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TIME VALUE OF MONEY (TVM)

FOR RBI GRADE B & SEBI GRADE A EXAMS

Time value of money is central to the concept of finance. And this topic is crucial for the Finance part asked in RBI Grade B & SEBI Grade A Exams. Let us learn it in detail here in this eBook.

Time Value of Money (TVM)

Time value of money (TVM) is the idea that money that is available at the present time is worth more than the same amount in the future, due to its potential earning capacity. This core principle of finance holds that provided money can earn interest, any amount of money is worth more the sooner it is received.

In simpler terms, it would be safe to say that a Rupee was worth more yesterday than today and a Rupee today is worth more than a Rupee tomorrow.

Interest

Interest can be a charge or an income, depending on whether you are borrowing money or lending/investing money. It is stated as a percentage over a specific period of time.

There are many types and forms of interest.

Simple Interest

Simple interest is computed on the original amount as the return on that principal for one time period.

SI = P×R×T

where

SI = Simple Interest

P = Amount borrowed (called "Principal")

R = Interest rate

T = time

Amount = Principal + SI

Example: Rs 1,000 invested for 10 years at 5% simple interest will yield Rs 1,500 by the end of ten years.

Amount = 1000 + (1,000 x 0.05 x10) = Rs 1,500.

For instance, if one were to receive 5% interest on a beginning value of Rs100, the first-year interest would be:

Rs 100 × 0.05 = Rs 5 in Interest

Continuing to receive 5% interest on the original Rs 100 amount, over five years the growth of the original investment would look like:

Year 1: 5% of Rs 100 = Rs 5 + Rs 100 = Rs 105
Year 2: 5% of Rs 100 = Rs 5 + Rs 105 = Rs 110
Year 3: 5% of Rs 100 = Rs 5 + Rs 110 = Rs 115
Year 4: 5% of Rs 100 = Rs 5 + Rs 115 = Rs 120
Year 5: 5% of Rs 100 = Rs 5 + Rs 120 = Rs 125

Compound Interest

Compound interest is computed on the original amount as the return on that principal plus all unpaid interest accumulated to date.

Compound interest is always assumed in TVM problems.

$CI = [P (1 + R)^{n}] – P$

$CI = P [(1 + R)^{n} – 1]$

For instance, if one were to receive 5% compound interest on a beginning value of Rs 100, the first-year interest would be the same as simple interest on the Rs100,

Rs 105 × .05 = Rs 5.25 in Interest

This provides a balance at the end of year two of Rs 110.25. If this were to continue for 5 years, the growth in the investment would look like:

Year 1: 5% of Rs 100.00 = Rs 5.00 + Rs 100.00 = Rs 105.00
Year 2: 5% of Rs 105.00 = Rs 5.25 + Rs 105.00 = Rs 110.25
Year 3: 5% of Rs 110.25 = Rs 5.51 + Rs 110.25 = Rs 115.76
Year 4: 5% of Rs 115.76 = Rs 5.79 + Rs 115.76 = Rs 121.55
Year 5: 5% of Rs 121.55 = Rs 6.08 + Rs 121.55 = Rs 127.63

This is a powerful concept that means money can grow at an exponential rate depending on how often interest is credited to the account. Once interest is credited, it becomes in effect principal.

Instead of calculating interest year-by-year, it would be simple to see the future value of an investment using a compound interest formula.

The formula for compound interest is:

$P_n = P_0(1 + i)^n$

- P_n = value at end of n time periods
- P_0 = beginning value
- i = interest
- n = number of periods

For example, if one were to receive 5% compounded interest on $100 for five years, to use the formula, simply plug in the appropriate values and calculate.

$P_n = Rs\ 100(1.05)^5 = Rs\ 127.63$

Fixed Interest Rate

Fixed interest rate is a straightforward rate that remains constant during the life of the loan or investment.

Variable Interest Rate

Variable interest rate changes during the life of the loan and is usually tied to the prime rate. It can go up or down depending on the prime rate set forth by the Central banks of a country.

Mixed Interest Rate

Mixed interest rate changes from fixed to variable or from variable to fixed. It has some merits depending on your situation, but it is not a rate you would want to choose for a long-term investment or debt.

Time Value and Purchasing Power

The time value of money is also related to the concepts of inflation and purchasing power. Both factors need to be taken into consideration along with whatever rate of return may be realized by investing the money.

Inflation and purchasing power must be factored in when you invest money because to calculate your real return on an investment, you must subtract the rate of inflation from whatever percentage return you earn on your money.

If the rate of inflation is actually higher than the rate of your investment return, then even though your investment shows a nominal positive return, you are actually losing money in terms of purchasing power.

For example, if you earn a 10% on investments, but the rate of inflation is 15%, you are actually losing 5% in purchasing power each year (10% – 15% = -5%).

Time Value of Money Formula

A specific formula can be used for calculating the future value of money so that it can be compared to the present value:

$$FV = PV \times [1 + (i / n)]^{(n \times t)}$$

Where:

FV = the future value of money
PV = the present value
i = the interest rate or other return that can be earned on the money
t = the number of years to take into consideration
n = the number of compounding periods of interest per year

Present Value of Future Money Formula

The formula can also be used to calculate the present value of money to be received in the future.

$$PV = P_0 = \frac{P_n}{(1 + i)^n}$$

Annuity

An annuity is an equal, annual series of cash flows.

When cash flows occur at the end of the year, this makes them an **ordinary annuity**. If the cash flows were at the beginning of the year, they would be an **annuity due**.

Annuities work as follows:

Annuity = Equal Annual Series of Cash Flows.

Assume annual deposits of Rs100 deposited at end of year earning 5% interest for three years.

Year 1: Rs 100 deposited at end of year = Rs 100.00

Year 2: Rs 100 × .05 = Rs 5.00 + Rs 100 + Rs 100 = Rs 205.00

Year 3: Rs 205 × .05 = Rs 10.25 + Rs 205 + Rs 100 = Rs 315.25

The primary types of annuities are:

1. Fixed Annuities

Annuities that provide fixed payments. The payments are guaranteed, but the rate of return is usually minimal.

2. Variable Annuities

Annuities that allow an individual to choose a selection of investments that will pay an income based on the performance of the selected investments. Variable annuities do not guarantee the amount of income, but the rate of return is generally higher relative to fixed annuities.

3. Life Annuities

Life annuities provide fixed payments to their holders until his/her death.

4. Perpetuity

An annuity that provides perpetual cash flows with no end date. Examples of financial instruments that grant perpetual cash flows to its holder are extremely rare.

Valuation of Annuities

Annuities are valued by discounting the future cash flows of the annuities and finding the present value of the cash flows.

The general formula for annuity valuation is:

$$\mathbf{PV} = \frac{P}{(1+r)} + \frac{P}{(1+r)^2} + \ldots + \frac{P}{(1+r)^n}$$

Where:

PV = Present value of the annuity

P = Fixed payment

r = Interest rate

n = Total number of periods of annuity payments

The valuation of perpetuity is different because it does not include a specified end date. Therefore, the value of the perpetuity is found using the following formula:

$$\mathbf{PV = P / r}$$

What Is the Rule of 72?

The Rule of 72 is a simple way to determine how long an investment will take to double given a fixed annual rate of interest. By dividing 72 by the annual rate of return, investors obtain a rough estimate of how many years it will take for the initial investment to duplicate itself.

How the Rule of 72 Works?

For example, the Rule of 72 states that Rs 1 invested at an annual fixed interest rate of 10% would take 7.2 years ((72/10) = 7.2) to grow to Rs 2.

In reality, a 10% investment will take 7.3 years to double ((1.107.3 = 2).

The Rule of 72 is reasonably accurate for low rates of return.

Rule of 114

One can use this method to estimate how much time it will take to triple the wealth. Here you have to divide 114 by interest rate to get in how many years your money gets tripled.

Time for investment to triple = 114/ %age Rate of Return

Going by the same example of mutual funds with an annual return of 14%, the time it is going to take to triple your money would be (114/ 14) = 8.14 years.

Rule of 144

The final rule in line is the rule of 144. As evident, this rule tells how long it will take for your money to become four times its original value or Quadruple. This rule is basically for people who stay invested for a really long-term in order to see their money actually become four times.

The rule goes as:

Time for investment to double = 144 / %age Rate of Return

Following the above example of a mutual fund with 14% annual return, the time it would take the money to become four times is (144/14) = 10.28 years.

This is all from us in this eBook of Time Value of Money.

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