

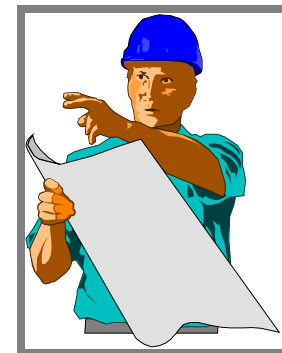


Department of Mechanical Engineering, Pulchowk campus, Institute of Engineering, Tribhuvan University

ENGINEERING ECONOMICS **Depreciation**



Dr. Shree Raj Shakya
2019
Lecture 10



Asset Depreciation

Depreciation is the gradual decrease in utility of fixed assets with use and time.

Physical Depreciation

It is the reduction in an asset's capacity to perform its service due to physical impairment.

Functional Depreciation

It occurs as a result of changes in the organization or in technology that decrease or eliminate the need for an asset.

Economic Depreciation

Economic Depreciation

=

purchase price - market value

Both **physical** and **functional depreciation** are **categories of economic depreciation**.

Accounting Depreciation

It is the **systematic allocation** of the **initial cost** of an **asset** (machine or equipment) **in parts over** a time known as its **depreciable life**.

(Financial statements, Balance Sheet and Income Statement)

In engineering economic analysis, we use the concept of accounting depreciation exclusively.

This is because **accounting depreciation** provides a **basis for determining the income taxes** associated with any project undertaken.

Depreciable Property

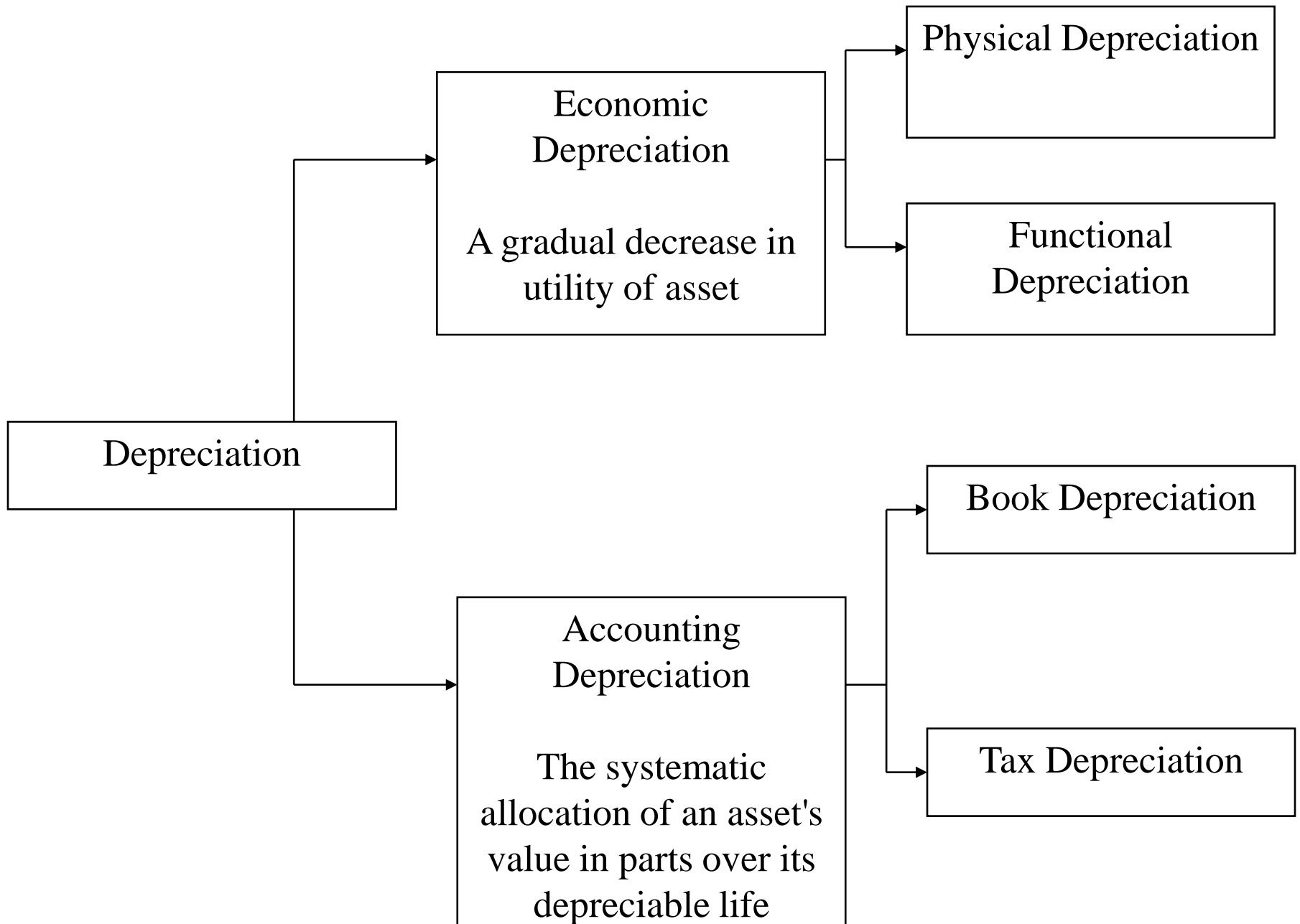
For the purposes of tax, any depreciable property has the following Characteristics.

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

Depreciable property includes buildings, machinery, equipment, and vehicles.

Inventories are not depreciable property, because they are held primarily for sale to customers in the ordinary course of business.

If an asset has **no definite service life, the asset cannot be depreciated** (*For example, Land*)



Net Income

When a project's revenue exceeds its expenses, we say that the project generated a ***profit*** or ***income***. If the project's revenue is less than its expenses, then we say that the project resulted in a ***loss***.

Revenue

- Expenses (cost of goods sold)

Gross Profit

- Operating expenses

- Depreciation

Taxable Income (Income before tax)

- Income Tax

Net Income

Retained Income

Cash flow = net income + depreciation

Depreciation Methods

The most widely used methods are:

1. Straight-line Method
2. Declining Balance Method, and
3. Sum-of-years'- digit method

1. Straight-Line Method

In this method, it is **assumed that the fixed asset is depreciated in a uniform way.**

$$D_n = \frac{P - S}{N}$$

Where

D_n = the **depreciation charge** during n year

P = the **cost of the asset**, including installation expenses

S = **salvage value** at the end of the useful life of asset

N = the **useful life**

The book value = cost base - total depreciation charges

$$B_n = P - (D_1 + D_2 + \dots + D_n)$$

2. Declining Balance Method

In this method, a **fixed fraction** of the **initial book balance** is deducted each year. The **fraction or declining balance rate** is obtained by

$$d = 1/N$$

The most common multiplier is '1'. If this is '2', then it is called double-declining balance method.

$$D_1 = dP$$

$$D_2 = d(P - D_1) = dP(1-d)$$

$$D_3 = d(P - D_1 - D_2) = dP(1-d)^2$$

For 'n' year, $D_n = dP(1-d)^{n-1}$

We can also compute the total DB depreciation at the end of 'n' years

$$\text{TDB} = D_1 + D_2 + D_3 + D_4 + \dots + D_n$$

$$= dP + dP(1-d) + dP(1-d)^2 + \dots + (1-d)^{n-1}$$

$$\text{TDB} = P[1-(1-d)^n]$$

3. Sum-of-years'-Digit Method (SOYD)

In this method,

$$\text{SOYD} = 1 + 2 + \dots + N = N(N + 1)/2$$

Where,

N = the useful life

$$D_n = (N - n + 1)(P - S)/\text{SOYD}$$

EXAMPLE: Straight-Line Depreciation

Given: $I = \$10,000$, $S = \$2,000$, and $N = 5$ years.

Find: D_n and B_n for $n = 1$ to 5.

The straight-line depreciation rate is $\frac{1}{5}$, or 20%. Therefore, the annual depreciation charge is

$$D_n = (0.20)(\$10,000 - \$2,000) = \$1,600.$$

The asset would then have the following book values during its useful life:

n	B_{n-1}	D_n	B_n
1	\$10,000	\$1,600	\$8,400
2	8,400	1,600	6,800
3	6,800	1,600	5,200
4	5,200	1,600	3,600
5	3,600	1,600	2,000

EXAMPLE: Double Declining-Balance Depreciation

Given: $I = \$10,000$, $S = \$778$, $N = 5$ years

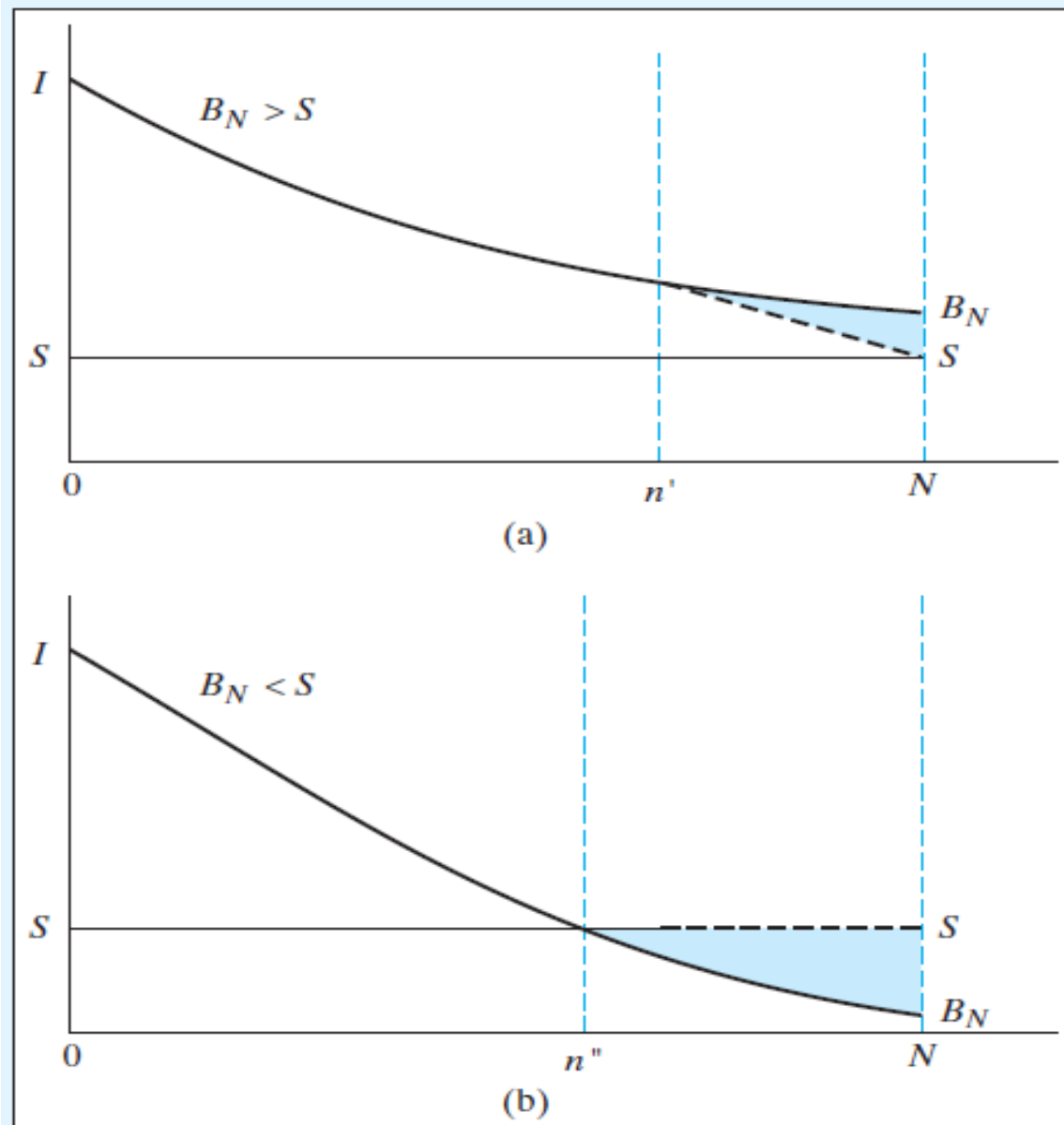
Find: D_n and B_n for $n = 1$ to 5

declining balance rate $d = 2/N$, For 'n' year, $D_n = dP(1-d)^{n-1}$

The book value at the beginning of the first year is \$10,000, and the declining-balance rate (α) is $(\frac{1}{5})(2) = 40\%$. Then the depreciation deduction for the first year will be \$4,000 ($40\% \times \$10,000 = \$4,000$). To figure the depreciation deduction in the second year, we must first adjust the book value for the amount of depreciation we deducted in the first year. The first year's depreciation from the beginning book value is subtracted ($\$10,000 - \$4,000 = \$6,000$), and the resulting amount is multiplied by the rate of depreciation ($\$6,000 \times 40\% = \$2,400$). By continuing the process, we obtain the following table:

n	B_n	D_n	B_n
1	10,000	4,000	6,000
2	6,000	2,400	3,600
3	3,600	1,440	2,160
4	2,160	864	1,296
5	1,296	518	778

EXAMPLE: Double Declining-Balance Depreciation for Final Book Value (B_N) \neq Salvage Value (S)



Useful Life

Assets Used	Asset Depreciation Range (Years)		
	Lower Limit	Midpoint Life	Upper Limit
Office furniture, fixtures, and equipment	8	10	12
Information systems (computers)	5	6	7
Airplanes	5	6	7
Automobiles, taxis	2.5	3	3.5
Buses	7	9	11
Light trucks	3	4	5
Heavy trucks (concrete ready-mixer)	5	6	7
Railroad cars and locomotives	12	15	18
Tractor units	5	6	7
Vessels, barges, tugs, and water transportation systems	14.5	18	21.5
Industrial steam and electrical generation and/or distribution systems	17.5	22	26.5
Manufacturer of electrical and nonelectrical machinery	8	10	12
Manufacturer of electronic components, products, and systems	5	6	7
Manufacturer of motor vehicles	9.5	12	14.5
Telephone distribution plant	28	35	42

Source: IRS Publication 534. *Depreciation*. Washington, DC: U.S. Government Printing Office, 1995

Tax Depreciation Rates

Houses & Building	5 %
Transportation equipment	
Car, Jeep, Van & Motorcycle	15 %
Cycle	20 %
Furniture	
Metal	10 %
Wooden	15 %
Equipment & Machinery	
Machinery	15 %
Computers	20 %
Laboratory equipment	15 %
X-Ray machine	20 %
Typewriter, photocopy machine	15 %

Equivalence between declining balance and straight-line depreciation method

Declining

5 %

7 %

10 %

15 %

20 %

25 %

50 %

Straight line

1.65%

2.60 %

3.40 %

5.30 %

7.30 %

9.60 %

19.20 %

Corporate Income Tax (manufacturing) 20 %

Other Industries 25 %

Value Added Tax 13 %

Practice

9.1, 9.2, 9.6, 9.7, 9.8, 9.9, 9.10,
9.11, 9.12, 9.13