Chapter 16 – Depreciation Methods

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Chapter Outline

• Depreciation terms
• Straight line
• Declining Balance
• MACRS
• Depletion

Depreciation Terminology

- **Depreciation** is the reduction in value over time of an asset.
- Brought on by:
  - Wear and tear, use;
  - Deterioration;
  - Obsolescence.
- **Book Depreciation** – used by businesses for internal accounting purposes
- **Tax Depreciation** – used in tax calculations according to government regulations.

Important Terms

- **First Cost or Unadjusted Basis - B**
  - Initial purchase price + all costs incurred in placing the asset in service
- **Book Value - BV**
  - Remaining undepreciated capital investment on the books after total amount of depreciation charges to date have been subtracted from the basis.
- **Recovery Period – n**
  - Depreciable life of the asset in question – often set by law.
- **Market Value - MV**
  - Amount realized by sale on the open market–depending on the asset, can be drastically different from BV
- **Salvage Value - S**
  - Estimated trade-in value or market value at the end the asset’s useful life
- **Depreciation Rate - d**
  - The fraction of the first cost removed by depreciation each year

Depreciation Methods

- **Classical methods for book depreciation**
  - Straight Line (SL) Model
  - Declining Balance (DB) Model
- **Modified Accelerated Cost Recovery System (MACRS) Methods**
  - Method for tax depreciation in the U.S.
  - Acceptable for book depreciation also.
General Book value Curves for Different Depreciation Models

![Diagram showing book value curves for different depreciation models.]

**Straight Line (SL) Depreciation**

- The standard on which all other depreciation models are compared

**Notation:**
- \( t = \) year \( (t = 1, 2, \ldots, n) \)
- \( D_t = \) annual depreciation charge
- \( B = \) first cost or unadjusted basis
- \( S = \) Estimated salvage value
- \( n = \) recovery period
- \( d_t = \) depreciation rate

- \( D_t = D = \frac{B - S}{n} \)
- \( d_t = \frac{D_t}{B - S} = \frac{1}{n} \)
- \( BV_t = B - tD_t \)

- \( BV_t \) is the book value at the end of year \( t \)

Excel Function: \( =\text{SLN}(B,S,n) \)

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

- DB is an accelerated depreciation method
- Provides greater depreciation amounts in the early time periods over straight line
- Fixed percentage (OR) Uniform percentage method
- A fixed percentage is removed each annually

**Declining Balance (DB)**

- Fixed percentage: \( d \)
- Book value at EOY: \( BV_t \)

Then, Depreciation for year \( t \):

\[ D_t = (d)BV_{t-1} \]

\[ BV_t = BV_{t-1} - D_t = (1-d)BV_{t-1} \]

Book value for year \( t \), relative to first cost \( B \):

\[ BV_t = B(1-d)^t \]

**Declining Balance (DDB)**

Depreciation for year \( t \), relative to \( B \):

\[ D_t = dBV_{t-1} = Bd(1-d)^{t-1} \]

Actual depreciation "rate" for year \( t \), relative to \( B \):

\[ d_t = \frac{D_t}{B} = \frac{Bd(1-d)^{t-1}}{B} = d(1-d)^{t-1} \]
Declining Balance (DB) and Double Declining Balance (DDB)

Max allowable depreciation rate:
\[ d_{\text{max}} = \frac{2}{n} \]
Double DB Method used this percentage.

Acceptable range for \( d \) is:
\[ 0 < d < d_{\text{max}} \]

When \( 0 < d < 1 \), BV never goes to zero for finite \( t \).

When given Salvage \( S > 0 \), the implied \( d \) is:
\[ d = 1 - \left( \frac{S}{B} \right)^{1/n} \]

Where given \( d \), the implied Salvage Value is calculated as:
\[ S = BV_n = B(1-d)^n \]

Excel Function: =DDB(B,S,n,t,d) *Read carefully before using!

Salvage Value in DB method

How to handle when both \( S \) and \( d \) are given?
- \( d \) gets priority over the given \( S \) in finding \( BV_t \)
- Call the given \( S \), the estimated salvage value \( (S_e) \) and find the implied salvage value \( S_i = B(1-d)^n \)
- Usually, \( S_e \) is in the range of 0 to \( S_i \) if so ignore \( S_e \)
- If \( S_i \) is more than \( S_e \), then it is correct to stop charging depreciation from that point onwards

Example 16.2

A fiber optics testing device is to be DDB depreciated. It has a first cost of $25,000 and an estimated salvage value of $2500 after 12 years. (a) Calculate the depreciation and book value for years 1 and 4. (b) Calculate the implied salvage value after 12 years.

Example 16.2

Solution:

(a) The DDB fixed depreciation rate is \( d = 2/n = 2/12 = 0.1667 \) per year. Use Equations (16.7) and (16.8).

Year 1:
- \( D_1 = 0.1667\times25,000 = 4167 \)
- \( BV_1 = 25,000 - 0.1667\times25,000 = 20,833 \)

Year 4:
- \( D_4 = 0.1667\times25,000 = 4167 \)
- \( BV_4 = 25,000 - 0.1667\times4167 = 24,111 \)

The DDB fractions for \( D_t \) and \( B_{t-1} \) are, respectively, DDB(2500,2500,12.1) and DDB(2500,2500,12.4).

(b) From Equation (16.10), the implied salvage value after 12 years is
\[ S_i = 25,000 - 0.1667\times25,000 = 2803 \]

Since the estimated \( S = 2500 \) is less than \( S_i = 2803 \), the asset is not fully depreciated and its 12-year expected life is reached.

Modified Accelerated Cost Recovery System (MACRS)

MACRS was derived from the 1981 ACRS system and went into effect in 1986.

- Defines statutory recovery (depreciation) percentages.
- Percentages were derived from the DDB method and SL method.

MACRS assumes all assets depreciated by this method will have a "0" salvage value at the end of the recovery life.

\[ d_t = \frac{d}{D} \]

\[ BV_{t+1} = BV_{t} - D_t \]

\[ BV_{t} = \text{first cost} - \sum_{j=1}^{t} D_j \]
Depletion Methods (Section 16.6)

- **Cost Depletion (See Ex 16.5)**
  - Also called *factor depletion*
  - Based upon the level of activity or usage;
  - Time is not involved.

  \[
  p_t = \frac{\text{first cost}}{\text{resource capacity}}
  \]

  \[
  p_t = \text{cost} t \text{ depletion factor for year } t
  \]

- **Percentage Depletion (See Ex 16.6)**
  - Applies a stated % of the resource's gross income provided it does not exceed 50% of the firm's current taxable income.
  - Percentage depletion amount = percentage x gross income from property

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**Example 16.5**

Temple Island Corporation has purchased the rights to extract ore property valued for $700,000. An estimated 350 million bushels of lumber are available.

(a) Determine the depletion amount for the first 2 years if 15 million and 22 million bushels are removed.

(b) After 2 years, the total recoverable volume was estimated to be 450 million bushels. If the timber rights were purchased, compute the new cost depletion factor.

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**Example 16.6**

A gold mine was purchased for $10 million. It has an anticipated gross income of $5.0 million per year for years 1 to 5 and $3.0 million per year after year 5. Assume that depletion charges do not exceed 30% of taxable income. Compute annual depletion amounts for the mine. How long will it take to recover the initial investment at i = 10%?

**Solution**

A 15% depletion applies to gold. Depletion amounts are:

- **Years 1 to 5:** $0.15(5) million = $75(000)
- **Years thereafter:** $0.15(0) million = $45(000)

A total of $3.75 million is written off in 5 years, and the remaining $6.25 million will be written off at $1.25 million per year. The total number of years is:

\[
5 \times \frac{3.75}{1.25} = 5 + 1.0 = 10.0
\]

In 10 years, the initial investment could be fully depleted.