PARSHWANATH CHARITABLE TRUST'S
A.P. SHAH INSTITUTE OF TECHNOLOGY
Department of Computer Science and Engineering
Data Science

CSE DATA SCIENCE

Semester: **VIII**   Subject: **AIFB**   Academic Year: **2024-25**

SHARPE RATIO :

Sharpe ratio is used to evaluate the risk-adjusted return of an investment. It measures how much excess return an investment provides for each unit of risk (volatility).

Formula :

$$\text{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p}$$

where,

R_p = Return of the portfolio or asset (the investment return)

R_f = Risk-free rate

σ_p = Standard Deviation of the asset return (a measure of volatility or risk)

(1) **Excess Return:** The numerator $(R_p - R_f)$ represents the return of the asset over and above the risk-free rate. This is "excess" return earned by taking on risk.

(2) **Risk (Standard Deviation):** The denominator (σ_p) is the standard deviation of the investment's returns, which is a measure of the investment's volatility or risk.

→ A <u>higher</u> Sharpe Ratio (eg. 1 or higher) indicates that the investment provides a higher return per unit of risk.

→ A <u>lower</u> Sharpe Ratio (eg. less than 1) suggests that the investment is not providing sufficient return relative to the level of risk.

→ A <u>negative</u> Sharpe Ratio indicates that the investment is underperforming the risk-free asset.

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Application of CAPM:

(1) Estimating Expected Returns:

Investors can use CAPM to estimate the expected return on an asset based on its risk and the expected market return. This helps in deciding whether an investment is worth making given the required return.

(2) Valuing stock:

Investors can use CAPM to help value individual stocks by calculating expected return on the stocks beta and the markets expected return. This can be compared with the stocks actual return to assess its fairvalue.

(3) Cost of Equity:

The CAPM formula is often used to calculate the cost of equity for a company. The cost of equity is the return of a company needs do offer to investors to compensate for the risk of investing in the company.

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Example:

Let's say an investor is evaluating a mutual-fund. The annual return of the fund is 12%, and the risk-free rate is 8%. The standard deviation of the fund's return is 10%. Calculate Sharpe Ratio.

Solution:

Fund's Return $(R_p) = 12\%$

Risk-Free Rate $(R_f) = 3\%$

Standard Deviation $(\sigma_p) = 10\%$.

$$\text{Sharpe Ratio} = \frac{12\% - 3\%}{10\%} = \frac{9\%}{10\%} = 0.9$$

A sharpe ratio suggests that for every unit of risk. the fund provides 0.9 units of excess return over the risk-free unit.

Example: Comparing two investments using the Sharpe Ratio.

An investor is comparing two potential investments: Stock A and Stock B. Both investments have the following data:

Stock A :

Return $(R_p) = 8\%$

$R_f = 2\%$

$\sigma_p = 10\%$.

Stock B :

$R_p = 12\%$

$R_f = 2\%$

$\sigma_p = 20\%$.

The investor wants to determine which stock has a better risk adjusted return.

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Solution:

Sharpe Ratio for Stock A $= \dfrac{8\% - 2\%}{10\%} = \dfrac{6\%}{10\%}$ $\boxed{= 0.6}$

Sharpe Ratio for Stock B $= \dfrac{12\% - 2\%}{20\%} = \dfrac{10\%}{20\%}$ $\boxed{= 0.5}$

Eventhough stock B has a higher return (12%). Stock A offers a better risk-adjusted return. This means that stock A provides more return per unit of risk. The investor would likely prefer stock A based on the Sharpe Ratio, as it offers a higher return relative to its risk.

Why is Sharpe ratio important?

(1) **Comparison Tool:** It allows investors to compare the risk-adjusted returns of different investments

(2) **Risk Management:** Sharpe Ratio helps investors understand whether they are receiving sufficient returns for the level of risk they are taking.

(3) **Asset Allocation:-** The sharpe Ratio can help in optimizing portfolio construction. By considering Sharpe Ratio of various assets, investors can allocate their investments to achieve an optimal mix that maximizes returns for a given level of risk.