

Basic Mathematics for Financial Planning

By

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Relevant Issues :

- **Future Value of one time investment.**
- **Expected Cost of Child's Education or a Medical Treatment.**
- **Opportunity Cost (Inflation & Purchasing Power) – Inverse Relation**



TIME VALUE OF MONEY

$$\text{Future Value} = \text{Present Value} (1 + r/m)^{mt}$$

or

$$\mathbf{FV = PV(1 + i)^n}$$

where, $i = r/m$ is the interest per compounding period, and
 $n = mt$ is the number of “compounding periods” per year

One-Time Investment:

For 4-year investment of Rs. 20,000 earning 8.5% per year, with interest re-invested each year, the future value is

$$FV = PV(1 + r/m)^{mt} = 20,000(1 + 0.085)^{(4)} = \text{Rs. } 27,717.17$$

Compounding Frequency – Monthly & Quarterly

Numerical Examples:

For 4-year investment of Rs. 20,000 earning 8.5% per year, with interest re-invested each month, the future value is

$$FV = PV(1 + r/m)^{mt} = 20,000(1 + 0.085/12)^{(12)(4)} = \text{Rs. } 28,065.30$$

For 4-year investment of Rs. 20,000 earning 8.5% per year, with interest re-invested each quarter, the future value is

$$FV = PV(1 + r/m)^{mt} = 20,000(1 + 0.085/4)^{(4)(4)} = \text{Rs. } 27,999.04$$

Future Value - Periodic Investments

$$FV = [PMT(1 + r)^n - 1] / r$$

Where, PMT = payments, r = rate of interest, and

n = number of payments

Systematic Investment Plan - Illustration :

Mr. Investor investing Rs 1,000 each month for the next 10 years through SIP of Mutual Fund, and expect a return of 15 per cent.

The outcome is Rs 2,78,657, which is the future value of the SIP

Present Value of Future Amount

$$PV = FV / (1 + r/m)^{mt}$$

Purchasing power of Rs 10,000 in future :

The value of Rs 10,000 will decline to Rs 6,139 in 10 years if inflation is 5 per cent.

“Not Investing is a bigger Risk”

Nominal & Effective Interest Rates

Effective Interest Rate:

If money is invested at an annual rate r , compounded m times per year, the effective interest rate is:

$$r_{\text{eff}} = (1 + r/m)^m - 1.$$

Application in Fixed Deposit Rates

FD fetching an interest (**Nominal Rate**) @ 9.25% per annum (reinvested every quarter).

And because of this quarterly compounding, the effective return is 9.58% whatever may be the period of FD.

“APPLE TO APPLE COMPARISON NEEDED”

The “PMT” function - Some Applications

- **Calculation of EMI on Loans**

Mr. Kumar bought a car in 2015 worth Rs 5.95 lakh. He made a down payment of Rs 1.5 lakh, took an auto loan for the rest of the amount at 12% interest per annum for four years. At present, he is paying an equated monthly instalment, or EMI, of Rs 11,700 per month.

- **SIP required for target Future Value**

Mr. Sinha is planning to create a corpus of Rs. 50,00,000 through monthly SIP over a 20 year period assuming a rate of return of 12%. What should be his monthly SIP amount be ?.....It has to be Rs. 5,054

- **Systematic Withdrawal Plan (SWP) Calculations**

Projecting the maximum amount that an investor can withdraw every year/month from his existing investments to fund his retirement.

UNDERSTANDING RETURNS FROM MUTUAL FUNDS – THE “RATE” FUNCTION

Absolute Returns (Point-to-Point)

(Irrespective of investment tenure)

$$\text{Absolute return} = (\text{Present NAV} - \text{initial NAV}) / \text{initial NAV} \times 100$$

So, if your initial NAV was 20, and the present NAV is 25, and you had stayed invested for 7 months,

The absolute returns would be 25%.

Extrapolation is Misleading for Volatile Assets

(SEBI stipulates using absolute returns for investment horizon of less than 12 months)

Annualised Returns - CAGR

Compounded Annual Growth Rate (CAGR) is a representation of the compounded growth of your investments over a specific period of time.

$$\text{CAGR} = (\text{Final Investment Value}/\text{Initial Investment Value})^{1/n} - 1$$

Mr. Arora invested Rs. 1 lakh in ABC Bluechip Fund in 2015 for 5 years. He invested on 22nd July 2015, at a NAV of 20.04, and got 5,000 units allotted to him. Now, at the end of 5 years, on 22nd July 2020, he redeemed his investments and received Rs. 1,51,000.

$$\text{CAGR} = (1,51,000/1,00,000)^{1/5} - 1 = 8.5\%$$

(SEBI stipulates using CAGR for investment horizon of more than 12 months)

Performance Sheet – Real Life Case

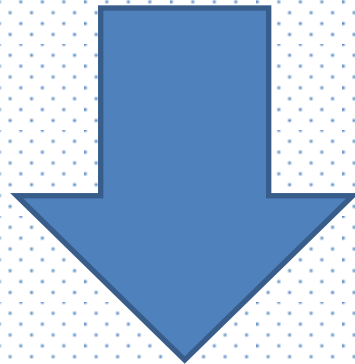
Fund name	1D	1M	3M	6M	1Y	3Y	5Y	7Y
Axis Bluechip	1	-4.1	8.5	-2.3	-11	13	13.4	13.86
S&P BSE 100 TRI	0.8	-5	8.3	-1	-4.4	17	12.2	12.94

Data as on Oct 14, 2022

Source - AMFI

Limitations of CAGR

- CAGR is good for lump sum investments & does not take periodic investments into account
- Where there are different **cash inflows** and **cash outflows**, like in SIPs, SWPs, CAGR is not the right measure.



Extended Internal Rate of Return (XIRR)

- XIRR takes into account multiple Cash Flows – Occurring at Regular or Irregular Intervals
- In XIRR, the CAGR of each instalment is calculated, and then they are added together to compute overall Compounded Annual Growth Rate.

XIRR – Returns from SIP

SIP of Rs 10,000 made for six months and redeemed on 1st of the 7th month. Amount received on redemption Rs.62,000.

XIRR is 11.92%

	A	B
1	1-Jan-2019	-10000
2	1-Feb-2019	-10000
3	1-Mar-2019	-10000
4	1-Apr-2019	-10000
5	1-May-2019	-10000
6	1-Jun-2019	-10000
7	1-Jul-2019	62000
8		11.92

**THANK YOU
&
HAPPY INVESTING**

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