9.2.1 Straight Line Method of Depreciation

In this method of depreciation, a fixed sum is charged as the depreciation amount throughout the lifetime of an asset such that the accumulated sum at the end of the life of the asset is exactly equal to the purchase value of the asset. Here, we make an important assumption that inflation is absent.

Let

P = first cost of the asset,

F = salvage value of the asset,

n = life of the asset,

B_t = book value of the asset at the end of the period t,

D_t = depreciation amount for the period t.

The formulae for depreciation and book value are as follows:

$$D_t = (P - F)/n$$

$$B_t = B_{t-1} - D_t = P - t \times [(P - F)/n]$$

EXAMPLE 9.1 A company has purchased an equipment whose first cost is Rs. 1,00,000 with an estimated life of eight years. The estimated salvage value of the equipment at the end of its lifetime is Rs. 20,000. Determine the depreciation charge and book value at the end of various years using the straight line method of depreciation.

$$
\begin{aligned}
P &= \text{Rs. } 1{,}00{,}000 \\
F &= \text{Rs. } 20{,}000 \\
n &= 8 \text{ years} \\
D_t &= (P - F)/n \\
&= (1{,}00{,}000 - 20{,}000)/8 \\
&= \text{Rs. } 10{,}000
\end{aligned}
$$

In this method of depreciation, the value of D_t is the same for all the years. The calculations pertaining to B_t for different values of t are summarized in Table 9.1.

Table 9.1 D_t and B_t Values under Straight line Method of Depreciation

End of year (t)	*Depreciation* (D_t)	*Book value* ($B_t = B_{t-1} - D_t$)
0		1,00,000
1	10,000	90,000
2	10,000	80,000
3	10,000	70,000
4	10,000	60,000
5	10,000	50,000
6	10,000	40,000
7	10,000	30,000
8	10,000	20,000

If we are interested in computing D_t and B_t for a specific period (t), the formulae can be used. In this approach, it should be noted that the depreciation is the same for all the periods.

EXAMPLE 9.2 Consider Example 9.1 and compute the depreciation and the book value for period 5.

$$
\begin{aligned}
P &= \text{Rs. } 1{,}00{,}000 \\
F &= \text{Rs. } 20{,}000 \\
n &= 8 \text{ years} \\
D_5 &= (P - F)/n \\
&= (1{,}00{,}000 - 20{,}000)/8 \\
&= \text{Rs. } 10{,}000 \text{ (This is independent of the time period.)} \\
B_t &= P - t \times (P - F)/n \\
B_5 &= 1{,}00{,}000 - 5 \times (1{,}00{,}000 - 20{,}000)/8 \\
&= \text{Rs. } 50{,}000
\end{aligned}
$$

9.2.2 Declining Balance Method of Depreciation

In this method of depreciation, a constant percentage of the book value of the previous period of the asset will be charged as the depreciation amount for the current period. This approach is a more realistic approach, since the depreciation charge decreases with the life of the asset which matches with the earning potential of the asset. The book value at the end of the life of the asset may not be exactly equal to the salvage value of the asset. This is a major limitation of this approach.

Let

P = first cost of the asset,

F = salvage value of the asset,

n = life of the asset,

B_t = book value of the asset at the end of the period t,

K = a fixed percentage, and

D_t = depreciation amount at the end of the period t.

P = first cost of the asset,

F = salvage value of the asset,

n = life of the asset,

B_t = book value of the asset at the end of the period t,

K = a fixed percentage, and

D_t = depreciation amount at the end of the period t.

The formulae for depreciation and book value are as follows:

$$D_t = K \times B_{t-1}$$

$$B_t = B_{t-1} - D_t = B_{t-1} - K \times B_{t-1}$$

$$= (1 - K) \times B_{t-1}$$

The formulae for depreciation and book value in terms of P are as follows:

$$D_t = K(1 - K)^{t-1} \times P$$

$$B_t = (1 - K)^t \times P$$

While availing income-tax exception for the depreciation amount paid in each year, the rate K is limited to at the most $2/n$. If this rate is used, then the corresponding approach is called the *double declining balance method of depreciation.*

- $D_t = KB_{t-1}$
- $B_t = B_{t-1} - KB_{t-1}$

- $D_1 = PK$
- $B_1 = P - D_1$
- $B_1 = P - PK$
- $B_1 = P(1 - K)$

End of year (n)	Depreciation (D_t)	Book value (B_t)
0		1,00,000.00
1	20,000.00	80,000.00
2	16,000.00	64,000.00
3	12,800.00	51,200.00
4	10,240.00	40,960.00
5	8,192.00	32,768.00
6	6,553.60	26,214.40
7	5,242.88	20,971.52
8	4,194.30	16,777.22

- $D_2 = KB_1 = PK(1 - K),\ B_2 = B_1 - D_2 = P(1 - K) - PK(1 - K)$
- $B_2 = P(1 - K)(1 - K) = P(1 - K)^2$

$$D_t = KP(1 - K)^{t-1}$$

$$B_t = P(1 - K)^t$$

EXAMPLE 9.4 Consider Example 9.1 and calculate the depreciation and the book value for period 5 using the declining balance method of depreciation by assuming 0.2 for K.

Solution

$$P = \text{Rs. } 1{,}00{,}000$$

$$F = \text{Rs. } 20{,}000$$

$$n = 8 \text{ years}$$

$$K = 0.2$$

$$D_t = K(1 - K)^{t-1} \times P$$

$$D_5 = 0.2(1 - 0.2)^4 \times 1{,}00{,}000$$

$$= \text{Rs. } 8{,}192$$

$$B_t = (1 - K)^t \times P$$

$$B_5 = (1 - 0.2)^5 \times 1{,}00{,}000$$

$$= \text{Rs. } 32{,}768$$

Sum-of-the-Years-Digits Method of Depreciation

In this method of depreciation also, it is assumed that the book value of the asset decreases at a decreasing rate. If the asset has a life of eight years, first the sum of the years is computed as Sum of the years

$= 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8$

$= 36 = n(n + 1)/2$

The rate of depreciation charge for the first year is assumed as the highest and then it decreases. The rates of depreciation for the years 1–8, respectively are as follows:

8/36, 7/36, 6/36, 5/36, 4/36, 3/36, 2/36, and 1/36.

For any year, the depreciation is calculated by multiplying the corresponding rate of depreciation with $(P - F)$.

$D_t = \text{Rate} \_ (P - F)$

$B_t = B_{t-1} - D_t$

The formulae for D_t and B_t for a specific year t are as follows:

$$D_t = \frac{n - t + 1}{n(n + 1)/2} (P - F)$$

$$B_t = (P - F) \frac{(n - t)}{n} \frac{(n - t + 1)}{(n + 1)} + F$$

EXAMPLE 3: Consider Example 1 and demonstrate the calculations of the sum-of-the-years-digits method of depreciation.

Solution

P = Rs. 1,00,000, F = Rs. 20,000, n = 8 years

End of year (n)	*Depreciation* (D_t)	*Book value* (B_t)
0		1,00,000.00
1	17,777.77	82,222.23
2	15,555.55	66,666.68
3	13,333.33	53,333.35
4	11,111.11	42,222.24
5	8,888.88	33,333.36
6	6,666.66	26,666.70
7	4,444.44	22,222.26
8	2,222.22	20,000.04

If we are interested in calculating D_t and B_t for a specific t, then the usage of the formulae would be better.

Sinking Fund Method of Depreciation

In this method of depreciation, the book value decreases at increasing rates with respect to the life of the asset. Let P = first cost of the asset, F = salvage value of the asset, n = life of the asset, i = rate of return compounded annually, A = the annual equivalent amount, B_t = the book value of the asset at the end of the period t, and D_t = the depreciation amount at the end of the period t.

The loss in value of the asset $(P - F)$ is made available the form of cumulative depreciation amount at the end of the life of the asset by setting up an equal depreciation amount (A) at the end of each period during the lifetime of the asset.

$A = (P - F)$ _ $[A/F, i, n]$

The fixed sum depreciated at the end of every time period earns an interest at the rate of i% compounded annually, and hence the actual depreciation amount will be in the increasing manner with respect to the time period. A generalized formula for D_t is

$D_t = (P - F)$ _ $(A/F, i, n)$ _ $(F/P, i, t - 1)$

The formula to calculate the book value at the end of period t is

$B_t = P - (P - F)\,(A/F, i, n)\,(F/A, i, t)$

The above two formulae are very useful if we have to calculate D_t and B_t for any specific period. If we calculate D_t and B_t for all the periods, then the tabular approach would be better.

EXAMPLE 4: Consider Example 9.1 and give the calculations regarding the sinking fund method of depreciation with an interest rate of 12%, compounded annually.

Solution

P = Rs. 1,00,000, F = Rs. 20,000, n = 8 years, i = 12%

$A = (P - F)$ _ [A/F, 12%, 8]

= (1,00,000 – 20,000) _ 0.0813 = Rs. 6,504

In this method of depreciation, a fixed amount of Rs. 6,504 will be depreciated at the end of every year from the earning of the asset. The depreciated amount will earn interest for the remaining period of life of the asset at an interest rate of 12%, compounded annually. For example, the calculations of net depreciation for some periods are as follows:

Depreciation at the end of year 1 (D_1) = Rs. 6,504.

Depreciation at the end of year 2 (D_2) = 6,504 + 6,504 *0.12 = Rs. 7,284.48

Depreciation at the end of the year 3 (D_3)

= 6,504 + (6,504 + 7,284.48) *.12 = Rs. 8,158.62

Depreciation at the end of year 4 (D_4)

= 6,504 + (6,504 + 7,284.48 + 8,158.62) *0.12 = Rs. 9,137.65

These calculations along with book values are summarized in Table

End of year t	*Fixed depreciation* (Rs.)	*Net depreciation* D_t (Rs.)	*Book value* B_t (Rs.)
0	6,504	–	1,00,000.00
1	6,504	6,504.00	93,496.00
2	6,504	7,284.48	86,211.52
3	6,504	8,158.62	78,052.90
4	6,504	9,137.65	68,915.25

End of year t	*Fixed depreciation* (Rs.)	*Net depreciation* D_t (Rs.)	*Book value* B_t (Rs.)
0	6,504	–	1,00,000.00
1	6,504	6,504.00	93,496.00
2	6,504	7,284.48	86,211.52
3	6,504	8,158.62	78,052.90
4	6,504	9,137.65	68,915.25
5	6,504	10,234.17	58,681.08
6	6,504	11,462.27	47,218.81
7	6,504	12,837.74	34,381.07
8	6,504	14,378.27	20,002.80

$$B_t = B_{t-1} - D_t$$

Service Output Method of Depreciation

In some situations, it may not be realistic to compute depreciation based on time period. In such cases, the depreciation is computed based on service rendered by an asset. Let P = first cost of the asset F = salvage value of the asset X = maximum capacity of service of the asset during its lifetime x = quantity of service rendered in a period. Then, the depreciation is defined per unit of service rendered:

Depreciation/unit of service = $(P - F)/X$

Depreciation for x units of service in a period = $\frac{P-F}{X}(x)$

EXAMPLE 5: The first coat of a road laying machine is Rs. 80,00,000. Its salvage value after five years is Rs. 50,000. The length of road that can be laid by the machine during its lifetime is 75,000 km. In its third year of operation, the length of road laid is 2,000 km. Find the depreciation of the equipment for that year.

Solution

P = Rs. 80,00,000, F = Rs. 50,000, X = 75,000 km, x = 2,000 km

Depreciation for year 3 = Rs. 2,12,000