**Case Study: Implementing the Capital Asset Pricing Model**

**Introduction**

The capital asset pricing model (CAPM) is a widely used model in finance that is used to price an individual stock or portfolio.

**Purpose of Study**

The purpose of this case study is to illustrate how to implement the CAPM using a simple linear regression model.

**Problem Description**

Sharpe (1964) and Lintner (1965) developed the CAPM, which can be used to price an individual stock or portfolio. Under the CAPM, all investors are assumed to be rational and risk-averse, have homogeneous expectations, be broadly diversified across a range of investments, and be able to borrow and lend money freely at the same risk-free rate. In such a market, the expected return of a stock can be written as

Where is the return on the stock, is the return on the market portfolio, is the return on the risk-free asset, and is a parameter that can be interpreted as the measure of the riskiness of the stock.

In the CAMP, is determined by

Where denotes the covariance between and , denotes the correlation between and , and denote the variances of and respectively.

To implement the CAPM, we can fit a simple linear regression model of a stock’s excess return on the market-portfolio’s excess return as follows

Where is the realized return on the stock in period is the realized return on the portfolio in period . is the realized return on the risk-free asset in period , is the number of observations, and is random noise.

We illustrate the implementation of the CAPM by estimating the of MetLife stock. MetLife  MetLife is among the largest global providers of insurance, annuities, and employee benefit programs, with 90 million customers in over 60 countries. with its corporate headquarters in New York, USA. In the implementation, we use the S&P 500 index as a proxy for the market-portfolio and the 3-month US treasury rate as the risk-free rate.

**Data Description**

Go to Yahoo Finance to download the following data sets from January 1999 to present

* S&P 500 index
* Manulife Financial’s stock
* 3-month US treasury rates

Provide a brief description of the data sets.

**Data Visualization and Summaries**

* Use histograms to display excess returns on MetLife stock and S&P 500 index
* Calculate the five-number summary, mean, standard deviation, skewness, and kurtosis of the excess returns on excess returns on MetLife stock and S&P 500 index.
* Create a scatter plot of excess returns on MetLife stock (y-axis) and S&P 500 index (x-axis).

**Fitting a Simple Linear Regression Model**

* Provide your fitted model results here
* Create a scatter plot of excess returns on MetLife stock (y-axis) and S&P 500 index (x-axis). Put the fitted line on the graph.

**Model Validation**

* Use R-squared to justify the quality of the fit of the regression model.

**Residual Analysis**

* Perform residual analysis i.e., check the residuals to see if there is any violations of assumptions.

**Statistical Inference**

* Perform a hypothesis test to see if the explanatory variable (excess returns on the S&P 500) is significant.

**Summary and Conclusion**