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**Python Project for FE520**

**Topic: Predicting stock price using machine learning (regression)**

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Our team's goal was to price a stock using Fama French 3 factor mode. Sishir has prior experience with Fama-French 3 factor model. Linh has experiences working with CAPM model and regression for her finance courses. Sishir has also worked with it on R studio; however, the data was provided. We chose to work with the same model on Python by selecting a stock of our choice. We chose Google as it was a growth stock in Sishir’s portfolio for the Bloomberg Trading Competition that he took part in. By that way, we could deal with the same stock data set on different models/ programming languages. Therefore, we could observe whether the outcomes are correct and similar.

For this project, Google's data is collected from Yahoo Finance, and data for the Fama French model has been collected from the Python package, "getFamaFrenchFactors."

**Fama-French Three-Factor Model:**

The Fama-French Three-Factor Model is considered as an extension of the Capital Asset Pricing Model. It aims to evaluate stock returns through three factors: (1) market risk, (2) the outperformance of small-cap companies relative to large-cap companies, and (3) the outperformance of high book-to-market value companies versus low book-to-market value companies. The rationale behind the model is that high value and small-cap firms tend to usually outperform the overall market.

The model is defined as follows:

**Rit−Rft = αit+β1(RMt−Rft)+β2 SMBt +β3 HMLt+ϵit,**

Where:

**Rit** = total return of a stock or portfolio i at time t

**Rft** = risk free rate of return at time t

**RMt** = total market portfolio return at time t

**Rit−Rft** = expected excess return

**RMt − Rft** = excess return on the market portfolio (index)

**SMBt** = size premium (small minus big)

**HMLt** = value premium (high minus low)

**Β1,2,3** = factor coefficients

In the above equation, "**RMt−Rft"** is the market risk premium (or excess return on the market portfolio). "**SMB"** is a historic excess returns of small-cap firms over large-cap firm. For instance, if **SMB** has a positive value on an average for the chosen time frame, it can be considered that small-cap firms make higher returns. "**HML**" is regarded as historic excess returns of value stocks (high book-to-price ratio) over growth stocks (low book-to-price ratio).

**Data Analysis with FAMA model:**

Google is a growing company and has a vast market capital. We chose to work with its historical data over the period of the last six year:

Graphical user interface, text, application, email

Description automatically generated

We also computed the stock returns for our analysis:

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Following are the outcomes of our Fama-French model:

Table

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Graphical user interface, chart

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As the above graphs shown, we find out that market premium over risk free rate and SMB returns are positive. This tells us that the market has shown growth during this timeframe and small-cap firms made greater returns compared to the large-caps. This is a positive sign because the main rationale behind this factor is that, in the long-term, small-cap companies tend to see higher returns than large-cap companies. However, HML has a negative value, indicating that value stocks did not outperform growth stocks in this specific period.

**Ordinary Least Square Regression Analysis:**

We run regression analysis to figure out the Betas (correlation coefficient) for our independent variables (factors) from FAMA model. Outputs shown as table below:

Table

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Beta (coef) of market premium is approximately equal to 1 with a p-value of 0, which dicates that Google stock price is strongly correlated with the market. In other words, Google stock has systematic risk. This is making sense because Google is one of the biggest companies on the S&P 500.

SMB is negative and its p-value is slightly higher than 0.5.Therefore, SMB might not have an statistically significant effect on Google stock.

The HMB has a negative value but it doesn't significantly impact the stock price since its p-value is high, 0.843.

In conclusion, with a market premium beta of 1.0647 ( *greater than 1*), we could assume that Google has been outperformed the market for the last six year. We also did some research on this and realized that our assumption is somehow correct.

Chart, line chart

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*Source: PortfoliosLabs*