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Problem based on Markowitz Mean, Variance Analysis

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Abstract:- The aim of this paper is to analysis on Markowitz Mean Variance Portfolio Theory and test how problems can be solved by this. The related data will be taken from National Stock Exchange (NSE). This research has been applied Markowitz Model on two Listed companies of National Stock Exchange by taking the data of February 2017.

Keywords:- *MPT, NSE, expected return, risk, diversification.*

I. INTRODUCTION

Mean-Variance Portfolio Theory, also known as the Modern Portfolio Theory (MPT), which is founded by Harry Markowitz in 1952. He received Nobel Prize for this invention. According to him any investors who invest in stock market or anywhere else, always want to minimize the risk and maximize the return. It is nothing but an optimization of Risk Return ratio to Stock Investors(SI). Modern Portfolio Theory specifies that it is not enough to look at individual security for its market risk and company specific risk.

The National Stock Exchange is the largest Stock Exchange in world and head quarter of NSE is in Mumbai, India. It was established in a year 1992. By number of contracts traded based on the statistics, it is the world's largest future exchange in 2021 By the World Federation of Exchanges (WFE), NSE is considered as world's 4th cash equities by statistics in 2021. A modern, fully self-operating, screen-based electronic trading system that offered easy trading facilities to investors spread across the length and breadth of the country is only provided by NSE.

II. MARKOWITZ MEAN VARIANCE ANALYSIS

Father of Modern Portfolio Theory, Harry Markowitz said that, two properties of an asset: risk and return which are concerned by the investors, but by diversification of portfolio it is possible to trade-off between them. The important of his theory is that risk of an individual asset hardly matters to an investor. It is possible to calculate which investment have the greats variance and expected return. Assume the following investments are an investors portfolio. For calculation of risk and return, here we taken mathematical expression which is given by Markowitz.

- **Mathematical Expression**
  Before calculate portfolio return and risk, first calculate indivisual company's expected return(mean), variance and standard deviation.

- **Expected return given by:**

$$E(\alpha_c) = \frac{\alpha_1 + \alpha_2 + \cdots + \alpha_k}{(k-1)} = \sum_{l=1}^{k} \frac{\alpha_l}{(k-1)}$$

Here, $\alpha_1, \alpha_2, \cdots, \alpha_k$ be the returns of company base on daily stock data , α_l be the lth number of data, $E(\alpha_c)$ be the expected return from company which is also written as $\overline{\alpha}_c$, k be the number of corresponding days.

- **Variance given by:**

$$\sigma_c^2 = \frac{\sum_{l=1}^{k} (\alpha_l - \overline{\alpha}_c)^2}{(k-1)}$$

Here, σ_c^2 be the variance of company, α_l be the lth number of data, $\overline{\alpha}_c$ be the expected return from company, k be the number of corresponding days.

- **Standard deviation given by:**

$$\sigma_c = \sqrt{\frac{\sum_{l=1}^{k} (\alpha_l - \overline{\alpha}_c)}{(k-1)}}$$

Here, σ_c be the standard deviation of return from company.

- **According to Markowitz the portfolio return of investment is given by:**

$$E(r_{inv}) = w_{inv1} \times r_{inv1} + w_{inv2} \times r_{inv2}$$

where,
$E(r_{inv})$ = expected return after investment,
w_{inv1} = weight of first investment,
r_{inv1} = return for first investment,
w_{inv2} = weight of second investment,
r_{inv2} = return for second investment.

- **The risk or portfolio risk of investment is given by:**

$$\sigma_{inv} = \left((w_{inv1})^2 \times (r_{inv1})^2\right) + \left((w_{inv2})^2 \times (r_{inv2})^2\right) + 2 w_{inv1} w_{inv2} r_{inv1} r_{inv2} \rho_{inv1inv2}$$

where,

σ_{inv} = risk after investment,

$\rho_{inv1inv2}$ = correlation between two investment.

- **Example**
Expected return and risk will be calculated in following and the corresponding data are taken from two companies like BATA INDIA and PC JEWELLERS of February 2017.

By calculation we getting the expected return of BATAINDIA is 0.23%, risk is 1.41% PC JEWELLERS is 0.04% and risk is 1.89%.

Assuming two investors Inv1 and Inv2 which have investment amount ₹ 150000, ₹350000 respectively.

So total portfolio value is 500000, the weight of each asset is:

$$\text{Weight of } Inv1 = \frac{150000}{500000} = 30\%$$

$$\text{Weight of } Inv2 = \frac{350000}{500000} = 70\%$$

If Inv1 invest in BATAINDIA and Inv2 invest in PC Jeweller. Then the total expected return of the portfolio is the weight of the asset in the portfolio multiplied by the expected return.

Portfolio expected return = (30% × 0.23%) + (70% × 0.04%) = 0.097%

Portfolio variance is more complicated to calculate because it is not a simple weighted average of the investments' variances. The correlation between the two investments is 0.50. The standard deviation, or square root of variance, for Inv1 is 1.41%, and the standard deviation for Inv2 is 1.89%.

The portfolio variance is:

$$= ((30\%)^2 \times (0.23\%)^2) + ((70\%)^2 \times (0.04\%)^2) \\ + (2 \times 30\% \times 70\% \times 0.23\% \times 0.04\% \times 0.50) \\ = 0.0000748\%$$

The portfolio standard deviation is the square root of the answer : 0.086%.

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If Inv1 invest in PC Jeweller and Inv2 invest inBATAINDIA. Then the total expected return of the portfolio is the weight of the asset in the portfolio multiplied by the expected return.

Portfolio expected return = (30% × 0.04%) + (70% × 0.23%) = 0.173%

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The portfolio variance is:

$$= ((30\%)^2 \times (0.04\%)^2) + ((70\%)^2 \times (0.23\%)^2) \\ + (2 \times 30\% \times 70\% \times 0.04\% \times 0.23\% \times 0.50) \\ = 0.00028\%$$

The portfolio standard deviation is the square root of the answer : 0.167%.

III. CONCLUSION

From Markowitz mean variance analysis we noticed that any asset or company or investment have risk as well return. In conclusion, most of the assumptions prevailed in the Markowitz's Mean Variance Portfolio Theory. Therefore, we need to ensure the model has a considerably minimum error in making analysis.

REFERENCES

[1.]The Markowitz Mean Variance Analysis: A Review from Shariah Perspective by Mohamad Hafiz Hazny, Haslifah Mohamad Hasim@Hashim (Dr.), Aida Yuzi Yusof in 2012.
[2.]Markowitz mean variance analysis- Investopedia.
[3.]Application of Markowitz Model in Indian Stock Market- Reference to Bombay Stock Exchange by KRISHNA JOSHI DR. CHETNA PARMAR, from Multidisciplinary International Research Journal of Gujarat Technological University, ISSN: 2581-8880, VOLUME 2 ISSUE 1 JANUARY 2020.
[4.]Application of Markowitz Model in Indian Stock Market by Arindam Das and Jeet Mukharjee, From an International Bilingual Peer Reviewed Refereed

Research Journal, Vol. 10, Issue 38 (IV)- page nos: 265-271, April-June 2020, ISSN: 2229-3620.
[5.]Mean-variance-time: An extension of Markowitz's mean-variance portfolio theory by Hany Fahmy from Journal of Economics and Business, Volume 109, May–June 2020, 105888, https://doi.org/10.1016/j.jeconbus.2019.105888.
[6.]Spectrally-Corrected Estimation for High-Dimensional Markowitz MeanVariance Optimization by Hua Li, Zhidong Bai, Wing-Keung Wong and Michael McAleer, from Econometrics and Statistics, https://doi.org/10.1016/j.ecosta.2021.10.0052452-3062/ © 2021.