**Introduction**

The portfolio analysis provides an intuitive understanding of how given a set of factors affect the components and the future behavior. Such analysis would be beneficial mostly to the smaller portfolios or individual investors.

The choice of factors is really important! Traditionally, similar analyses use an index as a primary factor, but diverse macro-economic factors such as interest rate, GDP, currencies, unemployment rate might provide better insights.

**Theory**

A portfolio can be comprised of any number of stocks over 0.5 – 3 years period. The factors are variables that reflect overall economy and affect the portfolio

For the correlation analysis, the daily returns of each individual component is linearly regressed against daily returns of each factor, and the regression coefficients are used to predict changes in the portfolio.

The regression is computed using the daily returns of the time series for either components or factors because the returns time series is stationary (constant variance and mean) while the absolute price is not. Regression over non-stationary series gives unstable results.

Each component $$y\_i$$ is assumed linearly related to $$x\_i$$s:

$$y\_i=\alpha \_i+\beta \_1\*x\_i1+…+\beta \_p\*x\_ip

$$\alpha$$ is the y-intercept, which is the part that cannot be explained by the factor, and usually indicates idiosyncratic risk. For this analysis, alpha is computed by adding a constant term to the regression.

$$\beta$$ is the slope of the line that best fits the data against the factor. It is a historical measure of the stock's volatilities against the factor. For S&P500 is a good measure of the market as a whole. When looking at S&P500, the return generated from a portfolio can be attributed to overall market returns. The value \beta can be interpreted for these conditions:

* + $$\beta$$ = 1, component moves with market
  + $$\beta$$ > 1, component is more volatile than the market (high tech)
  + $$\beta$$ < 1, component less volatile than the market (utility companies)
  + $$\beta$$ < 0, component is inverse to the market (gold)
  + $$\beta$$ = 0 component doesn't change with the market (cash)

There are two caveats in prediction using $$\beta$$

* + $$\beta$$ is a measurement of systematic risk, which is the risk that the market as a whole. It is based on the effect of market wide risk, not the risk of the company
  + $$\beta$$ is a historical measure of stock's volatility. This means that past volatility doesn't necessary predict future beta or future volatility. Study of Gene Fama and Ken French on cross-section of expected stock returns that examines the reliability of past $$\beta$$ indicate that individual stock’s past $$\beta$$ is not a good predictor of future $$\beta$$. $$\beta$$ tends to revert back to 1.