Chapter 6. PROPERTY VALUE CALCULATION METHODS

Objectives:

• To be able to assess the property using a variety of valuation methods.

• To model the situations which simulate the accounting of a companys asset, the performed audits.

Examined study results:

• Will use property value calculation methods.

• Will simulate real content situations, where asset valuation and its accounting will be performed.

Student achievement assessment criteria:

• Correct use of concepts

• Proper use of formulas

• Correct intermediate calculations

• Correct answers to questions.

Repeat the concepts:

Cash value, discounting, discount interest rate, discount rate, the present and future value of an annuity.

6.1 Introduction

It is easy to understand that over time the used and even unused property loses its value due to various reasons.

Definition. The process of decline in the property value over time is called the depreciation.

Assets can be very diverse, but their valuation methods are the same. Here are some concepts that will be used in solving the tasks of property depreciation. This section will explore the depreciation issues of the long-term assets (the property which may function more than one year). On the other hand, it will also analyze the long-term assets, which does not lose its physical appearance at the time of production or service and its value is not less than the specified minimum value.

1. A minimal value of the assets will be called a salvage value of the assets. This value will be marked by the symbol RV, sometimes with an index indicating the number of time periods of the asset use. Note that the salvage value of the assets should not exceed 10

Note. By modelling a variety of situations we will not always follow the provisions that the RV should not exceed 10

2. An initial (original) value of the assets will be called the value of the property, which at the initial moment of time performs all the functions projected to it. Note that an entity can buy both new and used property. The initial moment of time is the contractual term. An initial value will be marked by the symbol OV.

3. The *w*earing value (VV) which is the total amount of depreciation over the useful life of the asset: that is the difference between original cost and the residual value of the asset.

4. The useful life of the asset(stated in years).

5. The accumulated depreciation which is the total depreciation allocated at any point in the life of the asset to expired accounting periods.

6. The *b*ook value BV or net value of the asset at any point in the life of the asset; that is, the difference between the original cost and the accumulated depreciation.

7. *D*epreciation schedules showing the details of the allocating the cost of the asset to the various accounting periods.

Suppose that D_k is amount of depreciation in the k-th level. Then

$$BV_k = OV - \sum_{i=1}^{k} D_i, \;\; VV = \sum_{k=1}^{n} D_k,$$

if the assets is depreciated by n times to its salvage value. In short, asset depreciation is the decrease in the real value of assets over time.

6.2 Depreciation methods

We will consider ten depreciation methods, which are divided into three groups. 1. The methods of averages:

a) Linear method.

b) The number of worked hours.

c) The method of production quantity.

2. Allocation based on a diminishing charge per year:

a) The sum-of-the-years digits.

b) Double-balance method.

b1) Simple double-balance method.

b2) Complex double-balance method.

b3) Fixed percentage value method.

The third group consists of the depreciation methods, covering an interest margin within the invested assets:

3. The methods of compound value:

a) Annuity method.

b) Sinking fund method.

6.3 The methods of averages

a) Linear method

The essence of this method is the assumption that within equal time intervals the value drops to the same extent. When using this method, a constant (annual) value of an asset depreciation is found in the following manner:

$$D = \frac{OV - LV}{n},$$

n is the number of years of the property lifetime.

Example. The car wash equipment costing 10000 will have the salvage value of 1600 after five years. Let us find the following values using the linear method

1) An annual depreciation rate;

2) Determine a depreciation rate in the fourth year;

3) Make a depreciation table.

1) We have that$OV = 10000, RV = 1600, VV = 100001600 = 8400, n = 5.$

2) Then, the annual depreciation of assets is equal to the following sum

$$\frac{8400}{5} = 1680.$$

Since the depreciation is fixed within all of the intervals, within the fourth year it will be the same, i.e. 1680.

We make a depreciation table. In the column, which is marked by the symbol D, the value of depreciation recorded at the end of the year is written, in the column marked by the symbol SD the total (accumulated) depreciation recorded at the end of the denoted year, in the column marked by the symbol BV the book value recorded at the end of the denoted year.

Nr	D	SD	BV
0	–	-	10000
1	1680	1680	8320
2	1680	3360	6640
3	1680	5040	4960
4	1680	6720	3280
5	1680	8400	1600
Suma	8400	–	–

Please note that the total (gross) depreciation value is equal to the use value of assets.

Let us conclude general formulas, which could be used for the direct calculation of the book value of assets during any depreciation. Suppose that the annual depreciation rate is $D_k = D$. The accumulated depreciation after k years is $SD_k = k \cdot D$.

The book value after k years is equal to: $BV_k = OV - k \cdot D$.

The depreciation in the next year will be as follows: $DV_{k+1} = BV_k D$.

b) The method of worked hours

This method is analogous to the linear method only by its formula

$$D_n = \frac{OV - LV}{n},$$

n is the lifetime of assets in hours (typically working hours). D_n is the depreciation rate per hour.

Example. A water pump costs 40000. After 12000 working hours its salvage value is 4000.

1) By using the method of the number of hours, calculate the annual depreciation rate (the device is considered to have 1460 annual working hours).

2) Make a depreciation table for the period of five years.

1) We have that

$$OV = 20000, LV = 4000, VV = 400004000 = 36000, n = 12000.$$

The depreciation rate per hour is as follows::

$$\frac{36000}{12000} = 3.$$

Then the depreciation rate after 1 year will be: $31460 = 4380$. Make depreciation schedule:

Nr	D	SD	BV
0	–	-	40000
1	4380	4380	35620
2	4380	8760	31240
3	4380	13140	26860
4	4380	17520	22480
5	4380	21900	18100
...	...	...	...

Assume that the hourly rate of depreciation is D. The accumulated depreciation after k hours is $SD_k = k \cdot D$. The book value after k hours is equal to: $BV_k = OVAD_k$.

c) The method of production quantity

As it is easy to understand from the definition, when applying this method the depreciation rate is expressed by the number of units of the finished products:

$$DP_n = \frac{OV - LV}{n},$$

DP_n is the depreciation rate after the production of one product, n is the number of products produced during the lifetime of an asset.

The total amount of depreciation SD_m during the analyzed period T, when m products have been made up to this point, is obtained by multiplying the number of the finished products by the value of DP, i.e. $SD_m = mDP_n$.

Then the book value of assets after the production of m products is

$$BV_m = OV - SD_m.$$

Example. The machine with an initial value of 40000 and a salvage value of 8000, can manufacture 640000 production units during its lifetime.

1) Determine the depreciation rate by the number of production units.

2) Determine the depreciation rate after 4 years, if after four years 320000 production units will be produced.

3) Make a table of depreciation, provided that the annual production is 160000 production units.

1) We have that $OV = 400000, LV = 8000, VV = 400008000 = 32000, n = 640000$. Then after the production of one product, the machines depreciates by the value of

$$DP = \frac{40000 - 8000}{640000} = 0,05.$$

3) We make a table of depreciation:

No	D	SD	BV
0	–	-	40000
1	8000	8000	32000
2	8000	16000	24000
3	8000	24000	16000
4	8000	32000	8000
Suma	32000	–	–

6.4 Allocation based on a diminishing charge per year

a) The sum-of-the-years digits method. When applying this method it is assumed that an asset value decreases continuously over the years by a constantly decreasing value which is associated with the number of years of an asset use only in the reverse order. In other words, if the during the period of the use asset value the value is converted n times, while the depreciation rate D is known (we will discuss the methodology of its determination later), at the end of the first year, the asset value will decline by the value of $(n-1)D$, and so on, at the end of the k-th period of time by the value of $(n-k+1)D$.

Thus, using this method the year-depreciation rate pairs have to be formed. Years start with the first year. The largest depreciation is observed during this year, while the further pairing of years and the depreciation rate results in the formed sequence of pairs. We assume that the descending year value is $(n-k+1)D, k=1,...,n$. Having summing up all of these depreciation factors $n-k+1$, where $k=1,...,n$, we obtain that

$$\sum_{j=1}^{n}(n-(j+1)) = \frac{(n+1)n}{2} = S_n.$$

The total use value is divided into S_n equal parts, and these parts are assigned to the numbers of years in the provided manner, i.e. the more years of the asset use passes, the less this asset depreciates. The depreciation rate of one part is determined by the following correlation:

$$D = \frac{OC-RV}{S_n}.$$

Thus, the closer the time of use is to the beginning of the property acquisition, the more parts of depreciation it includes. Note that while using the sum-of-the-year-digits method, the pair including the duration of the asset use and the depreciation factor is correlated by $(k, n-k+1), k=1,...,n$. Then

$$WV = D\cdot S_n = D\cdot\frac{n(n+1)}{2},$$

$D-$ is the depreciation rate of one of the S_n parts, i.e.

$D=\frac{WV}{S_n}$.

Then, the book value of the property at the k-th moment in time, i.e. after k years, will be as follows:

$$BV_k = OV - SD_k, \quad SD_k = \sum_{l=1}^{k} D \cdot (n - (l-1)).$$

Example. Assume that an initial value of a PC is 5000, its lifetime is 5 years, and its salvage value is 500. By using the sum-of-the-year-digits method make a depreciation table. We have that $OV = 5000, RV = 500, WV = 4500$.

The asset is valued during the period of five years ($n = 5$). We set the number of depreciation parts.

$$S_5 = \frac{5 \cdot 6}{2} = 15.$$

Then, within one part the absolute depreciation value will be equal to

$$D = \frac{WV}{S_n} = \frac{4500}{15} = 300.$$

We make a table of depreciations:

Metai	MS	Nd	D	SD	BV
0	–	-	0	0	5000
1	1	5	1500	1500	3500
2	2	4	1200	2700	2300
3	3	3	900	3600	1400
4	4	2	600	4200	800
5	5	1	300	4500	500
S_n	300		–	4500	500

MS the year-defining digits; Nd the depreciation factor corresponding to years; ND the depreciation rate at the end of the indicated year; SD the total depreciation until to the indicated year; S_n the amount of depreciation rates (or based on the note, the sum-of-the-year-digits).

b) Double-balance method

The essence of this method the depreciation of a particular year is calculated from the book value of an asset of the last year. Moreover, this depreciation rate is always constant. We will discuss three modifications of this method.

b1) Simple double-balance method;

b2) Complex double-balance method;

b3) Fixed percentage value method.

All these methods are similar. They differ in the methodology for the depreciation rate setting. Let us consider these methods by the sequential order.

b1) Simple double-balance method;

Let n be the number of the asset life cycles, from an initial to a salvage period. Then, in the case of a simple double-balance method, the depreciation rate is established as follows:

$$d = 2 \times \frac{1}{n}.$$

The book value of an asset after k time interval of use is equal to:

$$BV_k = OV(1-d)^k.$$

Then the depreciation rate during the k -th year is

$$D_k = BV_{k-1} \cdot d, \; k = 1, 2, \ldots, n, \;\; BV_0 = OV.$$

Example. The original value of a mechanism is 10000, while its salvage value is 1000.

When using a simple double-balance method let us make a depreciation table for the five-year period. We find the depreciation rate the formula for the depreciation rate setting. We have that

$$d = 2 \times \frac{1}{n} = 2\left(\frac{1}{5}\right) = \frac{2}{5} = 0.4.$$

Each year the asset depreciates by 40%. Thus, during the first year the asset depreciates by the following value: $0.4 \cdot 10000 = 40000$. Consequently, the asset book value is equal to $BV_1 = 0,6OV = 6000$. During the following year the depreciation is calculated in the same way.

While considering an example, we make a table of depreciation.

Nr	D	SD	BV
0			10000
1	4000	4000	6000
2	2400	6400	3600
3	1440	7840	2160
4	864	8744	1296
5	296	900	1000
Bendra	9000		

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Please note that while using this method, the last line of the table is usually filled in such a way that balances all the calculations, i.e. the value attributable to the depreciation of the last year is usually smaller than the one found by formulas. This drawback can be eliminated by using the method presented below.

b2) Complex double-balance method.

Please note that while using a simple double-balance method the salvage value of an asset is ignored. The essence of a complex method is that this method does not ignore this value, but includes it in the general process of the depreciation calculation.

The depreciation rate is the key parameter for each depreciation method. How is the depreciation rate determined in this case?

When using this method it is assumed that after n periods, the value of an asset drops to its salvage value. Thus, in this case the correct equation is as follows: $BV_n = OV(1-d)^n$ or $\frac{LV}{OV} = (1-d)^n$. From the last equation it follows that

$$d = 1 - \sqrt[n]{\frac{BV_n}{OV}}.$$

Let us analyze the example which will illustrate the application of this method.

Example. Assume that a printer costs 15625 and after 6 years its salvage value is 729. Make a depreciation table using a complex double-balance method. We have that the original value is $OV = 15625; RV = 729; n = 6$. Then, applying the formula for the depreciation rate calculation we obtain that

$$d = 1 - \sqrt[6]{\frac{729}{15625}} = 1 - 0,6 = 0,4$$

Thus, the depreciation rate is$d = 0.4$. The book value after three years: We make a table of depreciation when the depreciation is calculated using a complex double-balance method.

Nr	D	SD	BV
0			15625
1	6250	6250	9375
2	3750	10000	5625
3	2250	12250	3375
4	1350	13600	2025
5	810	14410	1215
6	486	14896	729
Total	14896	–	–

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As usual: No the number of the end of a year, D an annual depreciation rate, SD total depreciation, BV a book value.

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b3) Fixed percentage method

The essence of this method is the depreciation by the chosen rate, depending on the type of property. In other words, assets are classified by types. We will explore the situation where assets are divided into three types. A fixed depreciation rate is ascribed to each category of assets. Usually the maximum rate of depreciation is used. In other words, each type of assets is linked to the depreciation factor.

Class 3. This class includes buildings. The maximum depreciation rate is 3%;

Class 8. Machines and other manufacturing equipment. The maximum depreciation rate is 20% ;

Class 0. Cars, tractors. The maximum depreciation rate is 30%.

Example. Suppose a detail-stamping machine costs 5000, its salvage value is 500. Considering that these devices belong to Class 8, let us make a table for the maximum capital depreciation costs for a five-year period.

We have that $OV = 20000, LV = 3200, n = 5$. The maximum depreciation rate is $d = 0,2$.

Nr	D	SD	BV
0			5000
1	1000	1000	4000
2	800	1800	3200
3	640	2440	2560
4	512	2952	2048
5	$409,6$	$3361,6$	$1638,4$
Total	$3361,6$		

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As usual: No the number of the end of the year, D an annual depreciation rate, SD total depreciation, BV a book value. Note that within the period of five years the asset depreciated to its salvage value. Consequently, it can be continued to use.

6.5 The methods of compound value

a) Annuity method

A depreciation method to be discussed below is slightly different by its nature than those given above. This property depreciation method includes the market cash value as well. Thus, in this case while calculating the asset depreciation its cash value also will be taken into account. The bigger the market cash value, the lower the annual depreciation rate. When using this method it is assumed that during the calculation of the asset depreciation, two values are included in the constant payment the depreciation rate and the interest calculated on the book values of an asset.

Note: VVP a present value of the use (wearing) value; LVP a value of the salvage value. Then the use value (during the time interval n) is

$$A_n = OV - LVP.$$

When using this method it is assumed that the use value during the life cycle of assets at the end of the k-th evaluation period, depreciates by the value of $D_k = R - i \cdot B_{k-1}$, B_{k-1} is the asset book value during a specified period. The value R is determined by using an annuity method:

$$R = \frac{A_n}{a_{\overline{n}|i}},$$

where i is the actual rate of a period (usually the year).

Let us conclude general formulas for the different value calculations. We have that a salvage value of the present value is $\frac{RV}{(1+i)^n}$,, while a present value of the use value of the depreciated asset over n years (periods of time) is as follows:

$$VVP = OV - LV(1+i)^{-n}.$$

According to the ideology of an annuity, this present value must be equal to the present value of the fixed annual payments:

$$OC - LV(1+i)^{-n} = Ra_{n\rceil i}.$$

From this correlation it follows that

$$R = \frac{OV - LV(1+i)^{-n}}{a_{n\rceil i}}.$$

Then

$$D_k = R - i \cdot B_{k-1}, \quad \text{ir} \quad B_k = B_{k-1} - D_k.$$

Example. The life period of a machine-tool with the initial value of 50000 is 5 years and its salvage value 10000. The interest rate -10% interest is converted every year. Let us calculate the depreciation by an annuity method:

1) The annual depreciation;

2) Make a table of depreciations for the period of five years.

1) We have that $OV = 50000; LV = 10000; n = 5; i = 0,1.$

Then a present value of the use value is

$$VVP = 50000 - 10000(1.1^{-5}) = 50000 - 10000(0.6209213) = 43790.78.$$

The whole of the present values of the five-year depreciation is an ordinary annuity with a present value of $A_n = 43790.78$. Then

$$43790.78 = Ra_{5\rceil 0.1}, \quad \text{arba} \quad R = \frac{43790.78 \cdot 0.1 \cdot 1.1^5}{1.1^5 - 1} = 11551.89.$$

Thus, a constant annual payment, which also includes the depreciation interest is $R = 11551.89$.

Note. No the number of the end of the year D an annual depreciation rate, SD total depreciation, BV a book value, D depreciation excluding an interest from the book value of asset, BI a balance interest rate. We make a table of depreciations, using an annuity method.

Nr	D	BI	LD	SD	BV
0					50000
1	11551.89	5000	6551.89	6551.89	43448.11
2	11551.89	4344.811	7207.079	13758.969	36241.031
3	11551.89	3624.1	7927.79	21686.76	28313.24
4	11551.89	2831.324	8720.57	30407.33	19592.67
5	11551.89	1959.27	9592.62	39999.95	10000.05
Suma	57759.45	17759.505	39999.95		

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Note that a table includes a small error, using the precision of 3 decimal points, since the numbers have been rounded during the calculation.

b) Sinking fund method

The essence of the savings fund method is the following: when calculating annual depreciations (marked by D_k) we add the interest accrued from all the depreciation until this period to the steady depreciations. In addition, during the entire period this amount of depreciations accumulates the use value. Let us formalize this situation. Based on the foregoing we have that $VV = OV - LV$.

Let as the above R be the size of payments to a savings fund. Let us assume that we consider n periods of depreciation and depreciations are calculated at the end of the period. In this case, using the savings fund method (calculating the future value of an ordinary conventional annuity), we obtain that

$$OV - LV = Rs_{n\rceil i}.$$

From the latter correlation it follows that

$$R = \frac{OV - LV}{s_{n\rceil i}}.$$

Then, the annual depreciation is

$$D_K = R + BI_k, \text{ and } BI_k = iSD_{k-1}.$$

Moreover

$$BV_k = OV - SD_k = BV_{k-1} - D_k.$$

Example. A computer with the initial value of 7000 is stored in the state agency for 5 years. Five years later its salvage value is 1000. Suppose that the market cash value is 5%, the interest is converted on an annual basis. When calculating the depreciation with the help of a savings fund method make a table of depreciations:

1) The anticipated annual payments to funds;

2) Make a table of depreciations.

1) We have that $OV = 7000, LV = 1000, n = 5, i = 0.05$.

Then $VV = 6000$.

Based on the calculation formula for the future value of an ordinary conventional annuity we have that

$$VV = Rs_{n\rceil i}. \quad \text{Thus} \quad R = \frac{VV}{s_{5\rceil 0.05}} = \frac{6000 \cdot 0.05}{1.05^5 - 1}.$$

Having calculated we obtain that $R = 1085.85$. We make a table of depreciations, using a savings fund method.

Nr	R	BI	D	SD	BV
0					7000
1	1085.85	0	1085.85	1085.85	5914.15
2	1085.85	54.3	1140.15	2230	4770
3	1085.85	111.5	1197.35	3427.35	3572.65
4	1085.85	171.36	1257.21	4684.56	2315.44
5	1085.85	234.23	1320.08	6004.4	995.4
5'	1085.85	230.15	1316	6000	1000
Total	5429.25	575.15	6004.04		

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We would like to note that line 5' is added in order to correct the rounding errors, which determined the formation of an error in the monetary unit of 4.4.

Tasks for the Practice

Note. Using an annuity method or s sinking fund method we assume that the interest rate is 6%.

1. Make tables for the depreciation of home appliances (washing machine), using all the above discussed methods. Assume that an original value of the machine is 2000, and its salvage value is 10. The evaluation period is 8 years.

2. The machine costs 75000, and after -5 years its price is 3500. Make a section in a table for the machine depreciation for the periods of the tenth and eleventh year using all the methods of depreciation.

6.6 Depletion of assets

The majority of natural resources that people use in their economic activities come from nature. These resources may be renewable, although not necessary immediately, such as timber, fish stocks, etc., or may be non-renewable, even though their amounts are very great, such as gas, oil, etc. This type of property is called *non-renewable assets.*

The issue of the non-renewable asset use is called the task of the asset depletion. In the section above we have analyzed at the problem of depreciation, i.e. we discussed the situations where assets retain their physical properties, appearance, even when they are fully depreciated, and while talking about resources, raw materials we note that in this case the analyzed asset is changing during the production process its volume decreases, physical properties change.

An investor investing their capital in the raw material extraction expects to receive an annual income from the investing in this depleting property; in addition, they hope to obtain not only interest but also the funds which could be used to ensure the restoration of capital invested in the property throughout the entire period of its operation. Assume that an entity acquires the property as an investment, the extent of which during its use is constantly decreasing. There is a natural question of how to calculate the value of the purchased asset, or in other words how to determine how much we pay for this property, if through the alternative investing of the available funds we are able to do this with the interest rate r? Restoration of the invested capital is usually performed by putting money to the annual savings funds. These funds are referred to as a depletion reserve fund. Their essence is as follows during the operating periods of an asset all the invested money (invested with the market interest rate i) accumulates the value equal to the invested capital. Let R be the constant payments to a depletion reserve fund and X be the invested initial capital. Let us assume that the number of investment periods (usually years) is n. Then

$$X = Rs_{n\rceil i}.$$

Let the average income received during each investment period be $P, k = 1, ..., n$ and the returns on the invested capital, or in other words, the received investment interest on an invested capital be $I = rX$; in this case the following equality is correct:

$$Ps_{n\rceil i} = rXs_{n\rceil i} + X.$$

In other words

$$P = X\Big(r + \frac{1}{s_{n\rceil i}}\Big).$$

If the investment period ends when a property is not fully depleted, i.e. the income of, say Y, can be received from its sales, the last formula is rewritten in the following way:

$$P = Xr + \frac{X - Y}{s_{n\rceil i}} \qquad (4.1).$$

To determine the rate of return of an investment project, in other words, to identify a project profitability, the last equations must be solved in respect of r as well. Based on the formula (4.1), we obtain that a project rate of return may be determined in the following way:

$$r = \frac{Ps_{n\rceil i} - X + Y}{Xs_{n\rceil i}}.$$

Example. Suppose that the aim is to invest in a clay pit. The investment would guarantee the constant annual income of 400000 for fifteen years. A salvage value of the pit is 20000. It is known that the payments to a depletion reserve fund are invested with the interest rate of 10The investment amount is marked by X (we can assume that this is a value of the assets to which investments are directed since while investing in assets we acquire the disposition right to this property at the same time) and Y = 20000. The annual operating income is P = 400,000, and the annual interest on the invested capital is $I = 0,12X$. Annual payments to the depletion reserve are as follows:

$$R = \frac{X - Y}{s_{15\rceil 0,1}} = \frac{X - 20000}{31,7725} = 00315(X - 20000).$$

Applying the formula (4.1) we obtain that

$$400000 = 0.12X + 0.0315X - 6300, \quad \Rightarrow \quad X = 2688148.$$

If we had that the pit is fully depleted, i.e. Y = 0, then the pit acquisition price would be $X = 2640264$.

6.7 Capitalization

Definition. *Capitalization* is a process during which the present value of an infinite number of payments is determined.

During the process of capitalization the present values of the income-generating assets and liabilities are determined. Capitalization is a lifetime annuity; consequently, the future value is calculated by one of the following ways:

In the case of an ordinary annuity $A = R$ and in the case of a complex annuity: $A = R$, where $p = (1+i)c - 1$.

Example. Suppose that during the rent of a property the owner earns the income of 60000 on a quarterly basis. Set the value of this liability at the current moment; in other words, determine the price of this property, if it was sold at the present moment at the interest rate:

1) of 8% converted on a quarterly basis?

2) of 8% converted on an annual basis?

We have that 1)

1)
$$R = 60000, \; i = 0.02, \quad A = \frac{60000}{0.02} = 3000000.$$

Thus, the market value of this property is 3000000. 2) In the case we have a complex annuity, thus: $R = 60000, i = 0.08, c = 0.25$. Then

$$p = 1.08^{0.25} - 1 = 0.0194265, \quad A = \frac{60000}{0.0194265} = 3088557.$$

Consequently, in this case the value of this property is 3088557.

We will discuss the problem when during the use of a property, in which the capital was invested, it wears out and needs to be renovated. Assuming that investments are made for an indefinite period of time, we can define a hypothetical present amount of the total cost.

The capitalization of this type of asset is defined in the following way: it is an initial (original) price of the property of that time, plus the lifetime annuity of periodic replacements (the future costs of asset renovation). The periodic change period of time will be called a time interval after which the device is replaced by a new one. Let us formalize the task of the asset capitalization of this type. Let K be the capitalized costs, OV the original cost, R the periodic replacement costs. According to the markings, the capitalized costs are calculated as follows:

$$K = OV + \frac{R}{p}, \; \; p = (1+i)^c - 1, \tag{4.2}$$

in addition, i is the interest rate of a conversion period, c is the parameter of a complex annuity, i.e.

$$c = \frac{m}{k},$$

where m is the number of interest conversion periods per year, k is the number of asset replacements per year (not necessarily a whole number).

For example, if $k = 0.25$, this means that a property is replaced every four years, $k = 2$ two times a year. Then c is the number of interest conversion periods during the replacement period. It is known that if the interest conversion range coincides with the replacement interval then $c = 1, p = i$.

Example. The device, the cost of which is 120000, must be replaced after six years. It is known that after six years the used equipment could be sold for 20000. Set the value of the property at the present moment (capitalize the costs) if the interest rate is 10%, which is converted once a year?

We have that OV = 120000, the replacement costs $R = 120000 - 20000 = 100000$. In addition,

$$i = 0.15; \quad c = \frac{1}{\frac{1}{6}} = 6; \text{ and } \ p = 1.1^6 - 1 = 0.7716.$$

Then

$$K = 120000 + \frac{100000}{0.7716} = 249607.4.$$

Example. A.B. purchased a license to engage in the transportation services for which he paid 6000. Moreover, he paid 30000 for the purchased car. He hopes to replace a car with a new one every three years, hoping to allocate 30000 for a new car. In addition, he can sell the car for 10000. Determine the costs of this business, if the interest rate is 12%.

We have that the initial business costs are 35000, the replacement costs are $R = 30000 - 10000 = 2000$.

In addition, $i = 0.12, c = 3, p = 0.404928$. Then

$$K = 35000 + \frac{20000}{0.404928} = 84391.5.$$

Thus, the capitalized general business costs will be as follows.

Tasks for the practice

1. A ravel pit can be purchased for 44000. The annual income of the operation amounts to I 2000 and a salvage value of the pit after eight years will be 5000. Determine the rate of return, if the reserve funds earn 10

2. The annual incomes of a peat quarry are 000000 for twenty years in a row. After twenty years, its salvage value is 2000000. What price could be offered by a buyer if it is known that the return on investment is 2%, and the rate of savings funds is 8%?

3. The car (M) costs 250000 and after twelve years it can be sold for 7000. The car (V) costs 220000 and after nine years it can be sold for 18000. Find the capitalized costs, as well as the annual investment costs to determine which model is the more cost-effective to use if

a) the interest rate is 3% ;

b) the interest rate is 20% .

4. The present value of assets is 400000. This property will be renovated after six years, and its salvage value is 30000. The annual maintenance costs are 48000. What are the capitalization costs if the interest rate is 5%?

Self-control exercises

1. A new promotional letter printing device costs 9-6000, and after six years is value is 223000. Make a depreciation table using the years-digits method.

Ans: The continuous part of depreciation $R = 33000. RV_1 = 198000, RV_2 = 33000$.

2. A new office building costs 8000000, and after 25 years its price will be 850000. Determine the book value of the building after 15 years using:

a) a declining balance method;

b) a savings fund method at the interest rate of 18%.

Ans:: a) 2290379, b) 6727681.

3. The machine-tool costs 7500000 and after 20 years its price is 350000. Determine the book value of the device during the 12th year, using:

a) a complex method of declining balance;

b) a sinking fund method at the interest rate of 21% .

Ans:: a) 197482, b) 2960251.

10. A well is proposed to acquire. The oil reserve is for 15 years, a fixed annual income is 200000 while the value of the remaining asset after 15 years is 500000. Determine the price to be offered by a buyer if they expect to receive a return of 20%, and the payments to the savings fund earn 11%.

Ans:: $\approx$ 936557.

11. A mine is offered for 60000000. After eighteen years when the mine is depleted, its salvage value will be 7500000. When purchasing the mine a businessman hopes to get 9000000 every years; and the returns of the depletion reserves is 12%. a) Find the rate of return, if it is known that the mine was purchased for 600000. b) How much should a buyer offer for the mine, if the return on investment is 16%.

Ans:: 1) 13.43%; 2) 51 335667.

12. The return of the purchased fruit trees is 22%. It is planned that the trees will be productive for fifteen years, and after this interval of time their salvage value will be 3500000. The annual income from the fruit trees is 2000000, and the saving funds pay the annual interest of 10%; find the depletion in the sixth year.

Ans:: 247928.

13. When operating a forest the income of 550000 is earned for eight years. It is known that the salvage value of the property after twenty years is equal to 1500000. The return on the savings fund with the accrued money to cover the investment is 10%. Determine the rate of return on investment if a potential buyer offers 2700000 for the forest.

Ans:: 16.48%.

14. The postal service bought a car for 12600, which it hopes to replace every two years, and to receive the amount of 5200 for the used one. The interest rate is 13

1) Determine the capitalization costs.

2) What are the annual investment costs?

Ans:: 1) 30752; 2) 4128.

Homework exercises

1. Make the furniture and equipment depreciation tables, if it is known that a coffee machine worth 1500, four chairs with a value of 200, three tables, a value of which is 600, two cupboards worth 2000, three computers each with a value of 3500, and a printer, a value of which is 1400, can be found in the office. Make a table of this asset depreciation for the period of 5 years; for furniture we apply a simple linear method (the salvage value of furniture is 10), for office equipment we apply a double (complex) balance method, the salvage value of office equipment is 20, for the coffee machine (salvage value 150) apply years-digits method.

2. A combine costing 32000 has a trade-in value of 5000 after eight years. Construct a depreciation schedule using
(a) the straight-line method;
(b) the sum-of-the-yeas-digit method;
(c) he simple declining-balance method;
(d) the complex declining-balance method;
(e) the annuity method;
(f) the sinking-fund method.

3. The invoice printing device costs 91600, and after eight years its salvage value is 13000. Make depreciation tables using the sum-of-the-years-digit method and the compound value method when a cash value is 10%.

4. Make a model of the company and tables for the evaluation of newly acquired property of this company within the period of ten years at a time when a sufficient number of objects are found in the company for the use of all the known methods of assessment to calculate their depreciation. The assessment must be performed using the formed tables. Later a table has to be made to integrate all the tables and to reveal the total scheme for the asset valuation that would establish the salvage value of assets for the selected years. In the beginning, the volume of the companys property shall be precisely specified (furniture, cars, computers, etc.). All the 10 presented methods must be used for depreciation.

Note. When using the annuity method or the saving fund method, you should choose the non-zero interest rate on your own.

5. Create a simulation model of the company considering that you have to make the audits of this company as its went bankrupt, and you have to give a report for the shareholders indicating the value of the remaining assets of the company. Assume that the remaining assets are diversified, and the assets of the same type can be of different ages. All the valuation methods must be used for the asset assessment. In the beginning, the detailed description of the assets (furniture, cars, computers, etc.) found in the company should be presented indicating its volume and age. All the 10 presented methods must be used for depreciation.

Note. When using the annuity method or the savings fund method, we assume that the interest rate is 10%.

6. A gravel pit is for sale at 85000. Estimated annual net income before depletion is 22000. The gravel pit will be exhausted after seven years and the property will then have a value of 30000. What is the yield rate if deposits into a depletion reserve earn 12%?

7. A dump truck costing 35000 has an estimated trade-in value of 7000 after five years. The owner of a fleet of such trucks set up a sinking fund earning 11% to replace the trucks. If the net annual income before depreciation is 10600, what is the yield rate on the investment?

8. An orchard was purchased to yield 22%. The trees are expected to be productive for fifteen years after which time the property will have an estimated value of 35000. If annual net income is 20000 and a replacement fund earning 10%is set up for the recovery of the capital invested, determine the depletion in Year 6.

9. A delivery service purchased a van for 12 600 and expects to trade every two years at a cost of 5200. Interest is 13% compounded semi-annually.
(a) What is the capitalized cost?
(b) What is the annual investment cost?

10. A pool heating and filtration system cost 2300. If exposed to weather, the system needs to be replaced every five years. If an enclosure is provided the life of the system including the enclosure is seven years. Scrap value in either case is 400. If money is worth 13%, what is the maximum amount that should be spent on the enclosure?

11. A machine costs 25 000 when new and has a scrap value of 1700 after twelve years. A second machine which can do the same job costs 22 000, has a life of nine years and a scrap value of 1800. Compute the capitalized cost and the annual investment cost to determine which machine is more economical under the assumption that interest is
(a) 13%, (b) 20%

12. A building can be painted at a cost of 1350 every three years if using Brand A. If longer lasting Brand B is used, the paint job needs to be done every five years. If interest is 12%, what is the maximum cost at which it is economical to switch to Brand B?

13. A machine costing 18 000 has a life of six years, a trade-in value of 2500 after six years and an annual productive capacity of 3600 units. A competitor's model costs 21 000, has a life of eight years, a trade-in value of 2200 after eight years and an annual productive capacity of 4000 units. At 16%
(a) which machine is a better buy?
(b) what is the difference in their annual investment cost per unit?

To be able to: To apply the asset valuation methods; to count the value of a property at any moments in time; to perform the property accounting. To capitalize assets. To capitalize costs.