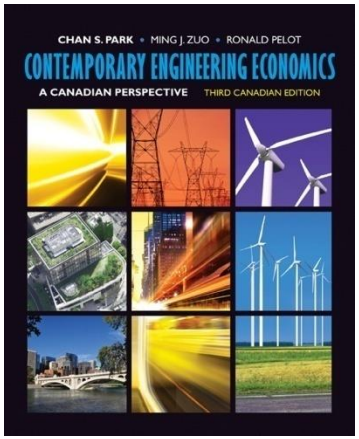
Depreciation



Lecture No. 23
Chapter 8
Contemporary Engineering Economics
Third Canadian Edition

Chapter Opening Story: IMP Aerospace's New Air Furnace

- IMP Aerospace purchased a new air furnace to replace the salt bath and two new aging ovens to replace the current aging oven. The new equipment is more flexible and has the ability to do larger parts and handle more than one batch a day. The cost of the new equipment is well over $300,000.
- How does the cost of this system affect the financial position of IMP?
- This equipment will wear out and the cost of maintaining its high level of functioning will increase. When will the competitive advantage the firm has just acquired become a disadvantage through obsolescence?

Average out through the life of the eq

Chapter 8 Objectives

- How does a business account for the loss of value of an asset?
- What is the meaning and types of depreciation?
- What is the difference between book depreciation and tax depreciation?
- What are the effects of depreciation on net income calculation?
- Canada uses the capital cost allowance (CCA) system for tax depreciation. How does it work?

Corporation Internal management

Keep two books

Tax

Recall income statement → SG & A

Future session

Lecture 23 Objectives

- How does a business account for the loss of value of an asset?
- What is the meaning and types of depreciation?
- What is the difference between book depreciation and tax depreciation?
- Book depreciation methods

Asset Depreciation

- Depreciation can be defined as the gradual decrease in utility of fixed assets with use and time.
- Economic Depreciation:
  - Economic depreciation = purchase price – market value
    - (1) Physical depreciation can be defined as a reduction in an asset's capacity to perform its intended service due to physical impairment.
    - (2) Functional depreciation occurs as a result of changes in the organization or in technology that decrease or eliminate the need for an asset.
- Accounting Depreciation: implicit
  - Based on matching concept: A fraction of the cost of the asset is chargeable as an expense in each of the accounting period.

Tracking the value of an asset

charge depreciation into SG&A

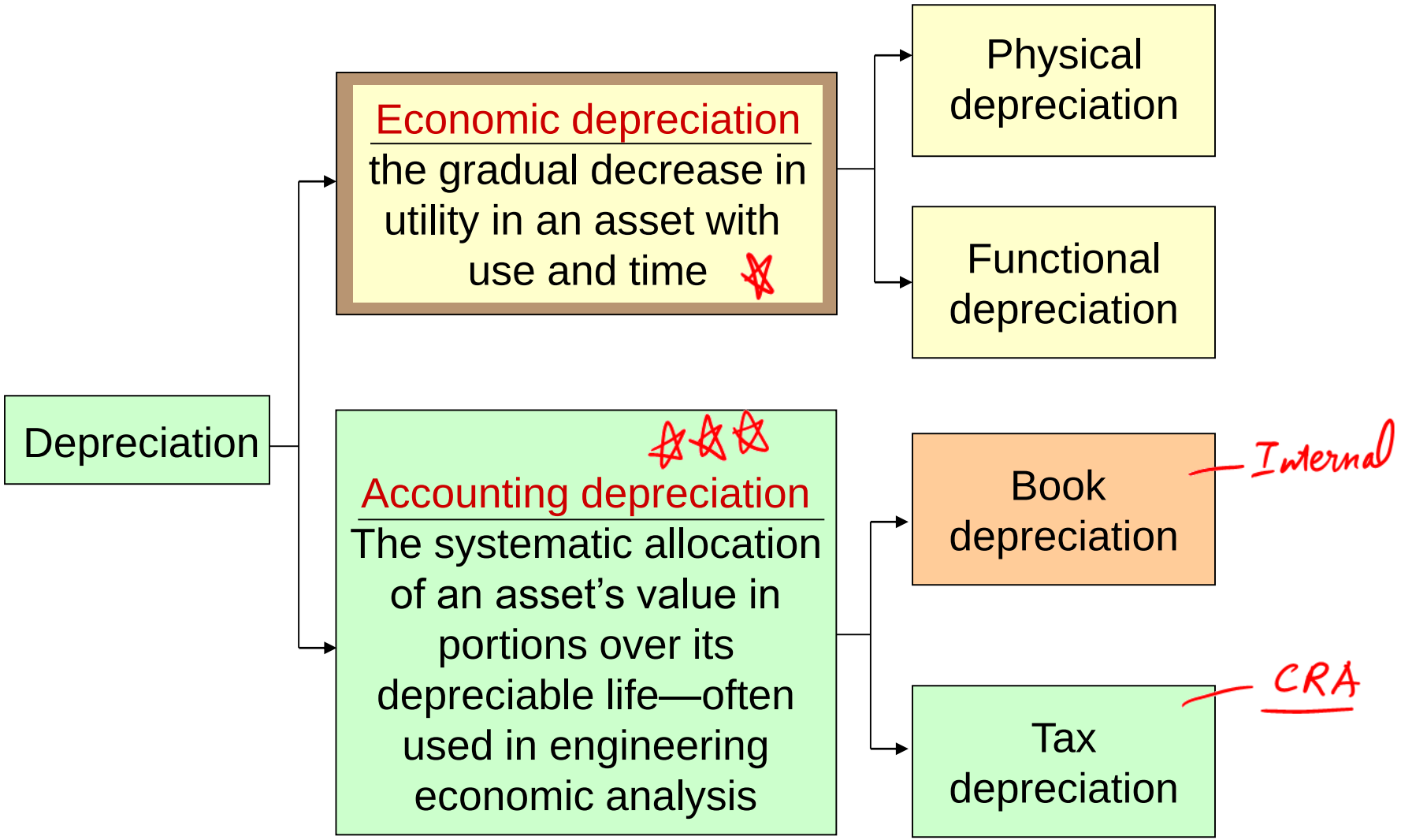
e.g. yearly

Accounting Depreciation

Lump sum, big amount

- The entire acquisition cost of a machine cannot be charged to any one year's production; rather, the cost is spread (capitalized) over the years in which the machine is in service, in accordance with the matching principle.
- The cost charged to operations during a particular year is called depreciation.
- From an engineering economics point of view, our primary concern is with accounting depreciation.

Classification of Types of Depreciation



Depreciable Property

- assets **used in business** or held for production of income
- assets having a **definite useful life** and a life longer than one year
- assets that **generally wear out**, become obsolete, or lose value
- A qualifying asset for depreciation must satisfy **all of the three conditions** above. Land can not be depreciated (no finite useful life).

Data Required to Calculate Depreciation

- The four components of information required to calculate depreciation are:
  1. the cost basis of the asset,
  2. the depreciable life of the asset,
  3. the salvage value of the asset, and
  4. The depreciation method used.

focused in today's lecture

Cost Basis

- Cost basis: represents the total cost to get the asset into usable condition; includes the initial cost of an asset and all other incidental expenses such as freight, and installation
- If a trade-in is involved in the purchased of an asset, the difference between the book value (cost basis minus the total accumulated depreciation) and trade-in allowance must be considered in determining the cost basis for the new asset.

Example 8.1: Cost Basis

- Lanier Corporation purchased an automatic hole-punching machine priced at $62,500. Lanier also paid the inbound transportation charges of $725 on the new machine as well as the labour cost of $2,150 to install the machine in the factory. Lanier also had to prepare the site at the cost of $3,500 before installation. Determine the cost basis for the new machine for depreciation purposes.

Example 8.1: Cost Basis

Cost of a new hole-punching machine (Invoice price)	$62,500
+ Freight	725
+ Installation labour	2,150
+ Site preparation	3,500
Cost basis to use in depreciation calculation	$68,875

Example 8.2: Cost Basis with Trade-In Allowance

- Revised Example 8.1, with the following information:
- Suppose Lanier purchased the hole-punching machine press by trading in a similar machine and paying cash for the remainder. The trade-in allowance was $5,000 and the book value of the machine that was traded in was $4,000.

Example 8.2: Cost Basis with Trade-In Allowance (continued)

Old hole-punching machine (book value)	$4,000
Less: Trade-in allowance	5,000
Unrecognized gains	$1,000
Cost of a new hole-punching machine	$62,500
Less: Unrecognized gains (Salvage − book value)	(1,000)
Freight	725
Installation labour	2,150
Site preparation	3,500
Cost of machine (cost basis)	$67,875

Adjustment of Cost basis

-1000

Useful Life and Salvage Value

- Useful Life: an estimate of the duration over which the asset is expected to fulfill its intended service. It may be based on the physical longevity of the asset or its functionality.
- Salvage Value: The asset's value at the end of its life. It is the amount recovered through sale, trade-in, or salvage net of all costs incurred for disposal and restoring the site to its original condition if required.
  - For long-lived assets, a zero salvage value is often assumed for simplicity.
  - If the salvage value does not equal the projected book value at the end of the asset's useful life, adjustments must be made.

$N \to \infty$

$S = 0$ ~ Conservative practice

of cost basis

Types of Depreciation

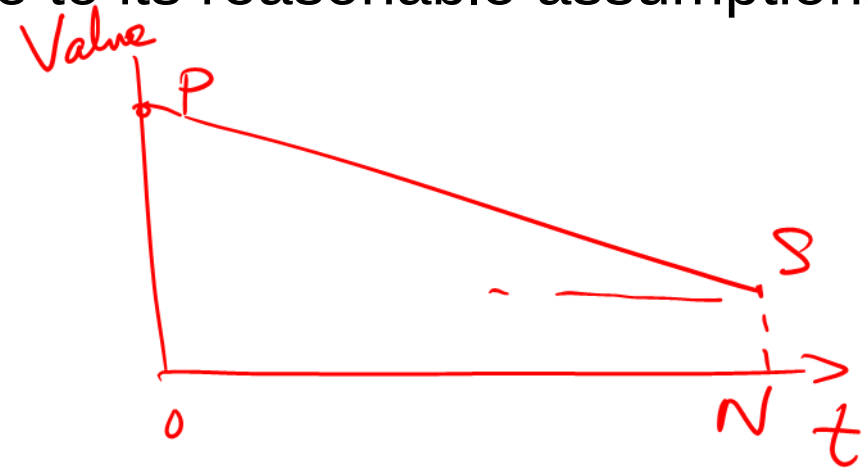
- Book Depreciation – purpose for internal reporting
  - in reporting net income to investors/stockholders
  - in pricing decision
- Tax Depreciation — for CRA
  - in calculating income taxes for Canada Revenue Agency
  - in engineering economics, we use depreciation in the context of tax depreciation

Book Depreciation Methods

- Three different methods are commonly used to calculate book depreciation. These are
  1. the straight-line method,
  2. accelerated methods, and
  3. the units-of-production method.

Straight-Line (SL) Method

- The straight-line (SL) method of depreciation interprets a fixed asset as one that provides its services in a uniform fashion. The asset provides an equal amount of service in each year of its useful life. SL is the prevailing book depreciation method, due to its reasonable assumptions and simplicity.



Straight-Line Depreciation

- Depreciation in period *n* using SL depreciation:

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

(Average)

- Book value of the asset at the end of period *n*:

$$BV_n = P - n\left(\frac{P - S}{N}\right)$$

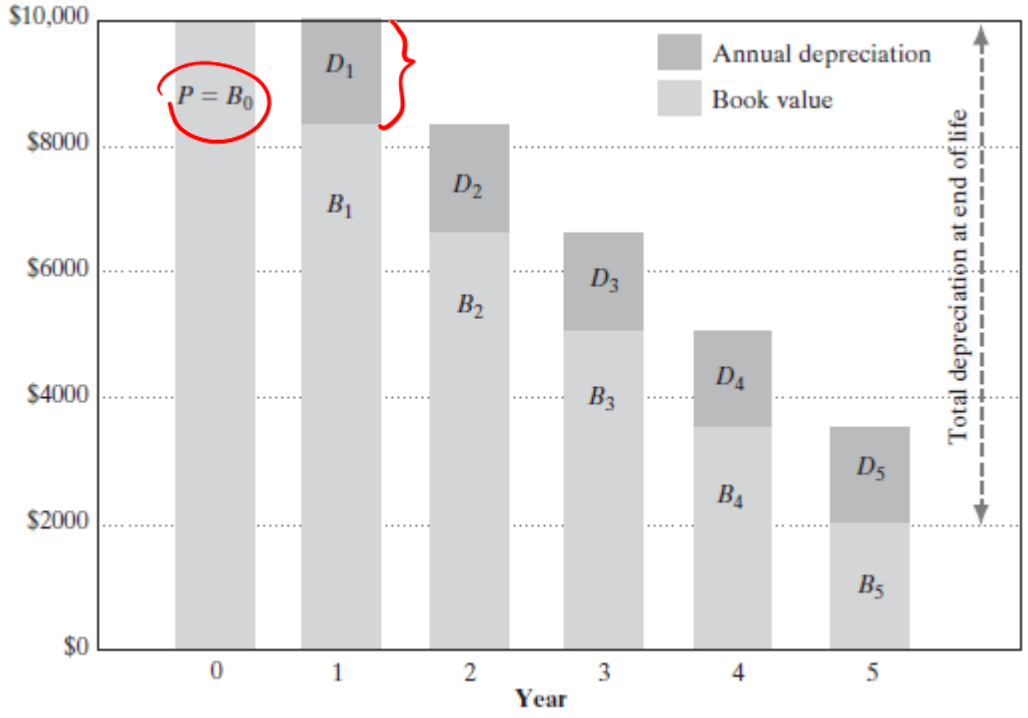
D_n

- where
  - *P* = Cost basis of the asset
  - *S* = Salvage value at the end of the asset's useful life
  - *N* = Useful life

Example 8.3: Straight-Line Depreciation

- An asset was purchased for $10,000. It was estimated to have a five-year service life and a salvage value of $2,000 at the end of its service life.
- If SLD is a good model of asset value, what is its book value at the end of year 4?

Example 8.3: Solution



n	B_{n-1}	D_n	B_n
1	$10,000	$1600	$8400
2	8,400	1600	6800
3	6,800	1600	5200
4	5,200	1600	3600
5	3,600	1600	2000

P= $10,000
N = 5 Years
S = $2,000

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

$$= \frac{10{,}000 - 2{,}000}{5}$$

$$= \$1600 \text{ /yr}$$

Declining Balance (DB) Method

- The DB method of calculating depreciation allocates a fixed fraction of the beginning book balance each year. The fraction, *d*, is obtained as follows:

  $d = (1/N)(\text{multiplier})$

- When the multiplier equals 1.0, the method is called DB of 100%DB. Multipliers of 150% and 200% are referred to as 150%DB and DDB, respectively.
- Depreciation in period *n*

$$D_n = dP(1-d)^{n-1} \text{ for } n \geq 1$$

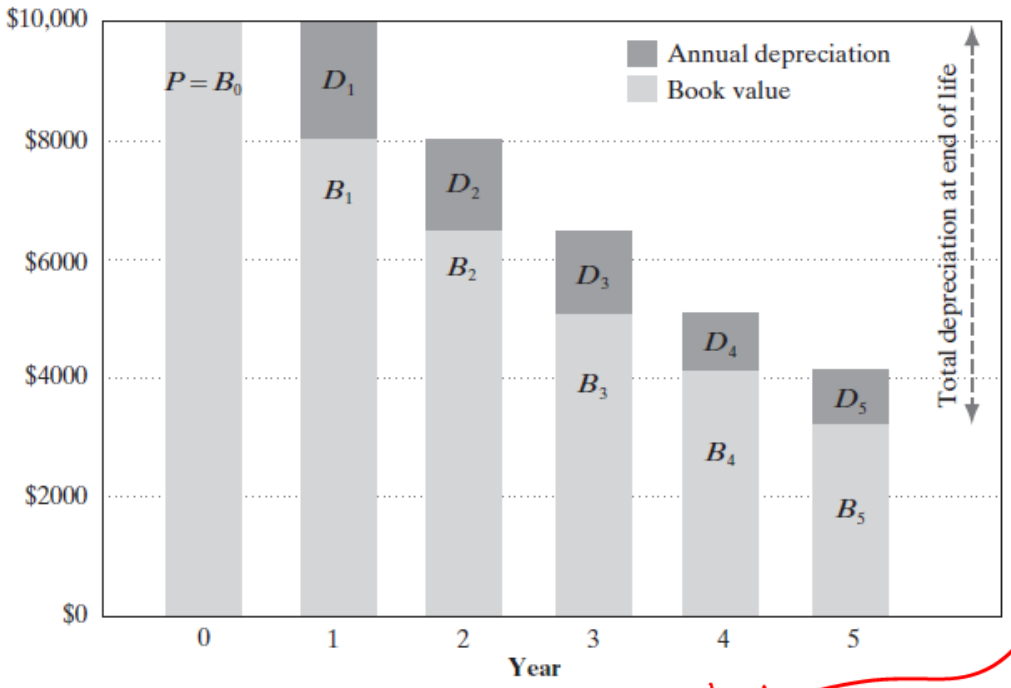
- Book value at the end of period *n*

$$BV_n = P(1-d)^n$$

Example 8.4: Declining Balance Method

- Consider the following accounting information for a photocopier:
- Cost basis of the asset, P = $10,000
- Useful life, N = 5 years
- Estimated salvage value in 5 years, S = $3,277.
- Compute the annual depreciation charges and the resulting book values using the declining balance depreciation method

Example 8.4: Solution



P = \$10,000

N = 5 years

S = \$3277

$d = \frac{1}{N} = \frac{1}{5} = 20\%$

d is held constant (DB)

n	B_{n-1}	D_n	B_n
1	\$10,000	\$2,000	\$8,000
2	\$8,000	\$1,600	\$6,400
3	\$6,400	\$1,280	\$5,120
4	\$5,120	\$1,024	\$4,096
5	\$4,096	\$819	\$3,277

Role played by the salvage value...

Extra Example Declining Balance Method with Switch to Straight Line Method

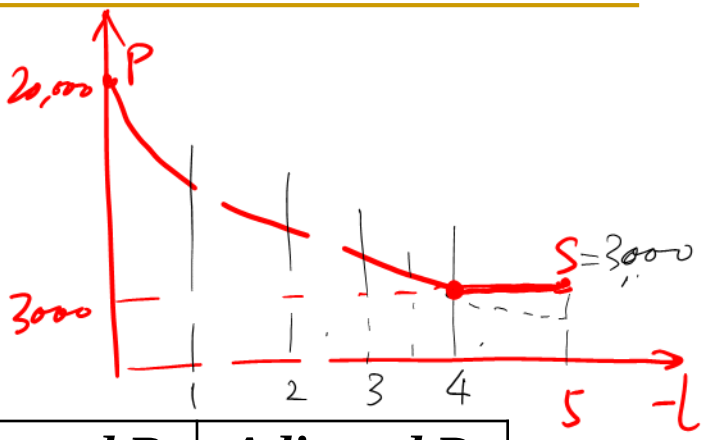
- Upjohn Company purchased new equipment with an estimated useful life of 5 years. The cost of the equipment was $20,000, and the salvage value was estimated to be $3,000 at the end of year 5. Compute the annual depreciation amounts and the book values of the equipment at the end of each year through its 5-year life under each of the following methods of book depreciation:

  (a) DDB with $B_N = S$.

  (b) DB with $B_N = S$.

Extra Example - Continued

$d = \frac{2}{N} = \frac{2}{5} = 40\%$



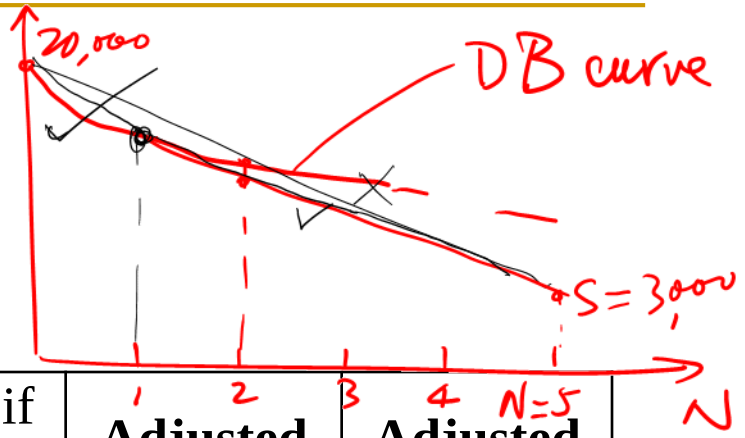
(a) DDB with d = 40%:

Year n	*Calculated DDB B_n*	*Calculated DDB D_n*	***Adjusted B_n***	***Adjusted D_n***
0	$20,000	0	**$20,000**	
1	$12,000	$8,000	**$12,000**	**$8,000**
2	$7,200	$4,800	**$7,200**	**$4,800**
3	$4,320	$2,880	**$4,320**	**$2,880**
4	$2,592	$1,728	**$3,000**	**$1,320**
5	$1,555	$1,037	**$3,000**	**$0**

$B_{n-1} - S = 4,320 - 3,000 = 1320$

Extra Example - Continued

(b) DB with d = 20%



Year n	Calculated DB B_n	Calculated DB D_n	The D Value if switching to S-L method at the beginning of year n	**Adjusted D_n**	**Adjusted B_n**
0	$20,000				**$20,000**
1	$16,000	**$4,000**	$3,400	**$4,000**	**$16,000**
2	$12,800	$3,200	**$3,250**	**$3,250**	**$12,750**
3	$10,240	$2,560	$3,267	**$3,250**	**$9,500**
4	$8,192	$2,048	$3,620	**$3,250**	**$6,250**
5	$6,554	$1,638	$5,192	**$3,250**	**$3,000**

Sum-of-Years-Digits (SOYD) Method

Example $1+2+3+4+5=15$

$\frac{5}{15}$ $\frac{4}{15}$ $\frac{3}{15}$ $\frac{2}{15}$ $\frac{1}{15}$

- SOYD also results in larger depreciation charges during the early years of an asset's life and smaller charges as the asset reaches the end of its estimated useful life. It guarantees $B_n = S$

$$SOYD = 1 + 2 + \ldots + N = \frac{N(N+1)}{2}$$

- Each year the depreciation charge is computed by:

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

① $N = 5$ $n = 1$

$$D_1 = \frac{5-1+1}{15}(P-S) = \frac{5}{15}(P-S)$$

② $N = 5$ $n = 5$

$$D_5 = \frac{5-5+1}{15}(P-S) = \frac{1}{15}(P-S)$$

Example 8.7: SOYD Depreciation

- Compute the SOYD depreciation schedule for an automobile if :

  P = $10,000

  N = 5 years (useful life)

  S = $2,000 (salvage value)

Example 8.7: Solution

- Given: P = $10,000, S = $2000, N = 5 years.
- Find: D_n and B_n for n = 1 to 5.
- We first compute the sum-of-years' digits:
  - SOYD = 1 + 2 + 3 + 4 + 5 = 5(5 + 1)/2 = 15

End of Year		D_n			B_n
1	(5/15)	× ($10,000 – $2,000)	=	$2,667	$7,333
2	(4/15)	× (10,000 – 2,000)	=	2,133	5,200
3	(3/15)	(10,000 – 2,000)	=	1,600	3,600
4	(2/15)	(10,000 – 2,000)	=	1,067	2,533
5	(1/15)	(10,000 – 2,000)	=	533	2,000

Units-of-Production (UP) Method

- The depreciation charge for a period is related to the number of service units consumed in that period.

$$D_n = \frac{\text{Service units consumed for year}}{\text{Total service units}}(P - S)$$

- The cost of each service units is the net cost of the asset divided by the total number of such units.
- Advantage: depreciation varies with production volume, giving a more accurate picture of machine use
- Disadvantage: the collection of data for machine use and accounting methods are somewhat tedious.

Example 8.8: Units-of-Production Depreciation

- A truck for hauling coal has an estimated net initial cost of $55,000 and is expected to give service for 250,000 kilometres, resulting in a $5,000 salvage value. Compute the allowed depreciation amount for the year in which the truck usage was 30,000 kilometres.

Example 8.8: Solution

- Given: P = \$55,000, S = \$5000, total service units = 250,000 kilometres, usage for this year = 30,000 kilometres
- Find: Depreciation amount in this year
- The depreciation expense in a year in which the truck travelled 30,000 kilometres would be

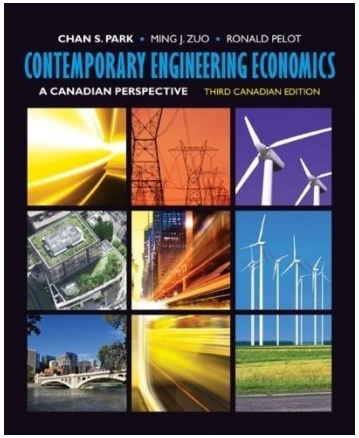
$$D_n = \frac{\text{Service}\ 30{,}000\ \text{kilometres}}{250{,}000\ \text{kilometres}}(\$55{,}000 - \$5000)$$

$$= \left(\frac{3}{25}\right)(\$50{,}000) = \$6000$$

Total life of the truck

Estimate $N = \frac{250{,}000}{30{,}000} = 8.3\ \text{yr}$

Summary



From an engineering economics point of view, our primary concern is with accounting depreciation, which is the systematic allocation of an asset's value over its depreciable life.