**FA541 Project**

**Portfolio Analysis with CAPM &Fama French Factors**

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**1. General Description**

For this project, we decide to build a portfolio with fifteen stocks from different sectors. The Market capitalization of each selected stock is located in the top three of its respective sectors. First, we calculated the returns of these stocks, the mean and variance of their prices, and the correlation between their returns, The mean-variance model is then used to calculate the optimal ratio between each stock. The period we select is from 2018-01-01 to 2021-03-30. At the same time, we download the data of the S&P 500, Nasdaq index and Dow Jones Industrial Average. The way we optimize our portfolio is to maximum the Sharpe ratio, because a higher Sharpe ratio means a higher return than the market index. Finally, we used the CAPM and Fama French model with all the data we calculate before to do the regression.

**2. Load Data**

Selected sectors: COMMERCIAL SERVICES, COMMUNICATIONS, CONSUMER, DISTRIBUTION SERVICES, ELECTRONIC TECHNOLOGY, ENERGY MINERALS, FINANCE, HEALTH, INDUSTRIAL SERVICES, PROCESS INDUSTRIES, PRODUCER MANUFACTURING, RETAIL TRADE, TECHNOLOGY SERVICES, TRANSPORTATION, UTILITIES.

We Use R Studio to load our data, The period is from 2018-01-01 to 2021-03-30.

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**3.Data Calculation**

表格

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表格

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图表, 树状图

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**4. Build Portfolio**

We build our portfolio of these 15 stocks. The way we optimize is to maximum the sharpe ratio. Here is the weight of stocks.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Stock | MCO | VZ | TSLA | SYY | AAPL | XOM | JPM |
| Weight | 0.0764 | 0.1078 | 0.0343 | 0.0487 | 0.0932 | 0.0818 | 0.0250 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UNH | ENB | LIN | ASML | AMZN | MSFT | UPS | NEE |
| 0.0436 | 0.0439 | 0.0843 | 0.0654 | 0.0868 | 0.0657 | 0.0915 | 0.0513 |

We use these weights to calculate the return of the portfolio from 2019-01-01 to 2021-03-30, also we calculate the Sharpe ratio. By consulting the information, we assume that the risk-free interest rate is 0.0053.

From the calculation, we can get the return, the risk and the Sharpe ratio of our portfolio.

|  |  |  |
| --- | --- | --- |
| Return | Risk | Sharpe ratio |
| 0.3883689 | 0.2755323 | 1.399904 |

**4. Capital Asset Pricing Model (CAPM) Model**

The Capital Asset Pricing Model (CAPM) is a model that describes the relationship between the [expected return](https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/expected-return/) and risk of investing in a security. It shows that the expected return on a security is equal to the risk-free return plus a [risk premium](https://corporatefinanceinstitute.com/resources/knowledge/finance/equity-risk-premium/), which is based on the [beta](https://corporatefinanceinstitute.com/unlevered-beta-asset-beta) of that security.

The beta of a potential investment is a measure of how much risk the investment will add to a portfolio that looks like the market. If a stock is riskier than the market, it will have a beta greater than one. If a stock has a beta of less than one, the formula assumes it will reduce the risk of a portfolio.

We try to use the CAPM model to regress the portfolio and the three indicators separately to verify the rationality of the portfolio. Here is the result.

As for the GSPC the alpha and beta values is statistical significant and corresponded to the time series chart. Also the R-squared is very high at 0.81. The turn for the DJI index, the alpha and beta values is statistical significant. But the R-squared is a little low at 0.71 which means it’s not appropriate to the three factor model we apply below. Lastly, the alpha and beta values is statistical significant and the R-squared is very high at 0.88 for IXIC but we consider that GSPC is more representative for the next analysis.

For GSPC:

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For IXIC:

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For DJI:

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Through three regressions, the risk-free interest rate we get is about 0.006, which has a smaller error with our assumed risk-free interest rate. At the same time, the α values obtained through regression calculation are all greater than 0, which shows that our overall portfolio performance is better than the market index.

**4. Fama French Three Factor Model**

The Fama and French 3-factor model is an asset pricing model developed in 1992. It is based on the Capital Asset Pricing Model (CAPM) and adds size risk and market risk factors. This model takes into account the fact that value and small cap stocks regularly outperform the market. By including these two additional elements, the model is tailored to this superior performance trend, which is considered a better tool for assessing performance.

The Fama and French model has three factors: the size of firms, book-to-market values, and excess return on the market. In other words, the three factors used are [small minus big](https://www.investopedia.com/terms/s/small_minus_big.asp) (SMB), [high minus low](https://www.investopedia.com/terms/h/high_minus_low.asp) (HML), and the portfolio's return less the risk-free rate of return. SMB accounts for publicly traded companies with small market caps that generate higher returns, while HML accounts for value stocks with high book-to-market ratios that generate higher returns in comparison to the market.

First, we download the data of SMB, HML, RF and other data as CSV document, here is some sample data:

We can get all the data we need in our CSV document, then we can do the regression, here is the result.

Table

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