

Students' ECONOMIC FORUM

A monthly publication from South Indian Bank

*To kindle interest in economic affairs...
To empower the student community...*



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Students' Corner

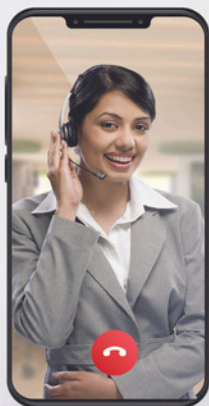


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TIME VALUE OF MONEY



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"Compound interest is the eighth wonder of the world. He who understands it, earns it; he who doesn't, pays it."

- Albert Einstein

The 'SIB Students' Economic Forum' is designed to kindle interest in the minds of the younger generation. We highlight one theme in every monthly publication. Topics of discussion for this month is "TIME VALUE OF MONEY"

I. Time Value of Money

The time value of money is the principle that money available today is worth more than the same amount of money in the future, due to its potential earning capacity. This concept underlies the calculation of present value.

II. Present Value

Present Value is the current worth of a future sum of money, discounted at a specific interest rate. It essentially translates future cash flows into today's equivalent value. In simpler terms, it helps us understand how much a future amount of money is worth to us today.

III. Why is money worth more today?

- **Inflation:** Over time, the purchasing power of money decreases due to inflation.
- **Opportunity cost:** If you invest money today, you can earn interest or returns, which increases its value over time.
- **Risk:** There is often a risk associated with future cash flows. Investors may demand a higher return to compensate for this risk.

IV. Factors Affecting Present Value

1) Interest Rates:

- **Higher interest rates:** The higher the interest rate, the lower the present value of a future sum. This is because a higher interest rate means that the money could earn more if invested today.
- **Lower interest rates:** The lower the interest rate, the higher the present value of a future sum. This is because a lower interest rate means that the money would earn less if invested today.

2) Time Period:

- **Longer time periods:** The longer the time period until the future cash flow, the lower the present value. This is because there is more time for the effects of compounding interest to reduce the present value.

- **Shorter time periods:** The shorter the time period until the future cash flow, the higher the present value. This is because there is less time for the effects of compounding interest to reduce the present value.

V. Discounting Methods

- **Simple interest** is calculated only on the principal amount. It's a straightforward method where interest is earned on the initial investment without considering any interest earned on previously earned interest.

- **Simple Interest = Principal * Rate * Time**

- **Present Value = Principal / (1 + Rate * Time)**

- **Compound interest** is calculated on both the principal amount and the accumulated interest. This means that interest is earned on the interest earned in previous periods, leading to exponential growth.

- **Future Value = Principal * (1 + Rate)^{Time}**

- **Present Value = Future Value / (1 + Rate)^{Time}**



VI. Different Compounding Frequencies

- **Annual Compounding:** Interest is calculated and added to the principal once a year.
- **Semi-Annual Compounding:** Interest is calculated and added to the principal twice a year.
- **Quarterly Compounding:** Interest is calculated and added to the principal four times a year.
- **Monthly Compounding:** Interest is calculated and added to the principal twelve times a year.

Formula for Different Frequencies:

- **Present Value = Future Value / (1 + Rate/n)^(n * Time)**
 - **Where: n is the number of compounding periods per year**

VII. Continuous compounding

Continuous compounding is a theoretical concept where interest is compounded infinitely many times per year. It's the maximum possible compounding frequency.

Formula:

- **Present Value = Future Value * e^(-Rate * Time)**
 - **Where:**
 - **e is the mathematical constant approximately equal to 2.71828**

Key Points:

- **Frequency of compounding:** The more frequently interest is compounded, the higher the future value and the lower the present value for a given rate and time period.
- **Continuous compounding:** While it's a theoretical concept, it's often used as a benchmark for comparing different compounding frequencies.
- **Discounting:** The process of calculating present value is essentially discounting future cash flows to their current equivalent value.



VIII. Present Value Calculations

Calculating Present Value of a Single Sum:

A single sum is a lump sum payment that will be received or paid at a specific point in the future. To calculate the present value of a single sum, we use the following formula:

Formula:

- **Present Value = Future Value / (1 + Rate)^{Time}**

Example : You want to invest a lump sum today to have ₹10,000,000 in 10 years. Assuming a conservative annual interest rate of 8% in India, what amount should you invest today?

- Present Value = ₹10,000,000 / (1 + 0.08)¹⁰
- Present Value ≈ ₹4,631,934.48

Therefore, you should invest approximately ₹4,631,934.48 today to have ₹10,000,000 in 10 years at an 8% annual interest rate.

Calculating Present Value of an Annuity:

An annuity is a series of equal cash flows received or paid at regular intervals. To calculate the present value of an annuity, we use the following formula:

- **Present Value of Annuity = Payment * [(1 - (1 + Rate)⁽⁻ⁿ⁾) / Rate]**
 - **Where: n is the number of periods**

Example: Suppose you are set to receive ₹50,000 every year for the next 4 years, and the annual discount rate is 8%. You want to determine the present value of these annuity payments.

Present Value of Annuity

$$= 50,000 * [1 - (1 + 0.08)^{-4}] / 0.08$$

$$= 50,000 * 3.313$$

$$= 1,65,650$$

The present value of receiving ₹50,000 every year for 4 years, given an 8% discount rate, is approximately ₹1,65,650.

Calculating Present Value of a Perpetuity:

A perpetuity is an annuity that continues indefinitely. To calculate the present value of a perpetuity, we use the following formula:

- **Present Value of Perpetuity = Payment / Rate**

Example: You want to purchase a government bond that pays a fixed annual coupon of ₹50,000 indefinitely. Assuming a market interest rate of 6% in India, what is the fair value of the bond?

- Present Value of Perpetuity = ₹50,000 / 0.06
 - Present Value of Perpetuity = ₹833,333.33
- Therefore, the fair value of the bond is approximately ₹833,333.33.

IX. Applications of Present Value

1) Bond Valuation:

Bond valuation involves determining the fair price of a bond based on its expected future cash flows. These cash flows typically include periodic interest payments (coupons) and the principal repayment at maturity.

Formula for Bond Price:

- **Bond Price = Present Value of Coupons + Present Value of Principal**

Example : A government bond with a face value of ₹1,000,000, a coupon rate of 7%, and a maturity of 5 years is trading in the market. Assuming a market interest rate of 6%, what is the fair price of the bond?

- Coupon Payment = ₹1,000,000 * 0.07 = ₹70,000
- Present Value of Coupons = ₹70,000 * [(1 - (1 + 0.06)⁻⁵) / 0.06] = ₹294,700
- Present Value of Principal = ₹1,000,000 / (1 + 0.06)⁵ = ₹746,215
- Bond Price = Present Value of Coupons + Present Value of Principal
- Bond Price = ₹294,700 + ₹746,215 ≈ ₹1,040,915
- The fair price of the bond, given the market interest rate of 6%, is approximately ₹1,040,915.

2) Stock Valuation:

Stock valuation involves estimating the fair value of a company's stock based on its future cash flows. Common methods include:

- Dividend Discount Model (DDM): This model values a stock based on the present value of its expected future dividends.
- Free Cash Flow to Equity (FCFE): This model values a stock based on the present value of the cash flows available to equity holders.
- Comparable Company Analysis: This method compares the valuation of a company to similar companies in the industry.

3) Capital Budgeting:

Capital budgeting is the process of evaluating potential investments to determine if they are worthwhile. Present value is a key tool in capital budgeting to compare the present value of expected future cash flows to the initial investment cost.

- Net Present Value (NPV): If the NPV is positive, the investment is considered profitable.
- Internal Rate of Return (IRR): The IRR is the discount rate that makes the NPV of an investment equal to zero.

4) Loan Amortization:

Loan amortization is the process of paying off a loan over time, with each payment consisting of both principal and interest. Present value can be used to calculate the periodic loan payments.

- Loan Payment Formula:
 - **Payment = (Principal * Rate) / (1 - (1 + Rate)⁻ⁿ)**

5) Project Evaluation:

Present value can be used to evaluate the profitability of various projects by comparing the present value of expected cash inflows to the initial investment cost.

By applying present value concepts to these areas, you can make informed decisions about investments, financing, and project evaluation.

X. Impact of Interest Rates:

1) Sensitivity Analysis of Present Value to Interest Rate Changes

Sensitivity analysis is a technique used to assess how changes in one variable (in this case, interest rates) affect another variable (present value). It helps to understand the risk associated with interest rate fluctuations.

Key points:

- **Inverse relationship:** There is an inverse relationship between interest rates and present value. As interest rates increase, the present value of future cash flows decreases, and vice versa.
- **Duration:** The duration of a bond or investment measures its sensitivity to interest rate changes. A longer duration means the bond is more sensitive to interest rate changes.
- **Convexity:** Convexity measures the curvature of the price-yield relationship. It helps to understand how the sensitivity of a bond to interest rate changes varies with changes in interest rates.

2) The Concept of Yield to Maturity

Yield to maturity (YTM) is the total return an investor expects to earn on a bond if held to maturity. It takes into account the bond's coupon payments, purchase price, and redemption value.

Key points:

- **Relationship with price:** When the YTM of a bond is higher than its coupon rate, the bond is trading at a discount. When the YTM is lower than the coupon rate, the bond is trading at a premium.
- **Interest rate risk:** Changes in interest rates affect the YTM of a bond, which in turn affects its price.

3) The Relationship Between Interest Rates and Bond Prices

- **Inverse relationship:** There is an inverse relationship between interest rates and bond prices. When interest rates rise, the present value of future cash flows from a bond decreases, leading to a lower bond price.
- **Duration:** The duration of a bond measures its sensitivity to interest rate changes. A bond with a longer duration is more sensitive to interest rate changes.
- **Convexity:** Convexity helps to understand how the sensitivity of a bond to interest rate changes varies with changes in interest rates.

Example: Consider two bonds with the same maturity and coupon rate but different durations. If interest rates rise, the bond with the longer duration will experience a larger price decline compared to the bond with the shorter duration.

XI. The Relationship Between Present Value and Future Value

Present value and future value are two sides of the same coin. They represent the time value of money.

- **Present value:** The current worth of a future sum of money, discounted at a specific interest rate.
- **Future value:** The amount to which a sum of money will grow if invested at a specific interest rate for a certain period.

The relationship between present value and future value is based on the concept of compounding. As time passes, the initial investment (present value) grows due to the accumulation of interest. The future value is the result of this compounding process.

Formula:

- **Future Value = Present Value * (1 + Rate)^{Time}**
- **Present Value = Future Value / (1 + Rate)^{Time}**

XII. Converting Between Present Value and Future Value

You can convert between present value and future value using the above formulas.

Example: You invest ₹1,000,000 today at an annual interest rate of 8%. What will be the future value of this investment after 5 years?

- **Future Value = ₹1,000,000 * (1 + 0.08)⁵**
- **Future Value ≈ ₹1,469,328.09**

To find the present value of a future sum, you would use the reverse formula:

- **Present Value = ₹1,469,328.09 / (1 + 0.08)⁵**
- **Present Value = ₹1,000,000**

XIII. Conclusion

Present value is a key finance concept used to determine the current worth of future cash flows. By understanding factors like interest rates and time, and using methods such as simple interest, compound interest, and continuous compounding, you can accurately assess investments, loans, and other financial matters.

Additional Reading:

<https://www.investopedia.com/terms/p/presentvalue.asp>



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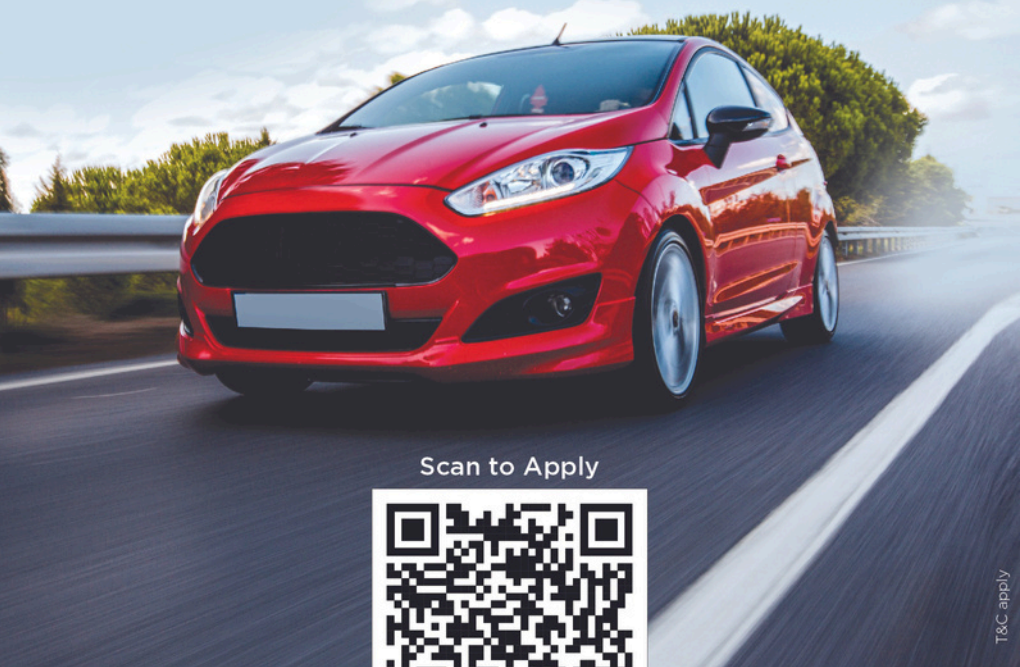
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