To: Professor Sury

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Re: Security Characteristic Line (SCL) Regression and Interpretation

Date: 08/15/2022

Introduction:

The goal of this assignment is to query a user for a singular US equity and write a Python program that will determine said company's equity beta, provide some statistical information, and interpret the results.

Once this is complete, we will have a final graph plotting a time-series analysis of this equity in the time frame the user indicated. This graph will also contain the Security Characteristic Line which summarized the securities systematic risk and the rate of return.

Methods and Procedures:

In order to execute this assignment we first found out which equity would like the analysis to be performed on. After this, we then filtered and cleaned the data to display monthly returns for the last trading day of the month for each month indicated in the user's timeline.

We converted these prices in to returns, and created a data frame consisting of the percent changes of the market, risk free rate, the excess return on the market, and the returns of our user-inputted equity.

Once we obtained this cleaned data frame, we then ran a regression in order to analyze the equity and find its equity beta. With our dependent variable being the equity at hand and our independent predictor being the market data we obtained; we then displayed a summary regression output.

We now have our alpha and equity beta and all summary statistics associated with each. One thing to note was that the t-stat and p-value for our equity beta was being tested against a null hypothesis of beta being 0. This is not true, since the null hypothesis for this circumstance to see if our equity beta is statistically significantly different than that of the market beta should be 1. After accounting for this, we obtained the true t-stat and p-value of our equity beta and from there could interpret its significance.

After the regression analysis, we plotted the time series analysis of our user-inputted equity, with the equity risk premium (the return on our equity less the risk-free rate) as the y-axis and the market risk premium (the return on the market less the risk-free rate) as the x-axis. Among this scatter plot, we then using our equity beta that was found and analyzing during the regression output to then plot the Security Characteristic Line. Under the CAPM equation, we know that the SCL line is equal to:

Return on equity(i) – risk-free rate = alpha + Equity Beta * (MRP).

Once this plot was displayed, the final step of our program consists of the user being asked if they would like to know the expected return of their desired equity over the course of the next year. If the user selects yes, our program will fetch the current 1yr United States Treasury yield from the internet. The user will also be asked for their expectations in regards to how the market will perform over the course of the next year as well. These values, along with the equity beta now accessible to us through the regression output, we have computed the expected return on the equity at question using the following formula:

E(return equity) = rf rate(1-year UST) * Equity Beta(E(return market) – rf(1yrUST)

Results:

As for our results, the following section displays images and outputs based off of the following information as if it were inputted by the user:

- Equity ticker: WYNN
- Start year: 2013
- Star month: 4 (April)
- End year: 2020
- End month: 9 (September)

```
Please enter the ticker for the US equity you are interested in: Wynn

Please enter the start year you would like for WYNN: 2013

Please enter the month (1-12) you want to start in for WYNN: 4

Please enter the end year you would like for WYNN: 2020

Please enter the month (1-12) you want to end in for WYNN: 9
```

Once this information is computed, a regression analysis is displayed:

```
------------------------------------------------------------------------------
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.419
Model:                            OLS   Adj. R-squared:                  0.412
Method:                 Least Squares   F-statistic:                     62.79
Date:                Mon, 15 Aug 2022   Prob (F-statistic):           7.07e-12
Time:                        13:50:15   Log-Likelihood:                 77.541
No. Observations:                  89   AIC:                            -151.1
Df Residuals:                      87   BIC:                            -146.1
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept     -0.0193      0.011     -1.720      0.089      -0.042       0.003
x              2.1241      0.268      7.924      0.000       1.591       2.657
==============================================================================
Omnibus:                        3.623   Durbin-Watson:                   2.109
Prob(Omnibus):                  0.163   Jarque-Bera (JB):                2.380
Skew:                           0.206   Prob(JB):                        0.304
Kurtosis:                       2.313   Cond. No.                         24.7
==============================================================================
```

The table can be used to provide information on the following statistics such as systematic risk, idiosyncratic risk, correlation, R^2, Beta, and Standard Error.

The systematic risk is the risk inherent to the entire market where idiosyncratic risk is the company or firm-specific risk specifically denoted to holding each individual equity.

Correlation is the relationship between two variables (in our case the overall market and the one specific equity under question) and how these two move in relation to one another.

R^2 is the percent explained variability in Y (the equity dependent variable) by X (the market independent variable).

As for standard error, this is the measure of accuracy of an estimate to see how reliable our data is relative to our results.

Since the p-value of the Equity beta (x coefficient) assumes a null hypothesis of 0, our program also displays the newly solved p-value under the assumption that the null hypothesis is 1.

```
The p_value of beta when our null is 1 is:  3.295423335410635e-05

Since the p_value is less than 0.05 we can reject the null of beta = 1
```

Furthermore, once the equity beta is found (2.12 as depicted by the regression output) the program then queries the user with respect to if they would like to know the expected return for their equity over the course of the next year. If prompted yes, the user will then input their expected return of the market over the next year, and the expected return is then displayed using a risk-free rate of the 1 yr UST sourced in real-time from the internet.

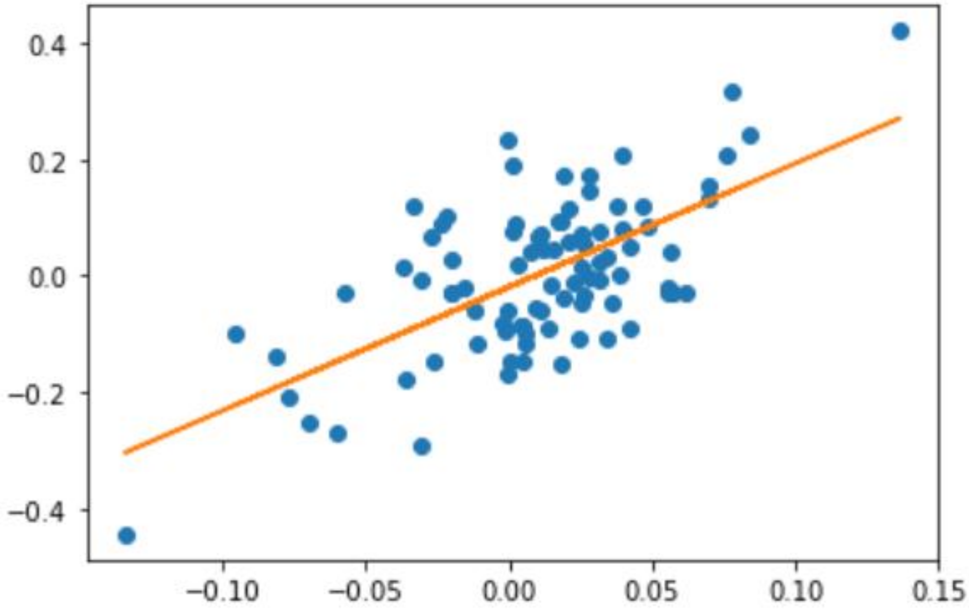
```
Would you like to find out the expected return for WYNN over the next year? [Y/N] y

What is the expected rate of the market return over the next year? (In percentage terms) 10
[*********************100%***********************]  1 of 1 completed



The expected return of WYNN for the next year is  0.13995569899845683
```

Finally, the scatterplot of the time series analysis of our equity as well as the SCL line are displayed as well with (Ri – Rf) as the y-axis and (Rm – Rf) as the x-axis:



Lessons Learned / Future Actions:

Throughout this assignment we learned how to take historical equity and market data from the internet and implement it in our program. Having the ability to compare market returns against equities in order to analyze and predict future expected returns is a critical skill that we now have the ability to automate in a language such as Python.

We found the assignment to be very thought-provoking and the instructions of the data-importing to be loose in a way that played to our advantage. We gained valuable knowledge testing and experimenting different methods and procedures that lead us to successfully gathering our equity and market data from online.