Sr No	Quantitative Measures / Risk Measures	Brief Descriptions /Inference of the Quantitative Measures
1	Total Expense Ratio (TER)	TER is the fee charged by a mutual fund to cover the costs of managing and operating the fund.
2	Sharp Ratio	The Sharpe Ratio is a measure of risk-adjusted return. It indicates how much excess return an investment generates for each unit of risk taken. A higher Sharpe Ratio means the investment provides better returns relative to its risk.
3	Beta Ratio	Beta is a measure of an investment's systematic risk, or how sensitive its returns are to changes in the overall market. It helps investors understand whether a stock or mutual fund is likely to move more or less than the market. Beta = 1: The investment moves in line with the market. Beta > 1: The investment is more volatile than the market. Beta < 1: The investment is less volatile than the market. Beta = 0: The investment's returns are not related to market movements. Beta < 0: The investment tends to move in the opposite direction of the market (rare).
4	Standard Deviation of Returns	Standard Deviation of Returns (σ) is a statistical measure that indicates how much an investment's returns fluctuate around their average (mean) return. It is one of the most commonly used measures of investment risk or volatility. A higher standard deviation means returns vary widely from the average, indicating higher risk. A lower standard deviation means returns are more consistent, indicating lower risk.
5	Modified Duration	Modified Duration is a measure used in bond investing to estimate how much the price of a bond will change when interest rates change. It shows the sensitivity of a bond's price to changes in market interest rates
6	Macaulay Duration	Macaulay Duration is a measure of the weighted average time (in years) an investor takes to receive all cash flows from a bond, including coupon payments and the principal repayment.
7	Portfolio Turnover Ratio (Not applicable to Passive Funds)	Portfolio Turnover measures how frequently a mutual fund or investment portfolio buys and sells its securities during a given period (usually one year).
8	Average Maturity	Average Maturity refers to the weighted average time remaining until the securities in a portfolio mature. It is commonly used for evaluating debt mutual funds and bond portfolios. It indicates the overall maturity period of the portfolio and helps investors understand its interest rate risk.
9	Portfolio Yield	Portfolio Yield is the income or return generated by the securities held in an investment portfolio, usually expressed as an annual percentage of the portfolio's value. It is commonly used for bond portfolios and debt mutual funds to measure the income-generating ability of the investments

10	Risk Free Return	Risk-Free Return is the return an investor can earn from an investment with little or no risk of loss. It represents the minimum return that investors expect without taking any investment risk. In finance, the risk-free return is usually based on the return from government securities, such as short-term government treasury bills, because governments are considered to have a very low probability of default.
11	Tracking Error	Tracking Error measures how much the returns of an investment fund (especially an index fund or exchange-traded fund) differ from the returns of its benchmark index. It shows the consistency of a fund in following its benchmark.
12	Tracking Difference	Tracking Difference is the difference between the return of an investment fund and the return of its benchmark index over a specific period. It shows whether a fund has outperformed or underperformed its benchmark.

Numerical Examples

1) Total Expense ratio

Methodology : Weighted Average i.e. Total Expense of the month / Average Asset / number of days in month * days in a year

Numerical Example

- Total Expense for the month = ₹10,00,000
- Average Assets (AUM) = ₹100 crore
- Number of days in the month **=** 30 days
- Days in a year = 365 days

$$\text{TER} = \frac{10,00,000}{100,00,00,000} \times \frac{365}{30}$$

0.0012167 0R 0.12167%

Interpretations : The fund charges approximately ₹0.122 per ₹100 invested annually

2) Sharp Ratio

Methodology = (Ri-Rf)/Stdev of Fund returns

Where,
Ri= Fund Return
Rf = Risk free Return (TREPs)

TREPs would serve as a more appropriate risk free rate instead of MIBOR as Mutual Funds deploy idle cash in TREPs.

Given:

- Fund Return(Ri) = **15%**
- Risk-free return (R_f) = **5%**
- Standard deviation (σ_p) = **10%**

Excess Return = Ri-Rf = 15% - 5% = 10%

Sharp Ratio = 10% / 10% = 1

Interpretation = The portfolio earns 1 unit of excess return for every 1 unit of risk taken.

3) Beta Ratio

Methodology =
Covariance of NAV returns vs Index returns/ Variance of Index returns
Further, for Beta, as Benchmark Total Return may not be easily available /calculated, price return is suggested to be used.

<u>**Numerical Example**</u>

$$\beta = \frac{\text{Covariance (Portfolio Returns, Market Returns)}}{\text{Variance (Market Returns)}}$$

Suppose the monthly returns are:

Month	Market Return (X)	Portfolio Return (Y)
1	2%	3%
2	4%	5%
3	6%	8%
4	8%	9%
5	10%	11%

Step 1: Calculate the means

Mean Market return:

$$\bar{X} = \frac{2+4+6+8+10}{5} = 6\%$$

Mean Portfolio return :

$$\bar{Y} = \frac{3+5+8+9+11}{5} = 7.2\%$$

Step 2: Calculate deviations

Month	**(X-\bar{X})**	**(Y-\bar{Y})**	**Product**
1	-4	-4.2	16.8
2	-2	-2.2	4.4
3	0	0.8	0
4	2	1.8	3.6
5	4	3.8	15.2

Sum of products:

$$16.8 + 4.4 + 0 + 3.6 + 15.2 = 40$$

Covariance:

$$\frac{40}{5-1} = 10$$

Step 3: Calculate variance of market returns

Month	(X-\bar{X})	Squared
1	-4	16
2	-2	4
3	0	0
4	2	4
5	4	16

Sum of squares:

$$16 + 4 + 0 + 4 + 16 = 40$$

Variance:

$$\frac{40}{5-1} = 10$$

Step 4: Calculate Beta

$$\beta = \frac{10}{10} = 1.0$$

Interpretation :

This means the portfolio moves **one-for-one with the market**. If the market rises by **1%**, the portfolio is expected to rise by about **1%** on average

4) **Standard Deviation of Returns**

Suppose a mutual fund has the following **annual returns** over 5 years:

Year	**Return (%)**
1	8
2	12
3	10

4	14
5	6

Step 1: Calculate the average return

$$\text{Average Return} = \frac{8 + 12 + 10 + 14 + 6}{5} = \frac{50}{5} = 10\%$$

Step 2: Calculate deviations from the average

Return (%)	Deviation from Mean	Squared Deviation
8	8 − 10 = −2	4
12	12 − 10 = 2	4
10	10 − 10 = 0	0
14	14 − 10 = 4	16
6	6 − 10 = −4	16

Sum of squared deviations

$$4 + 4 + 0 + 16 + 16 = 40$$

Step 3: Calculate the variance

$$\text{Variance} = \frac{40}{5 - 1} = 10$$

Step 4: Calculate the standard deviation

$$\text{Standard Deviation} = \sqrt{10} = 3.16\%$$

Interpretation

A standard deviation of 3.16% means that the fund's annual returns typically vary by about 3.16 percentage points from the average annual return of 10%.

5) Modified Duration

Methodology =
Macaulay Duration / (1 + Annualised Yield)

Numerical example
Given:

- Macaulay Duration = **5 years**
- Annualised Yield = **8%**
- Coupon payments = **2 times per year** (semi-annual)

$$\text{Modified Duration} = \frac{5}{1+\frac{0.08}{2}}$$
$$= \frac{5}{1+0.04}$$
$$= \frac{5}{1.04}$$
$$= 4.81 \text{ years}$$

<u>**Interpretation**</u>

A **modified duration of 4.81 years** means:

- If interest rates increase by **1%**, the bond price is expected to **fall by approximately 4.81%**.
- If interest rates decrease by **1%**, the bond price is expected to **rise by approximately 4.81%**.

6) Macaulay Duration

Methodology =

Macaulay Duration is a measure of the average time it takes to receive a bond's cash flows.

It is calculated by summing up all the multiples of the present values of cash flows and corresponding time periods and then dividing the sum by the market bond price. It can be calculated using the following formula:

$$\text{Macaulay Duration} = \frac{\sum_{t=1}^{n} PV(CF_t) * t}{\text{Market Bond Price}} = \frac{\sum_{t=1}^{n} \frac{t * C}{(1+Y)^t} + \frac{n * M}{(1+Y)^t}}{\text{Market Bond Price}}$$

Where:

- **PV(CF_t)** – Present value of cash flow (coupon) at period t
- **t** – Time period for each cash flow

- **C** – Periodic coupon payment
- **n** – Total number of periods to maturity
- **M** – the Bond's maturity value
- **Y** – Periodic yield

Assume a bond has:

- Face Value = **₹1,000**
- Coupon Rate = **10% per year**
- Maturity = **3 years**
- Yield to Maturity (YTM) = **10%**
- Coupon payment = **₹100 per year**

Calculation of Present Value of Cash Flows

Year (t)	Cash Flow (₹)	Discount Factor @10%	PV	t × PV
1	100	1/1.10	90.91	90.91
2	100	$1/(1.10)^2$	82.64	165.28
3	1,100	$1/(1.10)^3$	826.45	2,479.35

Calculation of Bond Price = 90.91+82.64+826.45 = 1000

Weighted Time Value =

$$\sum(t \times PV) = 90.91 + 165.28 + 2479.35$$

$$= ₹2,735.54$$

Macaulay Duration =

$$\text{Macaulay Duration} = \frac{2735.54}{1000}$$

$$= 2.74 \text{ years}$$

A **Macaulay Duration of 2.74 years**

- The investor will recover the bond's investment through coupon payments and principal repayment in approximately **2.74 years on a present value basis**.
- A higher Macaulay Duration indicates greater sensitivity to interest rate changes.
- A lower Macaulay Duration indicates lower interest rate risk.

7) Portfolio Turnover Ratio

<u>Methodology =</u>
Lower of purchase or sale during the period/Average AUM for the period. The period to be considered is last one year.

TREPS/CBLO/Repo/FD/Margin FD/ MFU/SLB are not considered for purchase and sale. Should include Fixed income securities and Equity derivatives.

Given:

- Total purchases of securities during the year = ₹80 crore
- Total sales of securities during the year = ₹60 crore
- Average AUM = ₹200 crore

Lower of Purchase and sales = Rs 60 Crore

$$\text{Portfolio Turnover Ratio} = \frac{60}{200} \times 100$$
$$= 30\%$$

Interpretation
A 30% portfolio turnover ratio means:

- The fund has replaced approximately 30% of its portfolio holdings during the year.
- It indicates whether the fund manager is holding securities for a longer period rather than frequently buying and selling.

8) Average Maturity

Methodology = Weighted avg maturity of the assets

Numerical Example

Assume a debt mutual fund has invested in the following bonds:

Bond	Investment Amount	Maturity Period
Bond A	₹50 lakh	2 years
Bond B	₹30 lakh	5 years
Bond C	₹20 lakh	10 years

Step 1 – Calculate Investment * Maturity

Bond	Investment (₹ lakh)	Maturity (Years)	Investment × Maturity
A	50	2	100
B	30	5	150
C	20	10	200
Total			450

Total Investment = 50 +30 +20 = 100 lakhs

Average Maturity =

$$\text{Average Maturity} = \frac{450}{100}$$
$$= 4.5 \text{ years}$$

Interpretation:

The portfolio's investments will mature, on average, in approximately **4.5 years**.

9) Portfolio Yield

Methodology = Weighted Average valuation yield of the assets

Numerical example

A debt fund has invested in three securities:

Security	Market Value (₹ lakh)	Yield (%)	Market Value × Yield
Bond A	50	7%	350
Bond B	30	8%	240
Bond C	20	10%	200

Total Market value = 50 + 30+ 20 = 100 lakhs

Total Weighted Yield = 350 + 240+ 200 =790 Lakhs

$$\text{Weighted Average Valuation Yield} = \frac{790}{100}$$

$$= 7.90\%$$

A **weighted average valuation yield of 7.90%** means:

- The portfolio's assets generate an average yield of approximately **7.90%**.

10) Tracking Error =

Numerical Examples

Suppose the monthly returns are:

Month	**Portfolio Return**	**Benchmark Return**	**Active Return (Difference)**
1	10.00%	9.50%	0.50%
2	8.00%	7.80%	0.20%
3	12.00%	11.50%	0.50%
4	9.00%	9.40%	−0.4%
5	11.00%	10.80%	0.20%

Step 1: Calculate the average active return

$$\frac{0.5 + 0.2 + 0.5 - 0.4 + 0.2}{5} = \frac{1.0}{5} = 0.2\%$$

Step 2: Find deviations from the average

Active Return	Deviation from Mean	Squared Deviation
0.50%	0.30%	0.09
0.20%	0.00%	0
0.50%	0.30%	0.09
−0.4%	−0.6%	0.36
0.20%	0.00%	0

Sum of squared deviations = **0.54**

Step 3: Calculate the standard deviation

Using the sample standard deviation:

$$\text{Tracking Difference (Tracking Error)} = \sqrt{\frac{0.54}{5-1}} = \sqrt{0.135} \approx 0.367\%$$

11) Tracking Difference

Methodology

Tracking Difference = Scheme returns – Benchmark index returns

Numerical Example

Suppose an index fund has the following annual returns:

Year	Scheme Return	Benchmark Return	Tracking Difference
	A	B	A-B
1	11.20%	12.00%	−0.8%
2	15.50%	16.00%	−0.5%
3	9.80%	10.50%	−0.7%

Interpretation

Negative Tracking Difference: The scheme underperformed the benchmark.
Positive Tracking Difference: The scheme outperformed the benchmark.
Zero Tracking Difference: The scheme matched the benchmark exactly.