

# Equity Portfolios: Factor Modelling and Efficiency Project

## Summary

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## 1 Overview

Over the past decade, the use of mathematical finance on portfolio selection and derivatives pricing has seen significantly greater applicability, driven by the increased availability of financial data on the scale of seconds, as noted by Bouchaud. This has opened a whole new door of statistical analysis to not just large, established financial institutions, but to the individual investor who wishes to maximize his returns and minimize his risk on his investments as well. This can be achieved through exploiting relationships between the movements of stock prices, in which we would discuss two commonly used models: the One-Factor Model and the Efficient Frontier.

## 2 The One-Factor Model

The One-Factor Model assumes that the performance of a given stock is only affected by one factor which is the market return. Drawing from simple linear regression, it is an asset pricing model which makes use of the historical relationship between the predictor (*independent*) variable and the criterion (*dependent*) to predict the possible value of the criterion variable in the future. The resulting linearly regressed line would minimize the set of distances between it and all points on the graph.

### 2.1 Investigating Ideal Time Frame

In our analysis, we have chosen Standard & Poor's 500 (SPY) market index as the predictor variable, and the stock of American multinational oil and gas corporation ExxonMobil (XOM) as the criterion variable. First, we investigate the ideal time-frame for use, by varying the time periods of training data used in producing the one-factor model and comparing the standard deviation of the predicted prices versus the actual prices. Our data shows that utilising any time period between 1 and 5 years is reasonable, all with standard deviations below 5.

## 3 The Efficient Frontier

The efficient frontier is a statistical model introduced by Nobel Laureate Harry Markowitz and William Sharpe which shows the optimum rate of return for each level of risk associated with the investment. Risk, in the construction of efficient frontier, is represented by the standard deviation, as it measures the mean deviation from the average. This allows the expression of risk in simple

numerical terms and enables investors to determine the exact fraction of money to invest in each stocks for a specified rate of return and risk that he is willing to take. The efficient frontier is also the upper bound of the minimum variance set, which is a parabola that contains the feasible set of portfolios.

### **3.1 Investigating effect of correlation on risk**

In this part of the paper, portfolios are carefully constructed so that they comprise stocks of low correlation or high correlation. Using these portfolios, we then observe how correlations of stocks can affect the risk of investment. For the investigation of high correlation, stocks of companies operating in the same industry *e.g. banking* are chosen as they usually tend to share a similar market trend. Similarly, stocks operating in contrasting industries are selected to construct the low correlation portfolio. Our data shows that stocks of low correlation tend to result in a smaller risk, as shown by a lower global minimum variance.