

TEXTILE ECONOMICS AND COSTING

CHAPTER 3: DEPRECIATION

3.1 Introduction and Definitions

- Property that is acquired and exploited for monetary gain, such as a machine, an office building, or a computer, is known as an ***fixed asset***.
- As time elapses, every asset undergoes a ***progressive loss of value*** resulting from wear and tear, exposure to the elements, and obsolescence.
- Therefore, a point is eventually reached at which it becomes economical to replace the existing asset with a new one.
- The decline in the value of the asset is known as ***depreciation***.

3.2 Introduction and Definitions

- The process of entering *depreciation charges* is known as writing off the asset.
- The *first cost*(B_0) of an asset is the total expenditure required to place it in operating condition.
- The *salvage value* (L) of an asset is its monetary value to the firm at the **date of retirement**.
- The value of an asset as displayed on the books of the firm is termed its *book value*.

Cont.

- Usually, the book value of an asset at a given date equals the difference between its first cost and the cumulative amount of depreciation charged up to that date.

3.3 The Notational System for Depreciation is as Follows:

- B_o = first cost of asset
- B_r = book value of asset at end of r^{th} year
- L = estimated salvage value
- D_r = depreciation charge for r^{th} year
- n = estimated life span of asset, years

3.4 Straight-line Method

- This is the simplest method of allocating depreciation. By this method, the **total depreciation is allocated uniformly over the life of the asset**. Then,

$$D_r = \frac{B_0 - L}{n} = \text{constant}$$

- The straight-line method has the **disadvantage of yielding a slow write-off of the asset**.

Cont.

E.g.3.1 A machine costing \$15,000 has an estimated life span of 8 years and an estimated salvage value of \$3000. Compute the **annual depreciation charge** and the **book value** of the machine at the end of the **third year** under the straight-line depreciation method.

SOLUTION

$$D_r = \frac{B_0 - L}{n} = \text{constant}$$

$$D = (15,000 - 3000)/8 = \$1500$$

$$B_r = B_0 - rD_r$$

$$B_3 = 15,000 - 3 \times 1500 = \underline{\underline{\$10,500}}$$

YEAR	BOOK VALUE AT THE BEGINNING	DEPRECIATION	BOOK VALUE AT THE END
1	15000	1500	13500
2	13500	1500	12000
3	12000	1500	10500
4	10500	1500	9000
5	9000	1500	7500
6	7500	1500	6000
7	6000	1500	4500
8	4500	1500	3000

TABLE 3.1

3.5 Sum-of-years'-digits Method

- This method of allocating depreciation was devised to **accelerate the write-off of the asset**. By this method, the depreciation charges form a ***descending arithmetic progression*** in which the **first term is n times the last term**.

- It follows that:
$$D_r = (n - r + 1)D_n$$

- The depreciation charge for the final year is the **total depreciation divided by the sum of the integers from 1 to n , inclusive**. Since this sum is $n(n + 1)/2$, we have

$$D_n = \frac{2(B_0 - L)}{n(n + 1)}$$

Cont.

E.g.3.2 A machine costing \$10,000 is estimated to have a service life of 8 years, at the end of which time it will have a salvage value of \$1000. Calculate the depreciation charges, applying the sum-of-years'-digits method.

SOLUTION

$$D_8 = [2(10,000 - 1000)]/[8(8+1)] = \$250$$

$$D_1 = 8 \times 250 = \$2000 \quad D_5 = 4 \times 250 = \$1000$$

$$D_2 = 7 \times 250 = \$1750 \quad D_6 = 3 \times 250 = \$750$$

$$D_3 = 6 \times 250 = \$1500 \quad D_7 = 2 \times 250 = \$500$$

$$D_4 = 5 \times 250 = \$1250$$

These charges total \$9,000, as they must

Cont.

- Under the sum-of-years'-digits method, the book value of the asset at the end of the r^{th} year is:

$$B_r = B_0 - \frac{[2nr - r(r - 1)](B_0 - L)}{n(n + 1)}$$

- For example, with reference to the asset in Eg. 3.2, we have
$$B_5 = 10000 - \{[(2 \times 8 \times 5 - 5(5-1)) (10000-1000)]/[8(8+1)]\}$$
$$= \underline{\underline{\$2500}}$$

Cont.

Comparing sum of year digit and Straight line method

TABLE 3.2: SUM OF YEAR DIGIT METHOD

YEAR	BOOK VALUE AT THE BEGINNING	DEPRECIATION	BOOK VALUE AT THE END
1	10000	2000	8000
2	8000	1750	6250
3	6250	1500	4750
4	4750	1250	3500
5	3500	1000	2500
6	2500	750	1750
7	1750	500	1250
8	1250	250	1000

TABLE 3.3: STRAIGHT LINE METHOD

YEAR	BOOK VALUE AT THE BEGINNING	DEPRECIATION	BOOK VALUE AT THE END
1	10000	1125	8875
2	8875	1125	7750
3	7750	1125	6625
4	6625	1125	5500
5	5500	1125	4375
6	4375	1125	3250
7	3250	1125	2125
8	2125	1125	1000

3.6 Declining-balance Method

- In this method, the **depreciation of an asset** for a given year is **directly proportional** to its **book value** at the beginning of the year.
- Let h denote the constant of proportionality. Then, $D_r = hB_{r-1}$
- *Salvage value is ignored*, and the expression for h is as follows:

$$h = k/n$$

where k is assigned the value 1.25, 1.5, and 2, depending on the nature of the asset. Then,

$$D_r = kB_{r-1}/n$$

Cont.

- Since **book value** diminishes as the asset ages, the depreciation charges form a **decreasing series**, and the declining-balance method also yields an **accelerated write-off**.
- Assume the **salvage value** of the asset is **zero**, and let D_{1s} and D_{1d} denote the **depreciation charge** for the first year as calculated by the **straight-line method** and the **declining-balance method**, respectively. Then,

$$D_{1s} = \frac{B_0}{n} \quad \text{and} \quad D_{1d} = \frac{kB_0}{n}$$

Thus $D_{1d} = kD_{1s}$

- called double declining-balance method, when $k=2$

Cont.

E.g.3.3 Applying the double-declining-balance method, calculate the depreciation charges for an asset having a first cost of \$20,000, a life span of 8 years, and an estimated salvage value of (a) \$4000 and (b) \$500.

SOLUTION

- We shall first establish the depreciation charges and final book value that result if the declining-balance method is applied throughout the life of the asset.
- $h = 2/8 = 0.25$

Cont.

- The table, on next slide, lists the depreciation charges and final book value stemming from consistent use. For example,

$$D1 = 20,000(0.25) = \$5000 \quad B1 = 20,000 - 5000 = \$15,000$$

$$D2 = 15,000(0.25) = \$3750 \quad B2 = 15,000 - 3750 = \$11,250 \text{ and so on.}$$

- And the final book value can be checked by this calculation:

$$B_n = B_0(1 - h)^n = 20,000(1 - 0.25)^8 = \underline{\$2002}$$

Cont.

TABLE 3.4: DECLINE BALANCE METHOD

YEAR	BOOK VALUE AT THE BEGINNING	DEPRECIATION	BOOK VALUE AT THE END
1	20000	5000	15,000
2	15,000	3750	11,250
3	11,250	2813	8,437
4	8,437	2109	6,328
5	6,328	1582	4,746
6	4,746	1187	3,559
7	3,559	890	2,669
8	2,669	667	2,002

Cont.

- **Part a:** Since the book value can never fall below the salvage value, the declining-balance method must be abandoned at the end of the fifth year. Depreciation is charged for the sixth year but not for the seventh and eighth years. Then,

$$D1 = \$5000 \quad D4 = \$2109 \quad D6 = 4746 - 4000 = \$746$$

$$D2 = \$3750 \quad D5 = \$1582 \quad D7 = D8 = 0$$

$$D3 = \$2813$$

Cont.

Modified table for Part A

TABLE 3.5: DECLINE BALANCE METHOD

YEAR	BOOK VALUE AT THE BEGINNING	DEPRECIATION	BOOK VALUE AT THE END
1	20000	5000	15,000
2	15,000	3750	11,250
3	11,250	2813	8,437
4	8,437	2109	6,328
5	6,328	1582	4,746
6	4,746	746	4,000
7	4,000	0	4,000
8	4,000	0	4,000

Cont.

- **Part b:** The declining-balance method yields a final book value of \$2002, but the salvage value is only \$500. One possibility is to adhere to the declining-balance method for the first 7 years and then set the depreciation for the eighth year equal to $2669 - 500 = \$2169$.
- However, if the objective is to write-off the asset as rapidly as possible, it is more advantageous to **transform to the straight-line method at the point where this method yields a higher depreciation charge than does the declining-balance method**

Cont.

- Assume that the **transfer from declining-balance to straight-line** method occurs at the **beginning of the r^{th} year**. The remaining depreciation must be allocated uniformly among the remaining years of the life of the asset. Therefore, the depreciation charge for the r^{th} year (and all subsequent years) is:

$$D_r = \frac{B_{r-1} - L}{n - r + 1}$$

Cont.

- Refer to the Table on next slide, which is constructed by applying the values obtained in the on **Table 3.4**.
- The depreciation charge for the r^{th} year as given by Equation ***on next slide*** is recorded in column 2 of the Table, and the depreciation charge as obtained by a continuation of the declining-balance method is recorded in column 3.

Cont.

TABLE 3.6: Transforming Decline Balance to Straight Line Method

Year	Depreciation if transfer is made at the beginning of year $Dr = \frac{Br_{-1} + L}{n - r + 1}$	Depreciation if transfer is deferred,
2	(15,000-500)/7=2071	3750
3	(11,250-500)/6=1792	2813
4	(8,437-500)/5=1587	2109
5	(6,328-500)/4=1457	1582
6	(4,746-500)/3=1415	1187
7	(3,331-500)/2=1530	890

Cont.

- A comparison of the values in the two columns discloses that a reversal occurs at the beginning of the sixth year, and therefore the transfer from declining-balance method to straight-line method should be made at that date. Then,

$$D1 = \$5000$$

$$D4 = \$2109$$

$$D2 = \$3750$$

$$D5 = \$1582$$

$$D3 = \$2813$$

$$D6 = D7 = D8 = \$1415$$

Cont.

Modified table for Part B

TABLE 3.7: DECLINE BALANCE METHOD

YEAR	BOOK VALUE AT THE BEGINNING	DEPRECIATION	BOOK VALUE AT THE END
1	20000	5000	15,000
2	15,000	3750	11,250
3	11,250	2813	8,437
4	8,437	2109	6,328
5	6,328	1582	4,746
6	4,746	1415	3,331
7	3,331	1415	1,916
8	1,916	1415	501

Units-of-production Method

- If deterioration of an asset can be ascribed primarily to its **exploitation** rather than to the **mere passage of time**, it is logical to base the annual depreciation charge on the extent to which the asset is used during that year.
- If the asset is a machine that is used to produce a standard commodity, the magnitude of its use can be measured by the **number of units it produces**.

Cont.

E.g.3.4 A machine costing \$42,000 will have a life of 5 years and a salvage value of \$3000. It is estimated that 10,000 units will be produced with this machine distributed in this manner: first year, 2000; second year, 2400; third year, 2100; fourth year, 1800; fifth year, 1700. If depreciation is allocated on the basis of production, calculate the depreciation charges.

SOLUTION

- The depreciation charge per unit of production is: $(42,000 - 3000)/10,000 = \3.90

Cont.

- Multiplying the volume of production by this unit charge, we obtain the following results:

$$D1 = 2000(3.90) = \$7800$$

$$D2 = 2400(3.90) = \$9360$$

$$D3 = 2100(3.90) = \$8190$$

$$D4 = 1800(3.90) = \$7020$$

$$D5 = 1700(3.90) = \$6630$$