

OPTIMIZATION OF PORTFOLIO BY DATA REDUCTION

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Abstract

In this paper data reduction is implemented and the parameters governing portfolio optimization were analyzed. Monthly data of five companies was considered for five years and portfolio optimized. In recent times feature reduction by artificial intelligence and machine learning techniques are studied. This only reduces the number of columns but keeps the number of rows exorbitantly high. A scientific reduction in the number of rows, without sacrificing optimality, also need to be studied to arrive at a compact data set. The data was reduced to four years, three years and two years and the parameters were calculated and analyzed. With the advent of big data, it is not possible to analyze the full data. In such cases, data reduction which will preserve optimization should be obtained. Portfolio optimization after data reduction was analyzed.

Keywords: Bigdata, Data reduction, Portfolio optimization, Sharpe's ratio, Markowitz model

1. INTRODUCTION

The process of selecting the best portfolio or asset from a given set of portfolios in consideration with the objective to maximize returns and minimize risks is Portfolio optimization. By diversifying the investments in different stocks the risk factor can be reduced and expected returns increased.

Monthly data of closing price of stocks for four periods from 1-9-2015 to 1-8-2020, 1-1-2016 to 1-8-2020, 1-1-2017 to 1-8-2020, 1-1-2018 to 1-8-2020 and of 5 companies obtained from yahoo finance were considered to optimize returns and effect of data reduction on portfolio optimization

i.e., volume of data required to predict optimal weights and Sharpe's ratio. minimize risks. This paper involves the study of any reduction in data below a critical level will result in high risk and low returns. Data is systematically reduced by n% and the parameters are analyzed.

2. LITERATURE REVIEW

Lucas Pelegrin da Silva et.al., studied the traditional portfolio optimization models when the returns of financial assets are highly volatile and its efficiency and developed an alternative optimization model as a hybrid of the conditional value at risk (CVaR) and mean absolute deviation (MAD) and they used historical data on the Brazilian stock market between 2004 and 2013, to analyze the efficiency of the proposed approaches and portfolios with higher returns are obtained through traditional models

Sun R, et.al., traced the development of the literature to identify areas that require further research. They provided a literature review of financial data, commonly used models of portfolio selection, and portfolio risk, global minimum variance (GMV) model, Mean-variance model, and factor models were analyzed.

Shintate T. et.al., used random sampling method (RSM) to study non-stationary crypto currency time series, based on deep learning (DL). They showed that the baseline approaches are easily biased by class imbalance and their model addressed this problem.

Jeff Grover, et.al., emphasized that portfolio management requires a substantial knowledge of statistical concepts.. They presented a solution to the strategic asset allocation problem that investors face when attempting to construct an optimal portfolio. This model, in Excel was used to find the fund valuation and the Sharpe Ratio to identify an optimal combination of the available funds using the principles of capital asset pricing model (CAPM).

Markowitz portfolio model: The Markowitz model is a portfolio optimization model which analyses various possible portfolios of the given securities to get the most efficient portfolio. The actual covariance between securities in a portfolio and correlation coefficient (the relative measure of association) is used to calculate the standard deviation or portfolio variance. The Modern portfolio theory states that adding assets to a diversified portfolio that has low correlations can decrease portfolio risk without sacrificing return.

Sharpe Ratio

$$\text{Sharpe's ratio} = \frac{\text{Portfolio returns} - \text{risk free rate}}{\text{Expected risk}}$$

Interpretation of Sharpe's ratio: If the portfolio offers excess returns relative to its volatility, the Sharpe Ratios is greater than 1.00 and is considered as a better portfolio. If the ratio is negative it implies that risk is more than returns or returns are negative!

3. METHODOLOGY

- i) Data is tabulated period wise (monthly) for the 5 companies.
- ii) The returns are calculated as [(Price-Previous price)-1]*100 for the full period of 5 years for all 5 companies.
- iii) The monthly average (MA), monthly covariance (MC), annual average (AA=MA*12), and annual covariance (AC=MC*12) are calculated for the 5 companies whose portfolios are to be maximized.

- iv) Excess returns are calculated as returns –MA for each company and data.
- v) The variance – covariance matrix is constructed.
- vi) The risk free rate is considered.
- vii) The expected returns, expected risk and Shapre’s ratio are calculated for the equally weighted portfolio.
- viii) The Shapre’s ratio is maximized by changing the equally weighted portfolio under the constraint that their sum is 1.
- ix) The results are calculated after reducing the period systematically by one year and the parameters are tabulated and analyzed.

The closing price of 5 companies A, B, C, D and E were considered with 0.7 (fixed) risk free returns.

Table 1.gives the returns, risk and Shapre’s ratio of equally weighted and optimally weighted portfolios for 4 periods from 1-9-2015 to 1-8-2020,1-1-2016 to 1-8-2020, 1-1-2017 to 1-8-2020, 1-1-2018 to 1-8-2020 of 5 companies. It was found that the returns were maximum and risk minimized for the period 1-1-2017 to 1-8-2020. The Shapre’s ratio was maximum for this period as 1.12. Table 2. indicates that the optimal portfolio is to invest 65 percent in company A and 35 percent in company B.

Table 1. Returns, Risk and Shapre’s ratio of 5 companies for 4 periods.

Period	Weights					Returns	Risk	Shapre’s ratio
	A	B	C	D	E			
1-1-2015 to 1-8-2020 Equally weighted	0.2	0.2	0.2	0.2	0.2	11.59	15.16	.719
Optimally weighted portfolio	0.72	0	0	0.28	0	16.77	15.89	1.01
1-1-2016 to 1-8-2020 Equally weighted	0.2	0.2	0.2	0.2	0.2	11.98	14.87	.759
Optimally weighted portfolio	0.44	0	0	0.27	0.28	14.34	15.46	.886
1-1-2017 to 1-8-2020 Equally weighted	0.2	0.2	0.2	0.2	0.2	13.12	15.74	0.789
Optimally weighted portfolio	0.64	0	0	0.36	0	17.32	14.82	1.12
1-1-2018 to 1-8-2020 Equally weighted	0.2	0.2	0.2	0.2	0.2	10.36	18.08	0.535
Optimally weighted portfolio	0.286	0.5489	0	0.4216	0	16.79	20.92	0.77

Table 2.The optimized portfolio of 5 companies A, B, C, D and E with 0.7 (fixed) risk free returns for 4 different periods.

Company/ Period	2015- 2020	2016- 2020	Optimal Portfolio	2018- 2020
A	72.35 %	43.92%	64.41%	2.86%
B	0.00%	0.00%	0.00%	54.98%
C	0.00%	0.00%	0.00%	0.00%
D	27.64 %	27.22%	35.58%	42.16%
E	0.00%	28.85%	0.00%	0.00%

Optimized Portfolio for 5 companies for 4 different periods

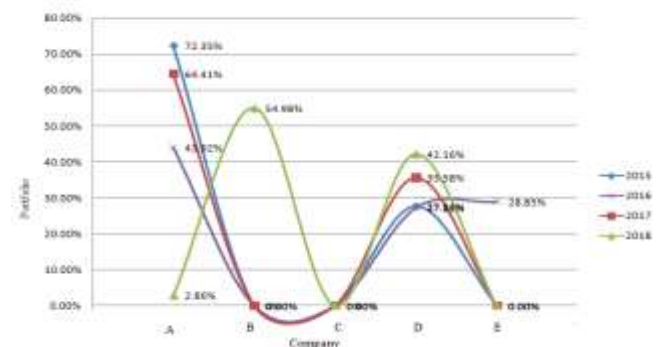


Fig. 1.Optimized Portfolio for 5 companies for 4 different periods

Table 3. Returns, Risk and Shapre's ratio for the 4 periods.

Period	Returns	Risk	Shapre's Ratio
2015-2020	16.77	15.89	1.01
2016-2020	14.34	15.46	.886
2017-2020	17.32	14.82	1.12
2018-2020	16.79	20.92	0.77

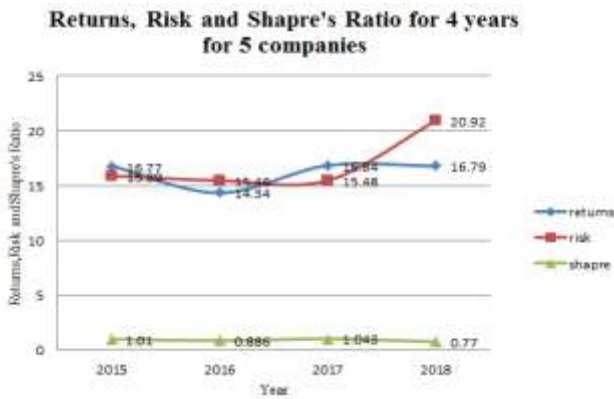


Fig. 2>Returns, Risk and Shapre's Ratio for 4 years for 5 companies

RESULTS

Monthly data of five companies was considered for a five year period and portfolio optimized. The data was systematically reduced by one year and four such periods were considered for the study of portfolio optimization using the Shapre's ratio. It was observed that the portfolio returns was maximum for the period 2017to 2020 and risk minimized for this period amongst the periods that were taken for investigation and analysis. Also the Shapre's Ratio was maximum in this period..The risk was maximum for the period 2018-2020.

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