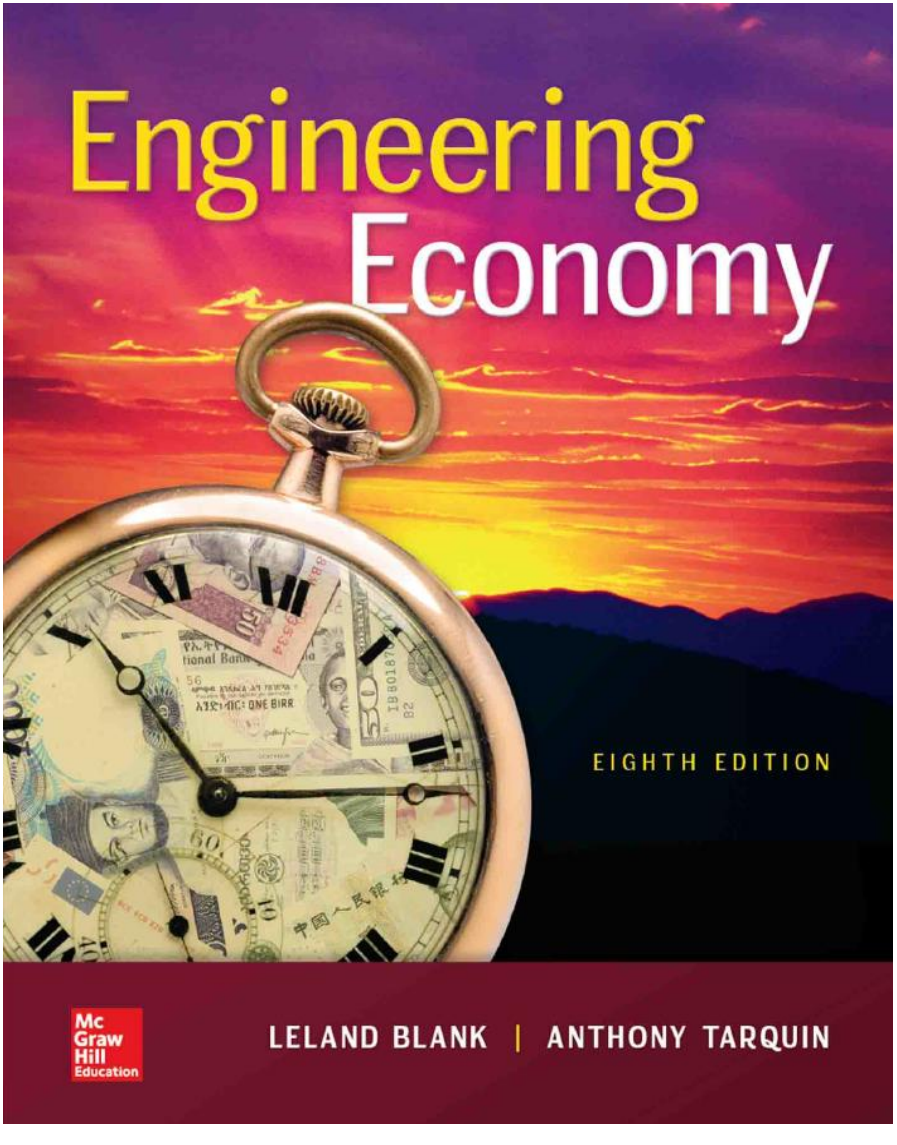

Chapter 16

Depreciation Methods

Lecture slides to accompany

Engineering Economy

8th edition

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Mc Graw Hill Higher Education

LEARNING OUTCOMES

1. Understand basic terms of asset depreciation
2. Apply straight line method of depreciation
3. Apply DB and DDB methods of depreciation
4. Apply MACRS method of depreciation
5. Select asset recovery period for MACRS
6. Explain depletion and apply cost depletion & percentage depletion methods

Depreciation Terminology

Definition: ***Book (noncash) method*** to represent **decrease in value** of a tangible asset over time

Two types: book depreciation and tax depreciation

Book depreciation: used for *internal accounting* to track value of assets

Tax depreciation: used to determine *taxes due* based on tax laws

In USA only, **tax depreciation** *must be calculated* ***using MACRS***; **book depreciation** *can be calculated* ***using any method***

Depreciation Terminology

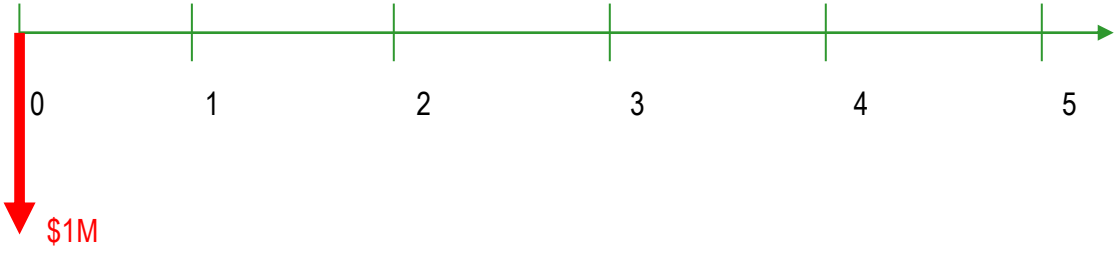
Assets		Liabilities & Owner's Equity	
Cash	$21,000	Invested Capital	$50,000
Accounts Receivable	$10,000	Retained Earning	$16,000
Tools	$35,000		
Total	$66,000	Total	$66,000

Assets		Liabilities & Owner's Equity	
Cash	$21,000	Invested Capital	$50,000
Accounts Receivable	$10,000	Retained Earning	$9,000
Tools(Tangible Asset)		($16,000 - **$7,000**)	
	$28,000		
($35,000 - **$7,000**)			
Total	$59,000	Total	$59,000

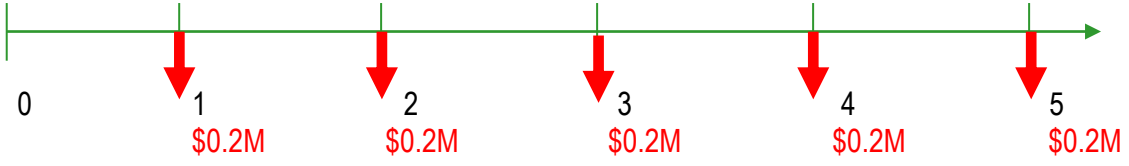
Concept

Assume A Co. purchase $1M machine that has 5 years of life with SL(or DB) depreciation.

- Actual Cash Flows

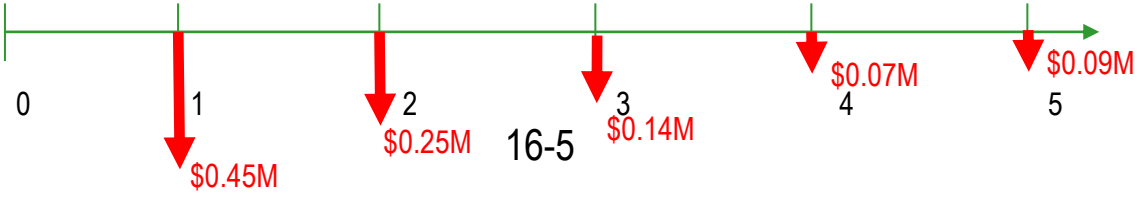


- Accounting Depreciation Cost (SL)



OR

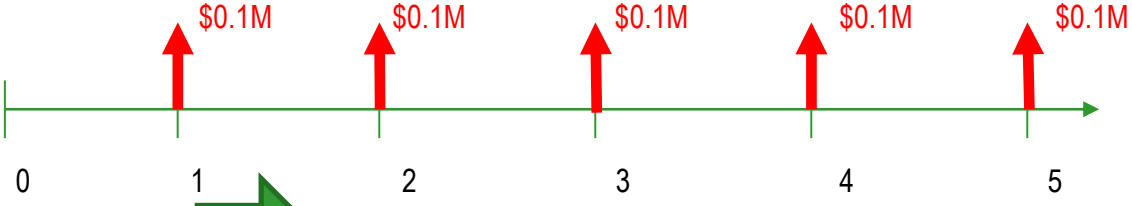
- Accounting Depreciation Cost (DB)



Concept (Discussed later)

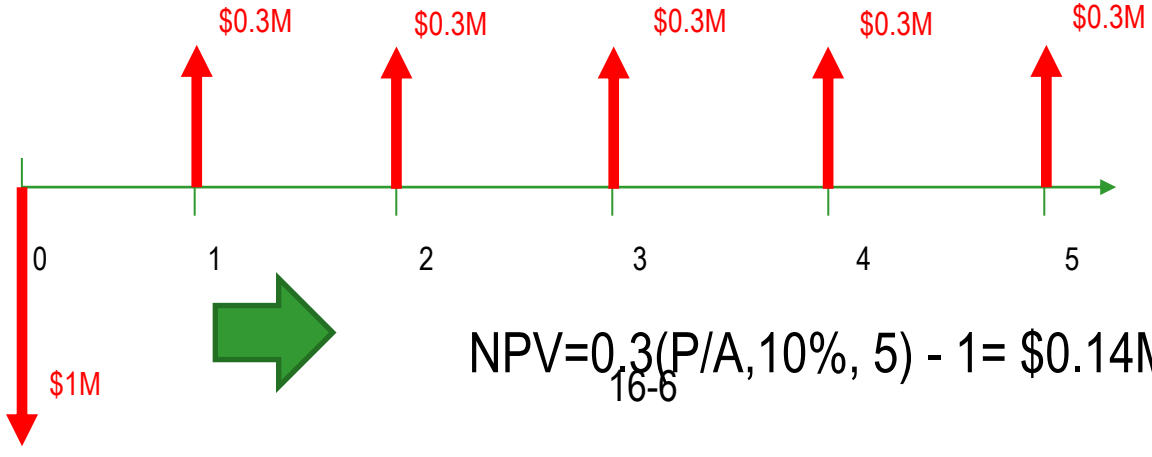
Assume A Co. purchase $1M machine that has 5 years of life with SL depreciation. Assuming NOPAT is $0.1M, compare Accounting analyses and Actual cash flows with i=10%.

- Accounting Depreciation Cost (SL)



NPV=0.1(P/A,10%, 5)=$0.38M

- Actual Cash Flows



NPV=0.3(P/A,10%, 5) - 1= $0.14M

Common Depreciation Terms

First cost *P* or unadjusted basis *B*: Total installed cost of asset

Book value BV_t: Remaining undepreciated capital investment in year t

Recovery period *n*: Depreciable life of asset in years

Market value *MV*: Amount realizable if asset were sold on open market

Salvage value *S*: Estimated trade-in or MV at end of asset's useful life

Depreciation rate d_t: Fraction of first cost or basis removed each year t

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Personal property: Possessions of company used to conduct business

Real property: Real estate and all improvements **(land is not depreciable)**

Half-year convention: Assumes assets are placed in service in midyear

Straight Line Depreciation

➡ **Book value decreases *linearly with time***

$$D_t = \frac{B - S}{n}$$

Where: D_t = annual depreciation charge
t = year
B = first cost or unadjusted basis
S = salvage value
n = recovery period

$$BV_t = B - tD_t$$

Where: BV_t = book value after t years

SL depreciation rate is **constant** for each year: $d = d_t = 1/n$

Example: SL Depreciation

An argon gas processor has a first cost of $20,000 with a $5,000 salvage value after 5 years. Find (a) D_3 and (b) BV_3 for year three. (c) Plot book value vs. time.

Solution: (a) $D_3 = (B - S)/n$

$= (20,000 - 5,000)/5$

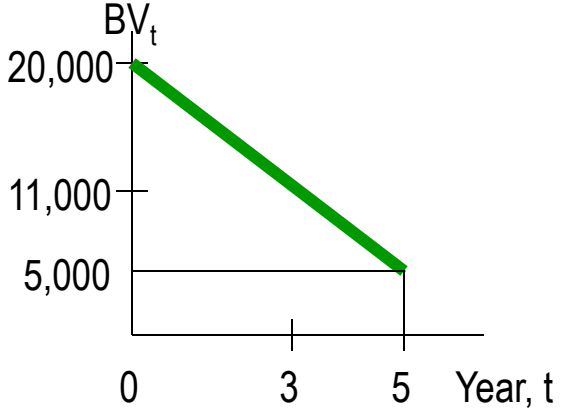
$= \$3,000$

(b) $BV_3 = B - tD_t$

$= 20,000 - 3(3,000)$

$= \$11,000$

(c) Plot BV vs. time



Declining Balance (DB) and Double Declining Balance (DDB) Depreciation

➡ **Determined by multiplying BV at beginning of year *by fixed percentage d***

- **Max rate for d is twice straight line ra**
- **Cannot depreciate below salvage val**

$BV_0 = B$

$BV_1 = BV_0 - BV_0 \cdot d = B(1 - d)$

$BV_2 = BV_1 - BV_1 \cdot d = B(1 - d)^2$

:

$BV_t = BV_{t-1} - BV_{t-1} \cdot d = B(1 - d)^t$

Book value for year t is given by:

$$BV_t = B(1 - d)^t$$

Depreciation for year t is obtained by either relation:

$$D_t = dBV_{t-1} = dB(1 - d)^{t-1}$$

Where: D_t = depreciation for year t

d = uniform depreciation rate (2/n for DDB)

B = first cost or unadjusted basis

BV_{t-1} = book value at end of previous year

Declining Balance (DB) Depreciation

➡ **Determined by multiplying B at beginning of year *by fixed percentage d where Max. d = 2/n***

Book value for year t is given by:

$$B_n = S = B(1 - d)^n$$

$$\therefore d = 1 - \sqrt[n]{\frac{S}{B}}$$

Where: B_n = Book value for year n
d = uniform depreciation rate
B = first cost or unadjusted basis

Example: Double Declining Balance

A depreciable construction truck has a first cost of $20,000 with a $4,000 salvage value after 5 years. Find the (a) depreciation, and (b) book value after 3 years using DDB depreciation.

Solution:

(a) $d = 2/n = 2/5 = 0.4$

$D_3 = dB(1 - d)^{t-1}$

$= 0.4(20{,}000)(1 - 0.40)^{3-1}$

$= \$2880$

(b) $BV_3 = B(1 - d)^t$

$= 20{,}000(1 - 0.4)^3$

$= \$4320$

Spreadsheet Functions for Depreciation

Straight line function: SLN(B,S,n)

Declining balance function: DB(B,S,n,t)

Double declining balance function: DDB(B,S,n,t,d)

Note: It is better to use the DDB(d= $n * depreciation\ rate$) function for DB and DDB depreciation. DDB function checks for BV < S and is more accurate than the DB function(3-digits only).

EXAMPLE 16.3

were used in column B (Figure 16–3), the fixed rate applied would be 0.188. The resulting D_t and BV_t values for years 8, 9, and 10 would be as follows:

t	D_t, \$	BV_t, \$
8	3,501	15,120
9	2,842	12,277
10	2,308	9,969

Also noteworthy is the fact that the DB function uses the implied rate without a check to halt the book value at the estimated salvage value. Thus, BV_{10} will go slightly below $S = \$10{,}000$, as shown above. However, the DDB function uses a relation different from that of the DB function to determine annual depreciation—one that correctly stops depreciating at the estimated salvage value, as shown in Figure 16–3, cells E17–E18.

14	6	5,310	22,974	5,243	20,972
15	7	4,313	18,661	4,194	16,777
16	8	3,503	15,157	3,355	13,422
17	9	2,846	12,311	2,684	10,737
18	10	2,311	10,000	737	10,000
19					
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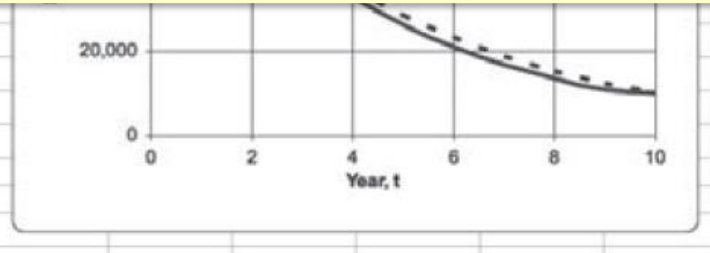

= DDB(B$2,B$3,B$4,$A18,10*B5)

= DDB(B$2,B$3,B$4,$A18)

Figure 16–3
Annual depreciation and book value using DB and DDB methods, Example 16.3.

MACRS Depreciation

Required method to use for **tax depreciation** in **USA only**

Originally developed to offer accelerated depreciation for economic growth

$$D_t = d_t B$$

Where: D_t = depreciation charge for year t
B = first cost or unadjusted basis
d_t = depreciation rate for year t (decimal)

Get value for d_t from IRS table for MACRS rates

$$BV_t = B - \sum_{j=1}^{j=t} D_j$$

Where: D_j = depreciation in year j
$\sum D_j$ = all depreciation through year t

MACRS Depreciation

- Always depreciates to **zero**; no salvage value considered
- Incorporates **switching from DDB to SL** depreciation
- ***Standardized recovery periods*** (n) are tabulated
- MACRS recovery time is always **n+1 years**;
  half-year convention assumes purchase in midyear
- No special spreadsheet function; can arrange **VDB function** to display MACRS depreciation each year

Example: MACRS Depreciation

A finishing machine has a first cost of $20,000 with a $5,000 salvage value after 5 years. Using MACRS, find (a) D and (b) BV for year 3.

Solution: **(a)** From table, $d_3 = 19.20$

$$D_3 = 20{,}000(0.1920)$$
$$= \$3{,}840$$

(b) $$BV_3 = 20{,}000 - 20{,}000(0.20 + 0.32 + 0.1920)$$
$$= \$5{,}760$$

Note: Salvage value **S = $5,000** is **not** used by MACRS and **$BV_6 = 0$**

EXAMPLE 16.4

Chevron Phillips Chemical Company in Baytown, Texas, acquired new equipment for its polyethylene processing line. This chemical is a resin used in plastic pipe, retail bags, blow molding, and injection molding. The equipment has an unadjusted basis of $B = \$400{,}000$, a life of only 3 years, and a salvage value of 5% of B. The chief engineer asked the finance director to provide an analysis of the difference between (1) the DDB method, which is the internal book depreciation and book value method used at the plant, and (2) the required MACRS tax depreciation and its book value. He is especially curious about the differences after 2 years of service for this short-lived, but expensive asset. Use hand and spreadsheet solutions to do the following:

(*a*) Determine which method offers the larger total depreciation after 2 years.
(*b*) Determine the book value for each method after 2 years and at the end of the recovery period.

TABLE 16–3 Comparing MACRS and DDB Depreciation, Example 16.4

		MACRS		DDB	
Year	Rate	Tax Depreciation, $	Book Value, $	Book Depreciation, $	Book Value, $
0			400,000		400,000
1	0.3333	133,320	266,680	266,667	133,333
2	0.4445	177,800	88,880	88,889	44,444
3	0.1481	59,240	29,640	24,444	20,000
4	0.0741	29,640	0		

MACRS Recovery Period

Recovery period (n) is function of ***property class***

Two systems for determining recovery period:

- **general depreciation system (GDS)** – **fastest write-off allowed**
- **alternative depreciation system (ADS)** – **longer recovery; uses SL**

IRS publication 946 gives n values for an asset. For example:

	MACRS n value	
Asset description	**GDS**	**ADS range**
Special manufacturing devices, racehorses, tractors	3	3 - 5
Computers, oil drilling equipment, autos, trucks, buses	5	6 - 9.5
Office furniture, railroad car, **property not in another class**	7	10 – 15
Nonresidential real property (not land itself)	39	40

Depletion Methods

Depletion*: book (noncash) method to represent decreasing value of *natural resources

Two methods: *cost* depletion (CD) and *percentage* depletion (PD)

Cost depletion: Based on level of activity to remove a natural resource

- Calculation: Multiply factor CD_t by amount of resource removed

  Where: **CD_t = first cost / resource capacity**

- Total depletion can not exceed first cost of the resource

Percentage depletion: Based on gross income (GI) from resource

- Calculation: Multiply GI by standardized rate (%) from table
- Annual depletion can not exceed 50% of company's taxable income (TI)

Example: Cost and Percentage Depletion

A mine purchased for $3.5 million has a total expected yield of one million ounces of silver. Determine the depletion charge in year 4 when 300,000 ounces are mined and sold for $30 per ounce using (a) cost depletion, and (b) percentage depletion. (c) Which is larger for year 4?

Solution: Let depletion amounts equal CDA_4 and PDA_4

(a) Factor, CD_4 = 3,500,000/ 1,000,000 = $3.50 per ounce

$$CDA_4 = 3.50(300{,}000) = \$1{,}050{,}000$$

(b) Percentage depletion rate for silver mines is 0.15

$$PDA_4 = (0.15)(300{,}000)(30) = \$1{,}350{,}000$$

(c) Claim **percentage depletion** amount, provided it is ≤ 50% of TI

Summary of Important Points

- **Two types** for depreciation: **tax and book**
- Classical methods are **straight line** and **declining balance**
- In USA only, **MACRS** method is ***required*** for ***tax depreciation***
- Determine MACRS recovery period using either **GDS** or **ADS**
- Switching between methods is allowed; MACRS switches automatically from DDB to SL to maximize write-off
- **Depletion** (instead of depreciation) used for ***natural resources***
  Two methods *of depletion:* ***cost*** *(amount resource removed* $\times$ CD_t *factor) and* ***percentage*** *(gross income* $\times$ *tabulated %)*

HOMEWORK

1. Please solve every Examples in your textbook. You do not have to submit your works.

2. No Exercise Homework.