Chapter 10: Depreciation

• Depreciation
  – A decrease in value of an asset each year
  – A non-cash cost (no money changing hands) that affects income taxes
  – An annual deduction against before-tax income
  – A business expense the government allows to offset the loss in value of business assets

• Usually you pay for the asset “up front”, but depreciate it over time (e.g., a new truck)

• Depreciation deductions reduce the taxable income of businesses and thus reduce the amount of tax paid

• Government allows some choice among depreciation methods
  – Firm wants to use the method that will minimize its taxable income
  – To do so, it must understand how the depreciation methods work

Depreciation

Example

• A firm has $1,000,000 of taxable income. If its tax rate is 25%, it would pay $250,000 in taxes ignoring depreciation
  – If it can deduct $50,000 in depreciation charges, its net taxable income is $950,000. Thus it would pay taxes of $0.25 (950,000) = $237,500
  – Depreciation saves $250,000 - $237,500 = $12,500 = $0.25(50,000)

• Joe invests $10,000 with a 10% return. His taxable income is $1,000
  – If you are in the 25% tax bracket, U.S. takes $250, so your net return is $750 ⇒ 7.5%
  – If you could have found an 8% investment for your $10,000 that was not taxable, you would have made a better choice (800 > 750)
  – Taxable vs. tax-free investments

• Taxes (Chapter 11) are essential to consider in realistic economic analyses. First we must understand how depreciation works
**Depreciation**

- **Economic depreciation**: the gradual decrease in utility in an asset with use and time
  - Physical depreciation
  - Functional depreciation

- **Accounting depreciation**: The systematic allocation of an asset’s value in portions over its depreciable life—often used in engineering economic analysis
  - Book depreciation
  - Tax depreciation

**Depreciation**

- Important reasons for depreciation include
  - deterioration (wear on parts that affect its functionality)
  - obsolescence (product becomes outdated)

- Economic depreciation can mean
  - a decrease in *market value* or *value to the owner*

- Accounting depreciation is defined as the systematic allocation of the cost of an asset over its depreciable life
  - This period may differ from the useful life

- Accountant definition is used for determining taxable income. It is this definition that is most important to us

- **NOTE**: While many things depreciate, some things, including land, do not. The value of land can change, but it is not because of depreciation
Depreciate or Expense?

• A business asset can be depreciated if:
  1) It is used for business purposes to produce income
  2) It has a determinable useful life that is longer than one year
  3) It is an asset that decays, gets used up, wears out, becomes obsolete, or loses value to the owner from natural causes

Example (Pizza Parlor)

Joe runs a pizza parlor. He classifies some of his cost items as follows:

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Type of Cost</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pizza dough, toppings</td>
<td>Expensed</td>
<td>Life &lt; 1 yr, loses value immediately</td>
</tr>
<tr>
<td>Delivery van</td>
<td>Depreciated</td>
<td>Meets 3 depreciation requirements</td>
</tr>
<tr>
<td>Employee wages</td>
<td>Expensed</td>
<td>Life &lt; 1 yr, loses value immediately</td>
</tr>
<tr>
<td>Furnishings for dining room</td>
<td>Depreciated</td>
<td>Meets 3 depreciation requirements</td>
</tr>
<tr>
<td>New baking oven</td>
<td>Depreciated</td>
<td>Meets 3 depreciation requirements</td>
</tr>
<tr>
<td>Utilities for refrigerator</td>
<td>Expensed</td>
<td>Life &lt; 1 yr, loses value immediately</td>
</tr>
</tbody>
</table>

Items to Expense

• Examples of Expensed Items
  – Labor
  – Utilities
  – Materials
  – Insurance

• Expensed items are (often recurring) expenses in regular business operations. They are consumed over short periods (e.g., monthly or biweekly salaries)

• Expenses are subtracted from business revenues, when they occur, for tax purposes

• Expenses reduce income taxes – businesses can write off their full amounts when they occur
Items to Depreciate

- First, we define what constitutes business property. Each class has different depreciation rules (will be discussed…)

Business Property can be classified as either:
- **Tangible property**, which can be seen, touched, and felt
  - **Real property** (think “real estate”) includes land, buildings, and all things growing on, built on, constructed on, or attached to the land
  - **Personal property** includes equipment, furnishing, vehicles, office machinery, and anything that is tangible excluding those assets defined as real property. (Note “personal” does not refer to being owned by a person or being private.)
- **Intangible property**, which includes all property that has value to the owner but cannot be directly seen or touched
  - Examples include patents, trademarks, trade names, and franchises

Assets to Depreciate

**Examples of depreciable business assets:**
- Copy machines, computer networks, pc's, ...
- Buildings and interior furnishings
- Production equipment

**Examples of non-depreciable business assets:**
- Land
  - Leased property (only the owner may claim depreciation expenses)
- Land does not wear out, lose value, or have a determinable useful life. In fact, it often increases in value
- Depreciation on tangible property used for both business and personal activities (e.g., home office) can be taken only in proportion to the use for business expenses
- Assets subject to depletion (covered later in this chapter)
Sample Depreciation Calculations

**Example**
A PC costs $1,800. Its annual depreciation charges are $800, $600, and $350 for three years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Depreciation</th>
<th>Book Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$1,800</td>
<td>$1,800</td>
</tr>
<tr>
<td>1</td>
<td>$800</td>
<td>$1,000</td>
</tr>
<tr>
<td>2</td>
<td>$600</td>
<td>$400</td>
</tr>
<tr>
<td>3</td>
<td>$350</td>
<td>$50</td>
</tr>
</tbody>
</table>

- $1,800 is called the *initial cost* or *cost basis*
- $D_n$ denotes the depreciation deduction in year $t$. Thus $D_1 = $800, $D_2 = $600, $D_3 = $350
- Depreciation charges made to date = $D_n^t = \sum_{i=1}^{n} D_i$
- Book Value at end of year $n$, $B_n$ (or also called $BV_n$)
  - The remaining unallocated cost of an asset
  - $B_n = \text{Cost Basis} - \text{Depreciation charges made to date} = I - D_n^t$

### Calculating the Cost Basis

<table>
<thead>
<tr>
<th>Cost Basis Calculation</th>
<th>Cost Basis with Trade-In Allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of new hole-punching machine (Invoice price)</td>
<td>$62,500</td>
</tr>
<tr>
<td>+ Freight</td>
<td>725</td>
</tr>
<tr>
<td>+ Installation labor</td>
<td>2,150</td>
</tr>
<tr>
<td>+ Site preparation</td>
<td>3,500</td>
</tr>
<tr>
<td>Cost Basis (for depreciation)</td>
<td>$68,875</td>
</tr>
<tr>
<td>Old hole-punching machine (book value)</td>
<td>$4,000</td>
</tr>
<tr>
<td>Less: Trade-in allowance</td>
<td>5,000</td>
</tr>
<tr>
<td>Unrecognized gains</td>
<td>$1,000</td>
</tr>
<tr>
<td>Cost of new hole-punching machine</td>
<td>$62,500</td>
</tr>
<tr>
<td>Less: Unrecognized gains</td>
<td>(1,000)</td>
</tr>
<tr>
<td>Freight</td>
<td>725</td>
</tr>
<tr>
<td>Installation labor</td>
<td>2,150</td>
</tr>
<tr>
<td>Site preparation</td>
<td>3,500</td>
</tr>
<tr>
<td>Cost Basis (for depreciation)</td>
<td>$67,875</td>
</tr>
</tbody>
</table>
Depreciation Methods

Book Depreciation Methods (Only options before 1981):
- Used for reporting net income to investors/stockholders
- Required an estimate of the asset’s useful life and salvage value
- Straight Line (SL)
- Sum-Of-Years Digits (SOYD)
- Declining Balance (DB)
- Units-of-Production (UOP)

Tax Depreciation Methods (Available after 1981):
- Often used for calculating income taxes paid to the IRS
- Modified Accelerated Cost Recovery System (MACRS)
  • First method was ACRS (1981 – 1986)
  • Salvage values assumed to be zero; estimates no longer required
  • Property class lives were created to categorize assets
  • Recovery periods accelerated, capital costs deducted more quickly

Straight Line Depreciation

Example
An asset has a cost of $I = $900, a useful life of $N = 5$ years, and an EOL salvage value of $S = $70. Compute depreciation as follows:
- Annual depreciation charge = $D_n = (I − S)/N = 830/5 = $166$
- The book value of the asset decreases by $166 each year!
- Straight line depreciation is the simplest and best known

<table>
<thead>
<tr>
<th>Year</th>
<th>Initial Book Value</th>
<th>Depreciation</th>
<th>EOY Book Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$900</td>
<td></td>
<td>$900</td>
</tr>
<tr>
<td>1</td>
<td>Cost = $900</td>
<td>$166</td>
<td>734</td>
</tr>
<tr>
<td>2</td>
<td>$734</td>
<td>$166</td>
<td>568</td>
</tr>
<tr>
<td>3</td>
<td>568</td>
<td>$166</td>
<td>402</td>
</tr>
<tr>
<td>4</td>
<td>402</td>
<td>$166</td>
<td>236</td>
</tr>
<tr>
<td>5</td>
<td>236</td>
<td>$166</td>
<td>Salvage Value = 70</td>
</tr>
<tr>
<td>Total</td>
<td>$830</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Straight Line Depreciation

Example (continued)
We can visualize the change in book value over time as follows.

- All depreciation methods can depict the book value declining over time
  - \( I - S \) is the total depreciation charge
  - With \( N = 0 \) the graph starts with cost basis \( I \), and decreases over time until it has salvage value \( S \) at the end of its useful life

<table>
<thead>
<tr>
<th>Initial Cost</th>
<th>Book Value</th>
<th>Salvage Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I = $900 )</td>
<td>( S = $70 )</td>
<td></td>
</tr>
</tbody>
</table>

Straight Line Depreciation – Intangible Property

Example
Veronica’s firm bought a patent in April. It was not acquired as part of acquiring a business. The firm paid \$6,800 for the patent. They must depreciate it using SL depreciation over 17 years, with no salvage value.

- Annual depreciation is \( \frac{6800}{17} = \$400 \)
- **First-year depreciation must be prorated** over the 9 months of ownership
- Therefore the first-year depreciation is \( \left( \frac{9}{12} \right) \times 400 = \$300 \). In later years the depreciation can be \$400
Sum-Of-Years Digits (SOYD) Depreciation

Example
An asset has a cost of \( I = $900 \), a useful life of \( N = 5 \) years, and an EOL salvage value of \( S = $70 \). Compute depreciation as follows:

\[
\begin{align*}
\text{Year} & \quad \text{Life, FOY} & \quad \text{Multiplier} & \quad I - S & \quad \text{Depreciation} & \quad \text{EOY Book Value} \\
0 & \quad 1 & \quad & & \quad \$900 \\
1 & \quad 5 & \quad 5/15 & \quad \$870 & \quad \$277 & \quad 623 \\
2 & \quad 4 & \quad 4/15 & \quad 870 & \quad 221 & \quad 402 \\
3 & \quad 3 & \quad 3/15 & \quad 870 & \quad 166 & \quad 236 \\
4 & \quad 2 & \quad 2/15 & \quad 870 & \quad 125 & \quad 155 \\
5 & \quad 1 & \quad 1/15 & \quad 870 & \quad 70 & \quad 830 \\[-1.5ex]
\text{Total} & & & \quad & \quad \$830
\end{align*}
\]

- For \( N \) years, \( 1 + 2 + \ldots + N = N(N+1)/2 \)
- The multiplier for year \( n \) is thus
  \[
  \frac{(N+1-n)}{N(N+1)/2} = 2(N+1-n)/[N(N+1)]
  \]
- And the depreciation charge is:
  \[
  D_n = (I - S) \left[ \frac{2(N - n + 1)}{N(N + 1)} \right]
  \]

SOYD (and DDB shown later) depreciation causes larger decreases in book value in earlier years than in later years

Would a firm prefer SOYD or SL depreciation?
Declining Balance (DB) Depreciation

- For straight line depreciation with N years, the rate of decrease each year is 1/N.
- Declining balance depreciation uses either 150% or 200% of the straight-line rate. Since 200% is twice the straight-line rate, it is called double declining balance (DDB).
- The DDB depreciation amount, $D_n$, in any year is:
  \[ D_n = \frac{2}{N} (B_{n-1}) = \frac{2}{N} (1 - D_{n-1}) \]
- It can be shown, in general, for DDB, that
  \[ D_n = \frac{2I}{N} (1 - \frac{2}{N})^{n-1} \]
- For 150% declining balance depreciation, just replace each “2” in the DDB formula by “1.5”

Example: DDB Depreciation

<table>
<thead>
<tr>
<th>Year</th>
<th>Multiplier</th>
<th>$I - D_{n-1}$</th>
<th>$D_n$</th>
<th>$B_n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>$900$</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2/5</td>
<td>900</td>
<td>360</td>
<td>540</td>
</tr>
<tr>
<td>2</td>
<td>2/5</td>
<td>540</td>
<td>216</td>
<td>324</td>
</tr>
<tr>
<td>3</td>
<td>2/5</td>
<td>324</td>
<td>130</td>
<td>194</td>
</tr>
<tr>
<td>4</td>
<td>2/5</td>
<td>194</td>
<td>78</td>
<td>116</td>
</tr>
<tr>
<td>5</td>
<td>2/5</td>
<td>116</td>
<td>46</td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$830$</td>
<td></td>
</tr>
</tbody>
</table>

DDB Book Value
DDB: Dealing with Salvage Values

- DDB ignores salvage values.
- If the salvage value ($S$) of this example had not been $70, a modification of DDB would be necessary. Either,
  1. Stop further depreciation when the $B$ equals $S$
  2. “Switch over” from DB depreciation to straight line
- We can skip these modifications because MACRS automatically incorporates the switch from DB to SL

<table>
<thead>
<tr>
<th>Year</th>
<th>$I - D^*_{n-1}$</th>
<th>$D_n$</th>
<th>$B_n$</th>
<th>$I - D^*_{n-1}$</th>
<th>$D_n(DB)$</th>
<th>$D_n(SL)$</th>
<th>$B_n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>900</td>
<td>360</td>
<td>540</td>
<td>900</td>
<td>360</td>
<td>180</td>
<td>540</td>
</tr>
<tr>
<td>2</td>
<td>540</td>
<td>216</td>
<td>324</td>
<td>540</td>
<td>216</td>
<td>135</td>
<td>324</td>
</tr>
<tr>
<td>3</td>
<td>324</td>
<td>130</td>
<td>194</td>
<td>324</td>
<td>130</td>
<td>108</td>
<td>194</td>
</tr>
<tr>
<td>4</td>
<td>194</td>
<td>78</td>
<td>116</td>
<td>194</td>
<td>78</td>
<td>97</td>
<td>97</td>
</tr>
<tr>
<td>5</td>
<td>116</td>
<td>46</td>
<td>70</td>
<td>116</td>
<td>46</td>
<td>97</td>
<td>0</td>
</tr>
</tbody>
</table>

Unit Of Production (UOP) Depreciation

- Occasionally, the recovery of depreciation on an asset is more closely related to use than time.
- For any year, do the following:
  - Compute the ratio of the yearly production of the asset to its total lifetime production.
  - Multiply the ratio and $(I-S)$ to get unit of production (UOP).
    
    \[
    D_n = \frac{\text{Service units consumed during year } n}{\text{Total service units}} (I - S)
    \]

- This method is not acceptable for general use in depreciating industrial equipment. It might be useful for machinery that processes natural resources when the resources are exhausted before the machinery wears out.
Example – UOP Depreciation

Example

The equipment will be used in a sand and gravel pit. The pit will be in operation during a five-year period while a nearby airport is built. The pit will then be shut down, and the equipment removed and sold. The airport will need 40,000 cubic meters of sand and gravel. I-S = $830.

<table>
<thead>
<tr>
<th>Year</th>
<th>m^3 needed</th>
<th>ratio</th>
<th>UOP deprec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4,000</td>
<td>0.1</td>
<td>$83</td>
</tr>
<tr>
<td>2</td>
<td>8,000</td>
<td>0.2</td>
<td>166</td>
</tr>
<tr>
<td>3</td>
<td>16,000</td>
<td>0.4</td>
<td>332</td>
</tr>
<tr>
<td>4</td>
<td>8,000</td>
<td>0.2</td>
<td>166</td>
</tr>
<tr>
<td>5</td>
<td>4,000</td>
<td>0.1</td>
<td>83</td>
</tr>
</tbody>
</table>

- The actual UOP depreciation charge in any year is based on the actual production for the year, and not the scheduled production.

Modified Accelerated Cost Recovery System (MACRS) Depreciation

- MACRS has major advantages
  - Salvage values are assumed to be zero!!
  - “Property class lives” are less than the “actual useful lives”
  - Recovery periods accelerated
  - Capital costs deducted more quickly
  - Larger tax deductions in early years
- Personal Property
  - DB depreciation with switchover to SL
  - Half-year convention
- Real Property
  - SL Method
  - Mid-month convention
MACRS Property Classes

- In 1971, the U.S. Treasury Dept. published guidelines for about 100 broad asset classes. The useful life range were called the Asset Depreciation Range (ADR)
- The ADR midpoint lives were somewhat shorter than the actual average useful lives
- In MACRS, ADR’s are grouped into a smaller set of property classes
- Table 10.1 (excerpt) Asset Guideline Classes – Asset Depreciation

<table>
<thead>
<tr>
<th>IRS asset class</th>
<th>Asset description</th>
<th>Class life (years)</th>
<th>MACRS property class (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00.11</td>
<td>Office furniture, fixtures &amp; equipment</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>00.12</td>
<td>Information systems: computers/ peripheral</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>00.22</td>
<td>Automobiles, taxis</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>00.241</td>
<td>Light general purpose trucks</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>00.25</td>
<td>Railroad cars &amp; locomotives</td>
<td>15</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.2: MACRS Property Classes

The table illustrates how all personal property (except real estate) falls into one of six classes. All real estate is in one of two classes

<table>
<thead>
<tr>
<th>Property class</th>
<th>Personal property</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-Year Property</td>
<td>• Special handling devices for food and beverage mfg.</td>
</tr>
<tr>
<td></td>
<td>• Special tools.</td>
</tr>
<tr>
<td></td>
<td>• Property with ADR midpoint life of 4 years or less</td>
</tr>
<tr>
<td>5-Year Property</td>
<td>• Automobiles and trucks</td>
</tr>
<tr>
<td></td>
<td>• Aircraft</td>
</tr>
<tr>
<td></td>
<td>• Computers</td>
</tr>
<tr>
<td>7-Year Property</td>
<td>• All other property not assigned to another class</td>
</tr>
<tr>
<td></td>
<td>• Office furniture, fixtures &amp; equipment</td>
</tr>
<tr>
<td></td>
<td>• Property with ADR midpoint life of 10 years or more and less than 16 years.</td>
</tr>
<tr>
<td>10-Year Property</td>
<td>• Assets used in petroleum refining &amp; certain food products.</td>
</tr>
<tr>
<td></td>
<td>• Property with ADR midpoint life of 16 years or more and less than 20 years.</td>
</tr>
<tr>
<td>15-Year Property</td>
<td>• Telephone distribution plants;</td>
</tr>
<tr>
<td></td>
<td>• Municipal sewage treatment plants;</td>
</tr>
<tr>
<td></td>
<td>• Property with ADR midpoint life of 20 years or more and less than 25 years.</td>
</tr>
<tr>
<td>20-Year Property</td>
<td>• Municipal sewers;</td>
</tr>
<tr>
<td></td>
<td>• Property with ADR midpoint life of 25 years and more.</td>
</tr>
<tr>
<td>Property Class</td>
<td>Real property (real estate)</td>
</tr>
<tr>
<td>27.5 years</td>
<td>Residential rental property (excludes hotels and motels)</td>
</tr>
<tr>
<td>39 years</td>
<td>Nonresidential real property</td>
</tr>
</tbody>
</table>
# MACRS Depreciation Steps

I. Determine that the property is eligible for depreciation  
II. Calculate its depreciation deductions over its life, using  
   1) Cost basis (I) of the property  
      - The cost to obtain and place the asset in service fit for use  
      - For real property the basis may also include certain fees and  
        charges the buyer pays as part of the purchase, and amounts  
        the seller owes that you pay (such as back taxes)  
   2) Property class and recovery period of the asset  
      - Each asset is placed in a MACRS Property Class, thus  
        defining the recovery period and the depreciation percentage  
        for each year  
      - Table 10-1 lists class lives for several depreciable assets  
      - Table 10-2 lists the MACRS property classes  
   3) Asset’s placed-in-life service date  
      - Depreciation begins when the business asset is placed in  
        service  

\[ D_n = I \times r_n \]

where  
\( D_n \) = depreciation deduction in year \( n \)  
\( I \) = cost basis being depreciated  
\( r_n \) = appropriate MACRS percentage rate
Table 10.3: MACRS Depreciation for Personal Property – Half-Year Time Convention

Table 10-3 gives the yearly depreciation percentages ($r_t$) for the six personal property classes (3, 5, 7, 10, 15 and 20 years).

Due to the half-year convention, depreciation percentages continue for one year beyond the property class life. Percentages in the first and last years are halved, which assumes all assets are placed in service at the mid-point of the first year.

The sum of the $r_n$ values in any column is 100%. MACRS fully depreciates assets at the end of the recovery period, where the assumed salvage value is zero.

<table>
<thead>
<tr>
<th>Recovery year</th>
<th>3-yr. class</th>
<th>5-yr.</th>
<th>7-yr.</th>
<th>10-yr.</th>
<th>15-yr.</th>
<th>20-yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33.33</td>
<td>20.00</td>
<td>14.29</td>
<td>10.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>44.45</td>
<td>32.00</td>
<td>24.49</td>
<td>18.00</td>
<td>9.50</td>
<td>7.219</td>
</tr>
<tr>
<td>3</td>
<td>14.81*</td>
<td>19.20</td>
<td>17.49</td>
<td>14.40</td>
<td>8.55</td>
<td>6.677</td>
</tr>
<tr>
<td>4</td>
<td>7.41</td>
<td>11.52*</td>
<td>12.49</td>
<td>11.52</td>
<td>7.70</td>
<td>6.177</td>
</tr>
<tr>
<td>5</td>
<td>11.52</td>
<td>8.93*</td>
<td>9.22</td>
<td>6.93</td>
<td>5.713</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5.76</td>
<td>8.92</td>
<td>7.37</td>
<td>6.23</td>
<td>5.285</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.461</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.231</td>
</tr>
</tbody>
</table>

MACRS Percentage Rates

- Three assumptions are important:
  - Salvage value = 0. The entire cost basis is depreciated
  - The first and last years of the recovery period are each ½ years
  - The DB rate is 200% for 3, 5, 7 and 10 year property; it is 150% for 15 and 20 year property

- MACRS percentages are based on the DB method, switching over to SL at the optimal point, thus giving the largest depreciation each year

- A half-year of depreciation is allowed in
  - the first recovery year, and
  - the last recovery year or when the property is retired from service, whichever comes first (assets may be retired early!!)
### Tables 10.4: MACRS Depreciation for Real Property (Real Estate)

**Table 10-4: Recovery Percentages for Residential Rental Property**  
Month placed in service:

<table>
<thead>
<tr>
<th>Recovery Year</th>
<th>1</th>
<th>2</th>
<th>…</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.485</td>
<td>3.182</td>
<td>0.758</td>
<td>0.455</td>
<td>0.152</td>
<td></td>
</tr>
<tr>
<td>2-9</td>
<td>3.636</td>
<td>3.636</td>
<td>3.636</td>
<td>3.636</td>
<td>3.636</td>
<td></td>
</tr>
<tr>
<td>10*</td>
<td>3.637</td>
<td>3.637</td>
<td>3.636</td>
<td>3.636</td>
<td>3.636</td>
<td></td>
</tr>
<tr>
<td>11**</td>
<td>3.636</td>
<td>3.636</td>
<td>3.637</td>
<td>3.637</td>
<td>3.637</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>1.97</td>
<td>2.273</td>
<td>3.636</td>
<td>3.636</td>
<td>3.636</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td>1.061</td>
<td>1.364</td>
<td>2.778</td>
<td></td>
</tr>
</tbody>
</table>

* Also all even years 12 through 26  
** Also all odd years 13 through 27

**Table 10-5: Recovery Percentages for Nonresidential Rental Property**  
Month placed in service:

<table>
<thead>
<tr>
<th>Recovery Year</th>
<th>1</th>
<th>2</th>
<th>…</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.461</td>
<td>2.247</td>
<td>0.535</td>
<td>0.321</td>
<td>0.107</td>
<td></td>
</tr>
<tr>
<td>2-39</td>
<td>2.564</td>
<td>2.564</td>
<td>2.564</td>
<td>2.564</td>
<td>2.564</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>0.107</td>
<td>0.321</td>
<td>2.033</td>
<td>2.247</td>
<td>2.461</td>
<td></td>
</tr>
</tbody>
</table>

Note: Useful lives are 27.5 years for residential rental property, and 39 years for nonresidential real property. Depreciation is straight line using the mid-month convention.

---

### MACRS Percentage Rates

**Example**  
A 5-year MACRS property asset has an installed and “made ready for use” cost basis of $100.

<table>
<thead>
<tr>
<th>Year</th>
<th>DDB Calculation</th>
<th>SL Calculation</th>
<th>MACRS (r) % Rates</th>
<th>Cumul. Deprec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>½ (2/5)(100-0) = 20</td>
<td>½ (100-0)/5 = 10.00</td>
<td>20.00 (DDB)</td>
<td>20.00</td>
</tr>
<tr>
<td>2</td>
<td>(2/5)(100-20) = 32.00</td>
<td>(100-20)/4.5 = 17.78</td>
<td>32.00 (DDB)</td>
<td>52.00</td>
</tr>
<tr>
<td>3</td>
<td>(2/5)(100-52) = 19.20</td>
<td>(100-52)/3.5 = 13.71</td>
<td>19.20 (DDB)</td>
<td>71.20</td>
</tr>
<tr>
<td>4</td>
<td>(2/5)(100-71.20) = 11.52</td>
<td>(100-71.20)/2.5 = 11.52</td>
<td>11.52 (either)</td>
<td>82.72</td>
</tr>
<tr>
<td>5</td>
<td>11.52</td>
<td>11.52 (SL)</td>
<td>11.52 (SL)</td>
<td>94.24</td>
</tr>
<tr>
<td>6</td>
<td>½ (11.52) = 5.76</td>
<td>5.76 (SL)</td>
<td>5.76 (SL)</td>
<td>100.00</td>
</tr>
</tbody>
</table>
MACRS Examples

Example
Use the MACRS method. Calculate the yearly depreciation allowances and book values for a firm that has purchased $150,000 worth of office equipment. The equipment qualifies as depreciable property. Estimated salvage value is $30,000.

Input Data
- The assets qualify as depreciable property, and MACRS applies
- \( I = 150,000 \)
- The assets are being placed in service in year 1
- Ignore the salvage value (0 with MACRS)
- Look up office equipment in Table 10-2 as 7-year property. Obtain the MACRS percentages from Table 10-3. Calculate the depreciation amounts, and update the book value:
  \[ B_n = I - D_n \]

<table>
<thead>
<tr>
<th>Year</th>
<th>( r_n )</th>
<th>( I )</th>
<th>( D_n )</th>
<th>Cum. ( D_n )</th>
<th>( B_n )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14.29%</td>
<td>$150,000</td>
<td>$21,435</td>
<td>$21,435</td>
<td>$128,565</td>
</tr>
<tr>
<td>2</td>
<td>24.49%</td>
<td>$150,000</td>
<td>$36,735</td>
<td>$58,170</td>
<td>$91,830</td>
</tr>
<tr>
<td>3</td>
<td>17.49%</td>
<td>$150,000</td>
<td>$26,235</td>
<td>$84,405</td>
<td>$65,595</td>
</tr>
<tr>
<td>4</td>
<td>12.49%</td>
<td>$150,000</td>
<td>$18,735</td>
<td>$103,140</td>
<td>$46,860</td>
</tr>
<tr>
<td>5</td>
<td>8.93%</td>
<td>$150,000</td>
<td>$13,395</td>
<td>$116,535</td>
<td>$33,465</td>
</tr>
<tr>
<td>6</td>
<td>8.92%</td>
<td>$150,000</td>
<td>$13,380</td>
<td>$129,915</td>
<td>$20,085</td>
</tr>
<tr>
<td>7</td>
<td>8.93%</td>
<td>$150,000</td>
<td>$13,395</td>
<td>$143,310</td>
<td>$6,690</td>
</tr>
<tr>
<td>8</td>
<td>4.46%</td>
<td>$150,000</td>
<td>$6,690</td>
<td>$150,000</td>
<td>$0</td>
</tr>
<tr>
<td></td>
<td>100.00%</td>
<td></td>
<td></td>
<td></td>
<td>$150,000</td>
</tr>
</tbody>
</table>

- Can also be calculated using VDB functions in Excel
Spreadsheets and Depreciation

Arguments of VDB Function:
(cost, salvage, life, start_period, end_period, factor, no_switch)
- cost: this is just what we have denoted by B
- salvage: use 0 (MACRS assumes no salvage)
- life: use 3, 5, 7, 10, 15 or 20 (years)
- start_period: (starting period: must have same units as life)
- end_period: (ending period: must have same units as life)
- factor: use 2 for recovery periods of 3, 5, 7 or 10 years;
  use 1.5 for recovery periods of 15 or 20 years
- no_switch: leave this blank

MACRS Examples

Example (Non-residential Real Property)
The JMG Group invests in a hotel resort in April. JMG paid $2.0
million for the hotel, and $500,000 for the grounds. JMG sold the
resort five years later in August. What is the depreciation deduction in
each of years 1 through 6? What was the final book value of the hotel?

Input Data
- Hotels are non-residential real property
- Hotels are depreciated over a 39-year life
- Table 10-4 has the percentages by year
  - placed in service in month # 4, year 1: 1.816%
  - years 2-5: 2.564%
  - sold in month #8, “year 40” values: 1.603%
- I = $2,000,000
- Ignore the information on the land
### MACRS Examples

#### Example (continued)

<table>
<thead>
<tr>
<th>Year</th>
<th>( r_n )</th>
<th>( I )</th>
<th>( D_n )</th>
<th>Cum. ( D_n )*</th>
<th>( B_n )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.816%</td>
<td>$2,000,000</td>
<td>$36,320</td>
<td>$36,320</td>
<td>$1,963,680</td>
</tr>
<tr>
<td>2</td>
<td>2.564%</td>
<td>$2,000,000</td>
<td>$51,280</td>
<td>$87,600</td>
<td>$1,912,400</td>
</tr>
<tr>
<td>3</td>
<td>2.564%</td>
<td>$2,000,000</td>
<td>$51,280</td>
<td>$138,880</td>
<td>$1,861,120</td>
</tr>
<tr>
<td>4</td>
<td>2.564%</td>
<td>$2,000,000</td>
<td>$51,280</td>
<td>$190,160</td>
<td>$1,809,840</td>
</tr>
<tr>
<td>5</td>
<td>2.564%</td>
<td>$2,000,000</td>
<td>$51,280</td>
<td>$241,440</td>
<td>$1,758,560</td>
</tr>
<tr>
<td>6</td>
<td>1.603%</td>
<td>$2,000,000</td>
<td>$32,060</td>
<td>$273,500</td>
<td>$1,726,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.680%</td>
<td>$273,500</td>
</tr>
</tbody>
</table>

- Book value when sold: $1,726,500

#### Additional Example

A house is purchased on October 1 to be used as a rental. The $200,000 purchase price represents $150,000 for the house and $50,000 for the land. Compute the MACRS depreciation for the first two calendar years by exact calculation and compare with Table 10-4.

**Year 1**
- Table value = 0.758% \( (150,000) \) = $1137
- SL depreciation = \( \frac{2.5}{12} \) \( \frac{150000}{27.5} \) = $1137
  - We use the house value of $150,000 and a useful life of 27.5 years
  - Mid-month convention (count from mid-October until end of year)

**Year 2**
- Table value = 3.636% \( (150,000) \) = $5454
- SL depreciation = \( \frac{150,000}{27.5} \) = $5454
MACRS vs. Previous Depreciation Methods

• Depreciation deductions benefit a firm after taxes. They reduce taxable income and taxes
• The time value of money ensures it is better to take depreciation deductions as soon as possible, assuming the same tax rate applies to the company in every year
• In general, MACRS, which allocates larger deductions earlier in the depreciation life, provides more economic benefits than previous historical methods

Depletion

• Depletion is the exhaustion of natural resources as a result of their removal. Depletion covers things such as
  – mineral properties (digging up minerals)
  – oil and gas wells (producing petroleum or natural gas)
  – standing timber (cutting down trees)
• The reason for depletion is essentially the same as the reason for depreciation
• The depletion allowance is based on two distinct methods of calculating depletion:
  – Cost depletion
  – Percentage depletion
• Except for standing timber and most oil and gas wells, depletion is calculated by both methods and the larger value is taken as depletion for the year. For standing timber and most oil and gas wells, only cost depletion is allowed
Cost Depletion

- Cost depletion is computed in the same manner as UOP depreciation:

\[
\text{Cost Depletion} = \frac{(\text{Adjusted basis of mineral property})}{\text{Total number of recoverable units}} \times (\text{number of units sold})
\]

Example
A lumber company buys a tract of timber for $35,000; $5,000 for the land, and $30,000 for the value of the estimated 1.5 million board-feet of standing timber. The company cut 100,000 board-feet of standing timber the first year. What was its depletion allowance for the year?

- Depletion allowance per board foot of timber =
  \[
  \frac{($35,000 - $5,000)}{1,500,000 \text{ board-ft}} = 0.02
  \]
- The depletion allowance for the year is
  \[
  100,000 \times 0.02 = 2,000
  \]

Percentage Depletion

- Percentage depletion is an alternate method of calculating the depletion allowance for mineral property and some oil or gas wells
- The allowance is a certain percentage of the gross income from the property during the year
  - This is an entirely different concept from depreciation
  - While depreciation is an allocation of cost over the useful life, \textit{percentage depletion is an annual allowance of a percentage of the gross income from the property}
- It is possible that the total depletion of the property \textit{may be more than the cost of the property}
- The percentage depletion allowance in any year is limited to \textit{not more than 50\%} of the taxable income from the property, computed without the deduction for depletion
Table 10.5: Percentage Depletion Allowance for Selected Items

<table>
<thead>
<tr>
<th>Type of deposit</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead, zinc, sulphur, uranium</td>
<td>22</td>
</tr>
<tr>
<td>Oil &amp; gas (small producers only)</td>
<td>15</td>
</tr>
<tr>
<td>Gold, silver, copper, iron ore</td>
<td>15</td>
</tr>
<tr>
<td>Coal &amp; sodium chloride</td>
<td>10</td>
</tr>
<tr>
<td>Clay and shale (for making sewer pipe or bricks)</td>
<td>7.5</td>
</tr>
<tr>
<td>Clay (used for roofing tile), sand, gravel, stone</td>
<td>5</td>
</tr>
<tr>
<td>Most other minerals and metallic ores</td>
<td>14</td>
</tr>
</tbody>
</table>

Example – Percentage Depletion

**Example**

A coal mine has a gross income of $250,000 for the year. Mining expenses equal $210,000. What is the allowable percentage depletion deduction?

**Solution**

- Coal has a 10% depletion allowance
- Percentage depletion deduction is computed from gross mining income

  \[
  \text{Computed percentage depletion:} \\
  10\% \text{ of } 250,000 = 25,000
  \]

- Allowable depletion deduction is limited to the smaller of the computed percentage depletion and the 50% of taxable income limitation

  \[
  \text{Taxable income limitation:} \\
  \text{Taxable income is } 250,000 - 210,000 = 40,000 \\
  50\% \text{ of } 40,000 = 20,000
  \]

  The allowable percentage depletion deduction is $20,000
Steps in Computing Depletion

- Compute percent depletion (appropriate % x gross income)
- Compute 50% of taxable income without depletion allowance
- Select the smaller as *Allowed Percentage Depletion*
- Select the larger as the *Depletion Allowance*
- Compute cost depletion (based on suitable depletion unit)

- For standing timber and most oil and gas wells, only cost depletion is allowed

---

Percentage Depletion vs. Cost Depletion

(Example 10.12)

<table>
<thead>
<tr>
<th>Percentage Depletion</th>
<th>Cost depletion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income from sale of 45,000 ounces</td>
<td>$16,425,000</td>
</tr>
<tr>
<td>Depletion percentage</td>
<td>$2,463,750</td>
</tr>
<tr>
<td>Computed percentage depletion</td>
<td>$16,425,000 × 15%</td>
</tr>
</tbody>
</table>

Cost depletion

\[
\frac{($30,000,000/300,000)(45,000)}{12,250,000} = \frac{4,500,000}{12,250,000} = 0.365
\]

Deduction limitation

\[
(4,175,000) \times 0.50 = 2,087,500
\]

Maximum depletion deduction

\[
2,087,500$2,088,000
\]

Allowable deduction

\[
2,088,000
\]

Select cost depletion with $4,500,000
Principle: Treat repairs and improvements as depreciable items. Adjust depreciation amounts as follows:

Book Depreciation:
Change the current book value and spread the value over the extended life.

Tax Depreciation:
Treat the repairs or improvements as separate MACRS properties.