types of property

- The rules of depreciation are linked to classification of business property into:
 - **Tangible property:** can be seen and touched.
 - Real property: includes land, building and all things constructed and attached to the land.
 - Business property: includes equipment, vehicles, and anything that is tangible excluding what has been defined as real property.
 - **Intangible property:** property that has value to the owner but cannot be directly seen or touched. Includes patents, trade names franchise.

“Asset's cost needs to be proportionally expensed based on the period over which the asset was used.”

- **Depreciation**
- **Amortization**
- **Depletion**

5.2 Rules of Asset Depreciation

- **Depreciation:** refers to proportional **tangible asset's cost** over that asset's life. **Example:** an *office building* can be used for many years before it becomes run down and is sold. The cost of the building is spread out over the predicted life of the building, with a portion of the cost being expensed each accounting year.
- **Amortization:** usually refers to spreading an **intangible asset's cost** over that asset's useful life. **Example:** a *patent* on a piece of medical equipment usually has a life of 17 years. The cost involved with creating the medical equipment is spread out over the life of the patent, with each portion being recorded as an expense on the company's income statement.
- **Depletion:** refers to the allocation of the **cost of natural resources** over time. **Example:** an *oil well* has a finite life before all of the oil is pumped out. Therefore, the oil well's setup costs are spread out over the predicted life of the oil well.
- All are methods that are used to prorate the cost of a specific type of asset over the asset's life. It is important to mention that these methods are calculated by *subtracting the asset's salvage value from its original cost*.
- **Salvage value:** is an asset's estimated value at the end of its life; it is the amount eventually recovered through sale, trade-in, or salvage.
- **Cost basis:** is the total cost that is claimed as an expense over an asset's life.
- **Book value:** difference between the cost of asset and depreciation charges made to date.

5.3 Methods of Asset Depreciation

→ How much should be charged as an expense each year?

- The process of depreciating an asset requires several preliminary determinations:
 - What is the cost of the asset?
 - What is the asset's value at the end of its useful life?
 - What is the depreciable life of the asset?
 - **What method of depreciation do we choose?**
- Three different methods can be used to calculate the periodic depreciation allowances for financial reporting:
 - Straight-line method,
 - Declining-balance method (DDB), and
 - Sum-of-years' Digits Depreciation (SOYD).

5.3 Methods of Asset Depreciation

→ How much should be charged as an expense each year?

- **Straight-Line Method:** The book value over time is a straight line. It is the simplest and least attractive (from a tax-minimizing perspective) depreciation strategy. It is the standard against which the more attractive accelerated methods are measured.
- The rate of depreciation is constant at $1/N$ per year. The amount of depreciation is constant as well.
- The deduction amount for period t is constant over the life and is expressed as:

$$D_t = \left[\frac{C - S}{N} \right] \quad D_t = \text{annual depreciation charge}$$

Example: Consider the following and compute the straight line depreciation schedule.

Cost of asset, C \$ 900
 Depreciable life, in years, N 5
 Salvage value, S \$ 70

$$D_t = \left[\frac{C - S}{N} \right] = \frac{900 - 70}{5} = 166$$

Yr.	D_t	Sum of depreciation charged to date (ΣD_t)	Book value at the year t , $BV_t = C - \Sigma D_t$
1	166	166	$900 - 166 = 734$
2	166	332	$900 - 332 = 568$
3	166	498	$900 - 498 = 402$
4	166	664	$900 - 664 = 236$
5	166	830	$900 - 830 = 70$

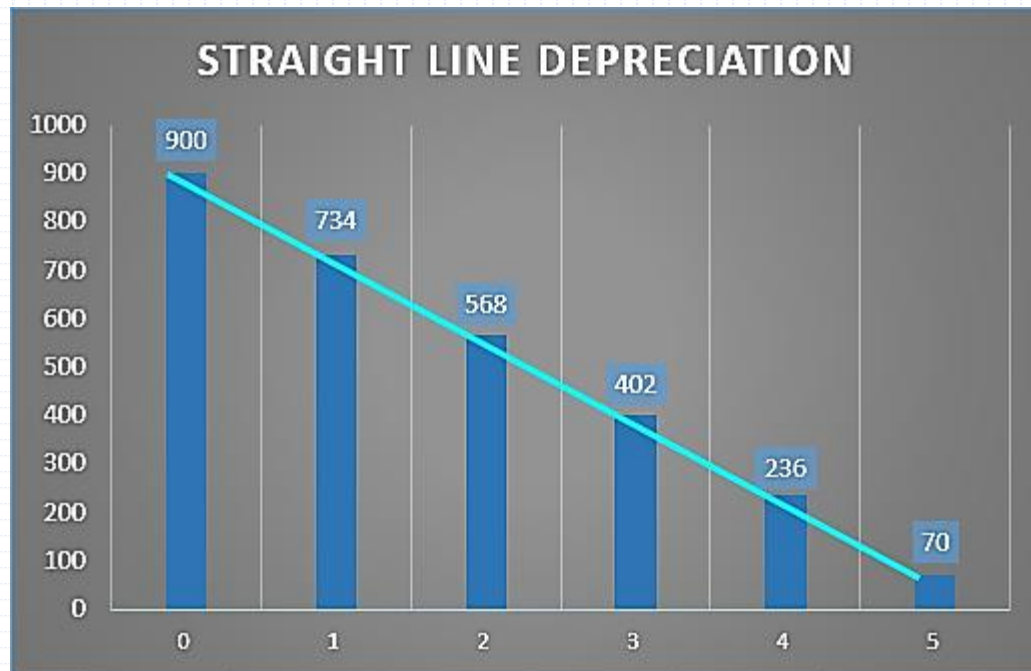
5.3 Methods of Asset Depreciation

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5	166	830	$900 - 830 = 70$



5.3 Methods of Asset Depreciation

Declining Balance Method/Diminishing Balance Depreciation:

- Applies a constant depreciation rate to the property's declining book value.
- each year's depreciation is computed by multiplying the beginning-of-year book value by the depreciation rate.
- The most common rate is 200% of the straight-line rate. Since 200% is twice the straight-line rate, it is called double declining balance or DDB.

$$D_t = \frac{2}{N} [Book _ value_{t-1}] \quad \text{Book value} = \text{Cost} - \text{Depreciation charged to date}$$

$$\text{DDB } D_t = 2/N [C - \Sigma D_t]$$

- **Example:** Consider the following and compute the straight line depreciation schedule.

Year, t	DDB $D_t = (2/N) * BV_{t-1}$	ΣD_t	$BV_t = C - \Sigma D_t$
1	$(2/5) * 900 = 360$	360	$900 - 360 = 540$
2	$(2/5) * 540 = 216$	576	$900 - 576 = 324$
3	$(2/5) * 324 = 130$	706	$900 - 706 = 194$
4	$(2/5) * 194 = 78$	784	$900 - 784 = 116$
5	$(2/5) * 116 = 46$	830	$900 - 830 = 70 = S$

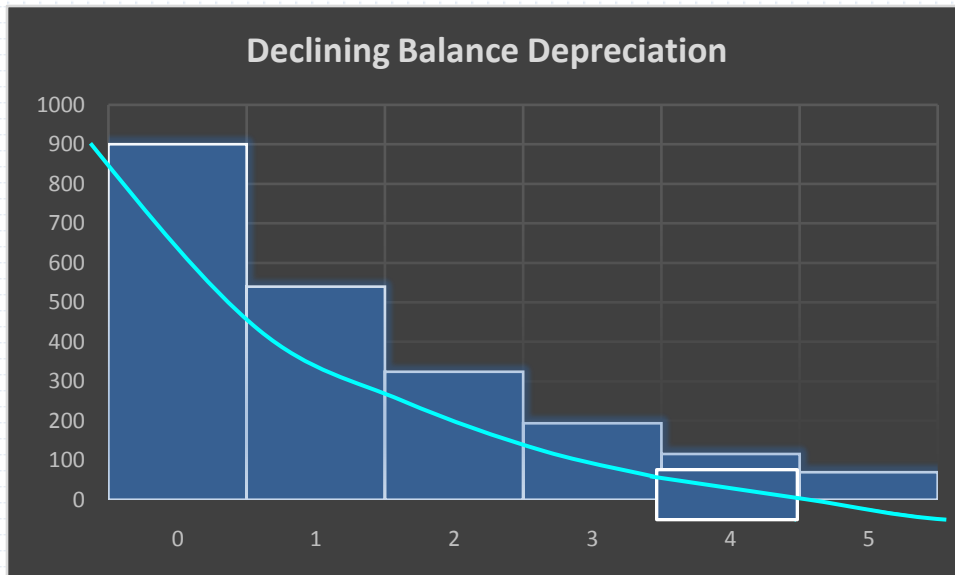
5.3 Methods of Asset Depreciation

Declining Balance Method/Diminishing balance depreciation:

- Example:** Consider the following and compute the DDB depreciation schedule.

$$Dt = \frac{2}{N} [Book_value_{t-1}]$$

Year, t	DDB $D_t = (2/N) * BV_{t-1}$	ΣD_t	$BV_t = C - \Sigma D_t$
1	$(2/5) * 900 = 360$	360	$900 - 360 = 540$
2	$(2/5) * 540 = 216$	576	$900 - 576 = 324$
3	$(2/5) * 324 = 130$	706	$900 - 706 = 194$
4	$(2/5) * 194 = 78$	784	$900 - 784 = 116$
5	$(2/5) * 116 = 46$	830	$900 - 830 = 70 = S$



5.3 Methods of Asset Depreciation

Sum-of-years' Digits Depreciation (SOYD):

- Is an accelerated depreciation technique that includes an arithmetic gradient.
- This depreciation technique uses fractions whose denominator equals the sum of the digits from 1 to N, or the sum-of-the-years'-digits (SOYD). The numerators for the fractions begin at N for the first year and decline by one each year.
- Example: For $N = 5$ the denominator equals $1 + 2 + 3 + 4 + 5 = 15$. The fractions become $\frac{5}{15}$ $\frac{4}{15}$ $\frac{3}{15}$ $\frac{2}{15}$ and $\frac{1}{15}$
- The depreciation charge shrinks by $1/15$ of $(C - S)$ each year.
- These fractions are multiplied by the total amount to be depreciated, which is the first cost or initial basis *minus* the salvage value $(C - S)$.

$$D_t = \left[\frac{N - t + 1}{SOYD} \right] (C - S)$$

D_t =depreciation charge in any year t

N =number of years in depreciable life

SOYD=calculated as $N(N+1)/2$

C =cost of the asset made ready for use

S =estimated salvage value after depreciable life

5.3 Methods of Asset Depreciation

Sum-of-years' Digits Depreciation (SOYD):

Example: Consider the following and compute the SOYD depreciation schedule.

Cost of asset, C \$ 900
 Depreciable life, in years, N 5
 Salvage value, S \$ 70

Yr.	D_t	Sum of depreciation charged to date(ΣD_t)	Book value at the year t, $BV_t = C - \Sigma D_t$
1	277	277	$900 - 277 = 623$
2	221	498	$900 - 498 = 402$
3	166	664	$900 - 664 = 236$
4	111	775	$900 - 775 = 125$
5	55	830	$900 - 830 = 70 = S$

$$D_t = \left[\frac{N - t + 1}{SOYD} \right] (C - S)$$

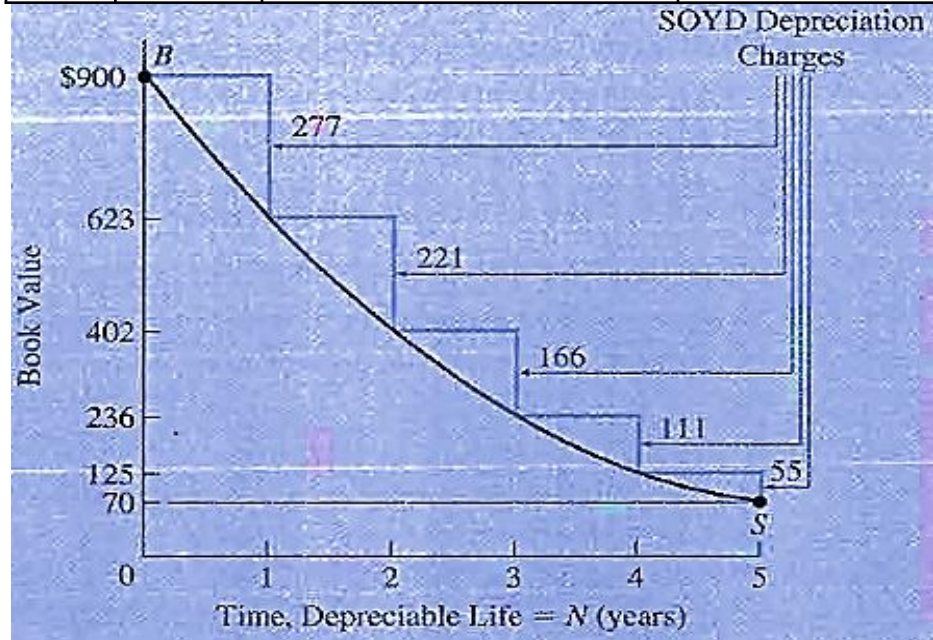
$$D_1 = \left[\frac{5 - 1 + 1}{15} \right] (900 - 70) = 276.67$$

$$D_2 = \left[\frac{5 - 2 + 1}{15} \right] (900 - 70) = 221.33$$

$$D_3 = \left[\frac{5 - 3 + 1}{15} \right] (900 - 70) = 166$$

$$D_4 = \left[\frac{5 - 4 + 1}{15} \right] (900 - 70) = 110.67$$

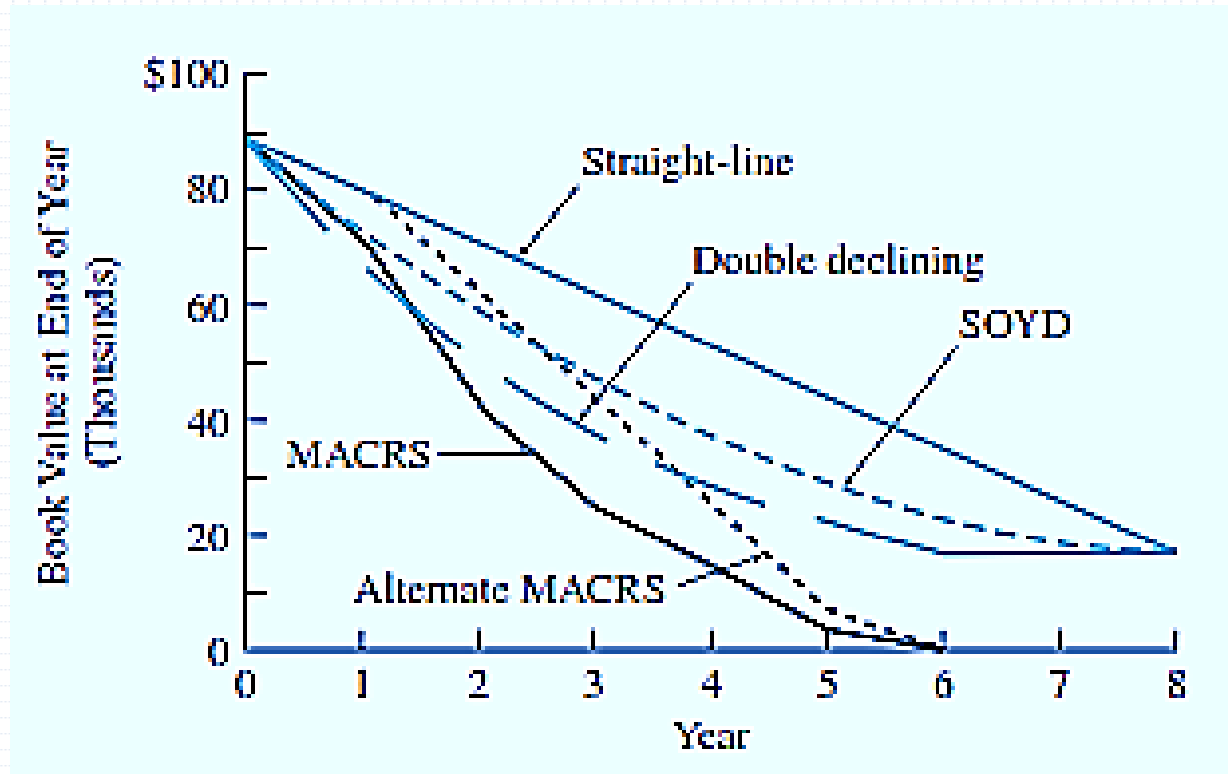
$$D_5 = \left[\frac{5 - 5 + 1}{15} \right] (900 - 70) = 55.33$$



5.3 Methods of Asset Depreciation

Comparison between Depreciation Methods

- The SOYD and declining balance methods are accelerated depreciation methods because the book value drops faster than with straight-line depreciation.
- Organizations should prefer to use accelerated depreciation when available. The TVOM ensures that it is better to the deduction as soon as possible.



5.3 Methods of Asset Depreciation

Asset Disposal

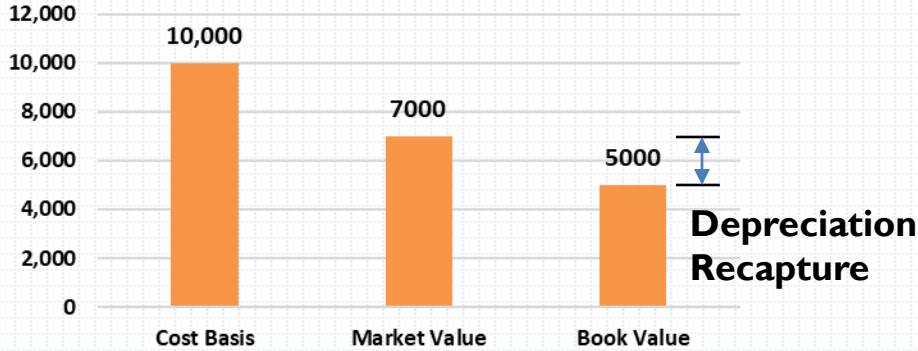
When an asset is disposed of, the key question is which one is larger?

1. Asset's book value (what we show in our accounting records after applying the rule set by the government)
 2. Asset's market value (what a willing buyer pays).
- **Book value < Market value:** Total of the depreciation deduction or capital allowance is too *high*. There will need to be *depreciation recapture* or a *capital balancing charge*.
 - **Depreciation recapture/Capital Balance/Gain on Sale:** we have taken too much expense for the asset's "**loss in value**" and the excess must be recaptured. *Gain on sale* describes the situation of an asset that we sold for more than it was worth in our accounting records, and the difference is a gain on sale.
 - If more than the original cost basis is received, only the amount up to original cost basis is recaptured depreciation. We call this excess amount is called *capital gains*.
 - **Book value > Market value:** There is a loss on the disposal. This loss is deducted like a depreciation, or there is a *capital balancing allowance*.
 - **Losses:** we have exchanged an asset worth its book value for something less. A company has not claimed enough depreciation expense or capital allowance. This loss is deductible directly or as capital balancing allowance.

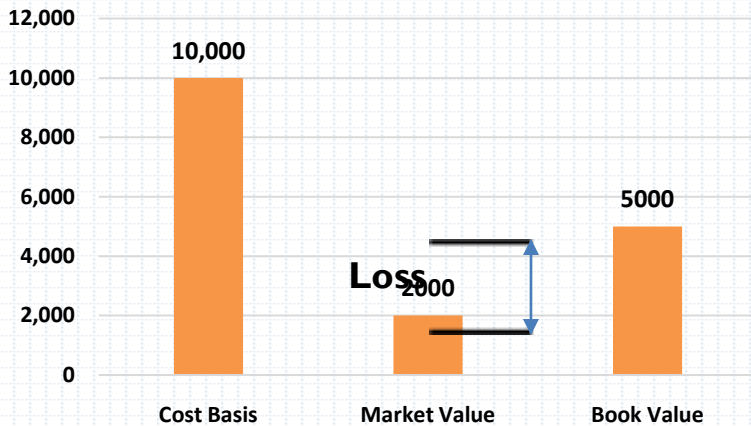
5.3 Methods of Asset Depreciation

Recaptured depreciation, loss on sale, and capital gain.

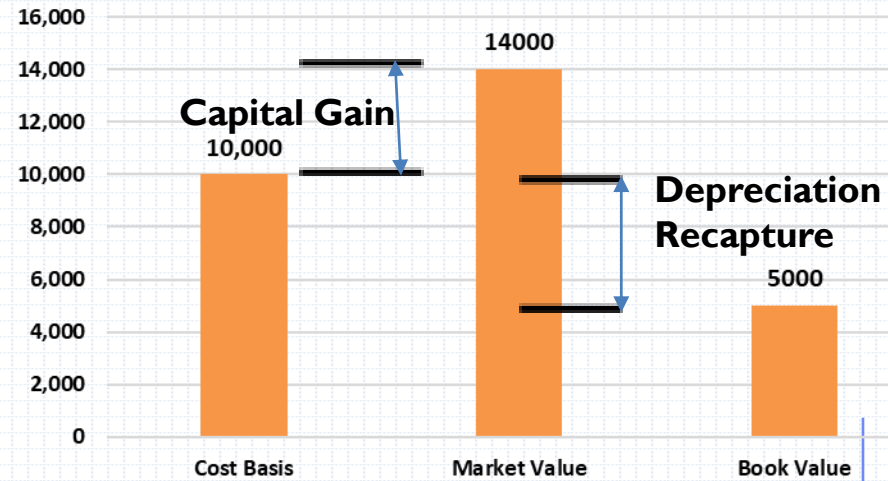
**Depreciation Recapture
(Ordinary gain)**



Loss



Capital Gain & Depreciation Recapture



5.3 Methods of Asset Depreciation

Declining Balance with Conversion to Straight-Line Depreciation

- When **BV** > **S**: we have not depreciated the entire cost of the asset and thus have not taken full advantage of depreciation.
- Reducing the book value of an asset to its salvage value as quickly as possible can be done by *switching from DB depreciation to SL depreciation* whenever **SL** depreciation results in **larger depreciation** charges and therefore a more rapid reduction in the book value of the asset.
- The switch from DB to SL depreciation can take place in any of the n years, the objective being to identify the **optimal year to switch**.
- The switching rule is as follows:
 - if DB depreciation in any year is **less than (or equal to)** the depreciation amount calculated by SL depreciation *based on the remaining years*, switch to and remain with the SL method for the duration of the asset's depreciable life.
- The straight-line depreciation in any year n is calculated by:

$$D_n = \frac{\text{Book value at beginning of year } n - \text{Salvage value}}{\text{Remaining useful life at beginning of year } n}$$

5.3 Methods of Asset Depreciation

Declining Balance with Conversion to Straight-Line Depreciation

Example: Consider the following accounting information for a computer system:

- Cost basis of the asset (C) = \$10,000;
- Useful life (N) = 5 years;
- Estimated salvage value (S) = \$0. Compute the annual depreciation allowance.

N	D_t	$BV_t = BV_{t-1} - D_t$	N	SL D_t	Comparison	DB D_t	BV_t
		10,000					10,000
1	$(2/5) * 10,000 = 4,000$	6,000	1			4,000	$10,000 - 4,000 = 6,000$
2	$(2/5) * 6,000 = 2,400$	3,600	2	$6,000 / 4 = 1,500$	<	2,400	$6,000 - 2,400 = 3,600$
3	$(2/5) * 3,600 = 1,440$	2,160	3	$3,600 / 3 = 1,200$	<	1,440	$3,600 - 1,440 = 2,160$
4	$(2/5) * 2,160 = 864$	1,296	4	$2,160 / 2 = 1,080$	>	864	$2,160 - 1,080 = 1,080$
5	$(2/5) * 1,296 = 518.4$	778	5	$1,080 / 1 = 1,080$		518	$1,080 - 1,080 = 0$

Note: If we don't switch method, we do not fully depreciate the entire cost and thus do not take full advantage of depreciation's tax deferring benefits.

5.3 Methods of Asset Depreciation

Reading Assignment

- What is incidental charge? Do we include all the incidental charges relating to the acquisition of a machine in its cost? Justify your answer?
- How long will an asset be useful to the company?

Thank You