Time value of money assignment

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**ANSWER 1**

Time value of money is a concept in finance which shows that a dollar today is worth more than that in future. This is because every dollar has some earning capacity. Other reasons behind this are that the person has decided not to consume the amount of money in hand today. If he decides to consume the amount today, then the investment opportunity that has to be sacrificed has some opportunity cost. The last consideration is that if the rate of inflation increases over the time under consideration then the purchasing power of the same amount will decrease.

From the calculations point of view the first consideration that the person has to make is whether the amounts calculated will be done by simple interest calculations or compound interest calculations. The main difference between the two aspects lies in the fact that in the simple interest case the amount of principal remains the same. We us the following formulae for calculations in case of simple interest:

**S= P \* R \* T**

**A= P+ S**

In the above formula S stands for simple interest, P stands for principal and T stands for time. The second formula calculates the total amount that will be received by the investor. In compound interest case the amount of principal does not remain the same, rather the interest calculated every year is added to the amount at the start of the year. The basic formula used for calculating the amount to be received by the investor in this case is:

 **FV= PV(1+i)^n**

The frequency of payments. In case we have a single amount of money that we need to find the value of in the future, then we will have to put in the following formula:

**FV= PV(1+i)^n**

In the above formula, FV is the future value to be calculated, PV is the present value or the amount in hand in case of a single value, I is the interest rate, n is the number of time periods. The next consideration that has to be taken into account is the matching of interest rate and the number of times that the compounding has to be done. If for example, the interest rate has been given as 6% compounded quarterly and n is given as 3 years, then we have to adjust both the interest rate by dividing it by 4 as there are 4 quarters in a year and we have to multiply the n by 4. The interest rate that was given as 6% compounded quarterly is the nominal interest rate while the rate adjusted according to the quarters is called the effective interest rate. The next case to be considered is the one that has unequal cash flow stream. In this case we have to calculate the appropriate values at any specific point in time. We may have to alter the above formula a little bit because in this case some values may have to be discounted back towards the specific point in time to arrive at their present values.

**FV/ (1+i) ^n = PV**

There are other cases where the investor will receive a defined stream of income at regular intervals over a period of time. There are two options available for the investors, either they can receive the payment at the end of the specified period or at the start of every specified period. The former case is called an annuity and the latter is called an annuity due.

In order to elaborate all the above cases correctly, it is better to use a time line and show all the available information on that.

**Maximizing Shareholder’s value**

There are different aspects of the concept of shareholder’s value. This is because the concept of value is perceived differently by the different sets of people. If we talk about the shareholders, they will consider value as an increase in the share price of the company so that their investment value rises. This is considered to be an approach based on future expectations.

The management or the company itself is interested in positive difference between the cost of capital that the company is using and the return that it is able to generate. The shareholder’s value will be increased only if there is a positive difference between the two values discussed.

The creation of shareholder’s value requires that the company develops some sustainable competitive advantage and then build a strategy that includes that particular competitive advantage. It is further important that the strategy is implemented properly and any risks involved in this process is properly accounted for.

The management can create or increase shareholder’s value by growth which is the same as perceived by the shareholders themselves or by increasing the efficiency of the processes undertaken. For the purpose of growth or investment, the company can use the tool named the competitive analysis. This method allows the company to identify the available opportunities for growth. These opportunities are then analyzed in the light of the sustainable competitive advantage that the company has.

The need to report the shareholder value arises because a prospective investor would have a future investigative approach. Thus the investor would decide on the base of analyzing the value created by the company over time. (The institute of Chartered accountants in England and Wales)

The shareholder’s value does not have to be confused with share price. The share price is the value of the share as decided in the market by the interaction demand and supply forces. Then come the business operations which focus on creating value through provision of service or making a product. The last part is the management of shareholder’s value that is done by keeping good relations with the investors. Another role that the management and the overall operations have to play is the creation or development of future expectations about upcoming operations. (cfa society)

**Difference between Nominal and Effective interest rates:**

A nominal interest rate is the one that is stated with the investment. This rate does not take into account the frequency or the number of compounding undertaken during a given period.

An effective interest rate on the other hand does take into account the number of compounding periods. Thus in order to ascertain the different investment opportunities, the effective rate of interest is used

**Example:**

A person is offered an investment at 6% rate. This is the nominal rate of interest. The same person has been offered two investment opportunities, one with 6% compounded semi annually and one with 6% compounded monthly. In the first option, the effective rate of interest would be 3% after every 6 months while in the second case the effective rate of interest will be 0.5% after every month.

We can use the nominal interest rate either in case of simple interest cases or in case the compounding option of both the investment opportunities is the same. If these criterion are not fulfilled, we will use the effective rate of interest.

**Difference between ordinary annuity and annuity due:**

The basic difference between the ordinary annuity and the annuity due lies with the time at which the payment or receipt has to be done. In an ordinary annuity, the payment is done at the end of the time period while in case of an annuity due it is done at the beginning of the time period.

The formulae used for calculating the future and present values for ordinary annuity and annuity due are as under:

**Future value of Ordinary annuity:**



**Present value of ordinary annuity:**



**Future Value of annuity due:**



**Present value of annuity due:**



**Solution to financial problems**

**Problem 1**

The data provided in the problem is first tabulated as follows

|  |  |  |
| --- | --- | --- |
| Initial Investment | Number of years | Rate of interest |
| 25000 | 2 | 15% |
| 40000 | 5 | 15% |
| 80000 | 8 | 15% |

The first step is to convert the nominal rate of interest to the effective rate of interest. For this we will divide the rate of interest by the respective number of months each investment is held by the company.

|  |  |  |
| --- | --- | --- |
| Initial Investment | Number of years | Rate of interest |
| 25000 | 2 | 0.00625 |
| 40000 | 5 | 0.0025 |
| 80000 | 8 | 0.0015625 |

In the above table, we have adjusted the rate of interest according to the number of months available for the investment. The reason behind this is that the rate of interest has been given as compounded monthly.

The next step will be to convert the years given into months, thus the following table shows the matched number of months for each option assessed.

|  |  |  |
| --- | --- | --- |
| Initial Investment | Number of periods | Rate of interest |
| 25000 | 24 | 0.00625 |
| 40000 | 60 | 0.0025 |
| 80000 | 96 | 0.0015625 |

In order to ascertain the value of all the options, we will have to see the values of all the investments at a given point in time and since we are given a comparative option at time 0 or today so we have to discount all the options as of today. The following formula will be applied:

**FV/ (1+i) ^n = PV**

In the above formula, the FV will be the amounts to be received after certain time period. I will be the effective interest rate matching to the case. N will be the number of periods used.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Amount** | **interest** | **(1+i)** | **(1+i)^n** | **FV/(1+i)^n** |
| 25000 | 0.00625 | 1.00625 | 1.161292 | 21527.746 |
| 40000 | 0.0025 | 1.0025 | 1.161617 | 34434.764 |
| 80000 | 0.0015625 | 1.0015625 | 1.161698 | 68864.699 |

In the above table, we have shown a step by step approach to the calculations. The first two columns have been explained previously. The third column shows adding 1 to each interest factor. The fourth column shows the number of periods taken as the exponential to the result of third column. Finally by dividing the amount values by the outcome of the fourth column, we arrive at the respective present values of all options.

**Conclusion:**

If we add up all the present values calculated, they add up to 124827 and the amount to be paid for today is 60000 so the person should accept the proposal.

**Problem 2**

In this problem, we have an unequal stream of cash flows in the first case. We will calculate the present values of all the future cash flows and then compare the sum with the amount to be paid today.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Amount | Rate  | Years | (1+i) | (1+i)^n | FV/(1+i)^n |
| 25000 | 10% | 3 | 110% | 1.331 | 18782.87 |
| 30000 | 10% | 4 | 110% | 1.4641 | 20490.404 |
| 20000 | 10% | 5 | 110% | 1.61051 | 12418.426 |
| 10000 | 10% | 6 | 110% | 1.771561 | 5644.7393 |
| 50000 | 10% | 7 | 110% | 1.9487171 | 25657.906 |
| 80000 | 10% | 8 | 110% | 2.1435888 | 37320.59 |

In the above table we have shown the calculations required for the first case.

**Perpetuity:**

A perpetuity is a form of annuity that has infinite payments. The formula used to calculate the present value of perpetuity is as follows:

**P = A/R**

The amount to be paid upfront is shown as A and the rate of return is shown as R thus in our problem,

**P = 25000/0.10**

This amount comes to 250000. However this is at the end of year 3 thus this has to be discounted back to the time 0. The present value of 250000 comes to 187828.

**Conclusion**

Comparing both the options, we can say that the investor should go for option 1 since the net present value of all the options is greater than present value of initial outflow.

**Problem 3**

In this problem, we have to calculate the present value of ordinary annuity in first case with the periodic payment of 7000. In the same case, we will have to calculate the present value of annuity due in case of the annual fee paid. The present value of an ordinary annuity has to be calculated for the second option with periodic payment of 1000 each month. The following tables will show the workings for the first option.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Periodic payment** | **(1+i)** | **(1+i)^-n** | **1-(1+i)^-n** |  |
| 7000 | 1.045 | 0.644 | 0.356 | 7.9127182 | 55389.027 |

In the above table we have shown all the supporting calculations for the calculation of present value of an ordinary annuity with the periodic payment of 7000. First of all we had to adjust the interest rate for bi annually payments which comes to 0.045. The overall present value factor for this annuity comes to 7.9127 which is then multiplied by the periodic payment of 7000 to arrive at the final present value of the annuity.

**Present value of annuity due:**

This problem involves the payment of annual fee of 300 for five years all at the beginning of the year. Thus we will apply the formula of present value of annuity due to calculate its value in the following table.



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Periodic payment** | **(1+i)** | **(1+i)^-(n-1)** | **1-(1+i)^-(n-1)** | **0.40373/0.09** | **0.40373/0.09\*300** |  |
| 300 | 1.09 | 0.596267327 | 0.403732673 | 4.48591859 | 1345.775577 | 1645.776 |

We have taken the interest rate at 9% as the fee payment will be done for each year. We will apply annuity due formula as the fee will be paid at the start of the year. The calculations have been shown in the above table. The second to last column has been arrived at by multiplying the factor by the periodic payment. In the last column the periodic payment is added to the amount in second to last column.

**Case 2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Periodic payment** | **(1+i)** | **(1+i)^-n** | **1-(1+i)^-n** | **[1-(1+i)^-n]/0.0083** | **[1-(1+i)^-n]/0.0083\*1000** |
| 1000 | 1.00833 | 0.607909157 | 0.3920908 | 47.0527833 | 47052.7833 |

The above table shows the calculations for an ordinary annuity with periodic payment of 1000 every month. For this reason, we have adjusted both I and n. The n is multiplied by 12 and I is divided by 12. The second last column shows the annuity factor and the last column is obtained by multiplying the annuity factor by 1000.

**Conclusion:**

When we consider the above two options, we see that the upfront payment of 50000 is more than the present value of annuity in case 2. In case 1 however the amount is less than the total of 2 present values. The investor should choose option 1.

# References

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