Assignment 2 ~ TESLA and S&P 500

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Econ 4140 Section B ~ Financial Econometrics

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1) The Capital Market Line (CML) is characterized by having no intercept within its formula. While during the Regression Analysis, we include an intercept as a part of the formula. Therefore we need to compare both models, where model 1 includes the intercept and model 2 does not include the intercept of β_0.

Model 1: $\mu R - \mu f = \beta_0 + \frac{\sigma R}{\sigma M}(\mu M - \mu f) + \epsilon t \rightarrow Y_t = \beta_0 + \beta_1 \cdot Xt + \epsilon t$

$\rightarrow \quad Y_t = 0.00264 + 1.34232\, xt + \epsilon t$

Model 2: $\mu R - \mu f = \frac{\sigma R}{\sigma M}(\mu M - \mu f) + \epsilon t \rightarrow Y_t = \beta_1 \cdot xt + \epsilon t$

$\rightarrow \quad Y_t = 1.35297\, xt + \epsilon t$

$\epsilon t \sim (0, \sigma^2)$

2) The parameters that are to be estimated are the intercept and coefficient, β_0 and β_1, where β_0 is the intercept and β_1 is the auto-regression coefficient. Model 1 estimates both β_0 and β_1 but model 2 estimates only β_1.

For Model 1, we would conduct a null hypothesis to test the significance of the intercept and the auto-regression coefficient. We would expect the intercept to be 0, and therefore, **not statistically significant,** and the coefficient to be greater than 1, and **statistically significant**.

For Model 2, we will again conduct the null hypothesis to test the significance of the auto-regressive coefficient, and we expect the coefficient to be greater than 1, and **statistically significant**.

$$H_0: \beta_0 = 0$$

$$H_1: \beta_0 \neq 0$$

$$H_0: \beta_1 = 0$$

$$H_0: \beta_1 \neq 0$$

3) For Model 1, we expected the value of the intercept (β_0) to be 0, and it is very close to 0 (0.00264), and we expected the coefficient (β_1) to be greater than 1, and the value is 1.34232.

We conduct the null hypothesis to test the significance of the intercept (β_0).

H_0 : intercept = 0 , $\beta_0 = 0$

H_A : intercept $\neq$ 0 , $\beta_0 \neq 0$

t-value = 1.91 and p-value = 0.0561

we reject if p-value < 0.05 or $|t| > 1.96$

since the p-value = 0.0561 is greater than 0.05

and the t-value = 1.91 is less than 1.96,

∴ we accept the ~~hypothesis~~ null hypothesis

so, $H_0 \Rightarrow$ intercept = 0

As we accept the hypothesis that the intercept is equal to 0, we can conclude that it is **not statistically significant**.

We conduct the null hypothesis again for the coefficient (β_1) to test the significance of the coefficient.

H_0 : $\beta_1 = 0$

H_A : $\beta_1 \neq 0$

t-value = 13.88 and p-value = < 0.0001

we reject if p-value < 0.05 or $|t| > 1.96$

since the p-value = < 0.0001 is less than 0.05

and the t-value = 13.88 which is ~~less than~~ greater than 1.96,

∴ we reject the null hypothesis.

so, H_A : $\beta_1 \neq 0$

Therefore, β_1 is not equal to zero and is statistically significant.

As we reject the null hypothesis that the coefficient is 0, we can conclude that it is **statistically significant**.

For Model 2, we expected the value of the coefficient to be greater than 1, and it is 1.35297 which is greater than 1. Both the values for the coefficient of models 1 and 2 are pretty close and greater than 1.

$H_0 : \beta_1 = 0$

$H_A : \beta_1 \neq 0$

t-value = 13.99 and p-value = <0.0001

we reject if p-value <0.05 or $|t| > 1.96$

since the p-value = <0.0001 is less than 0.05

and the t-value = 13.99 which is greater than 1.96,

∴ we reject the null hypothesis.

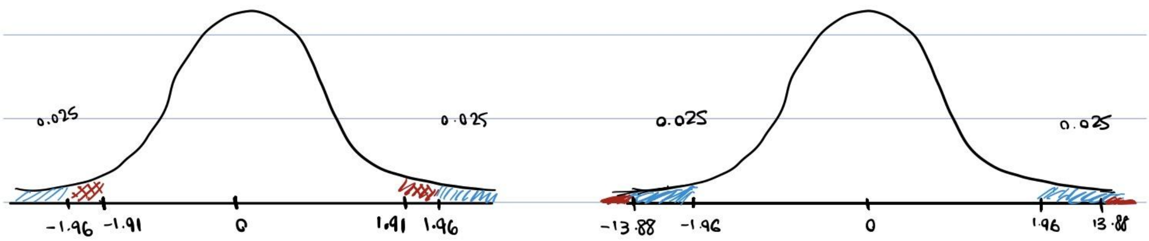
So, $H_A : \beta_1 \neq 0$

Therefore, β_1 is not equal to zero and is statistically significant.

As we reject the null hypothesis that the coefficient is 0, we can conclude that it is **statistically significant.**

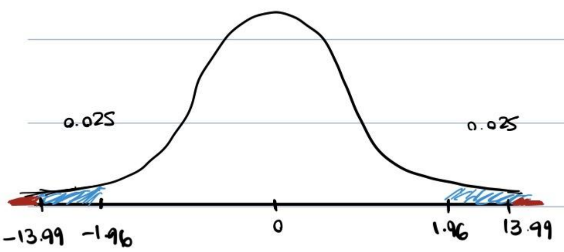
Model 1

For $\beta_0 = 0$, $\beta_0 \neq 0$ For $\beta_1 = 0$, $\beta_1 \neq 0$



Model 2

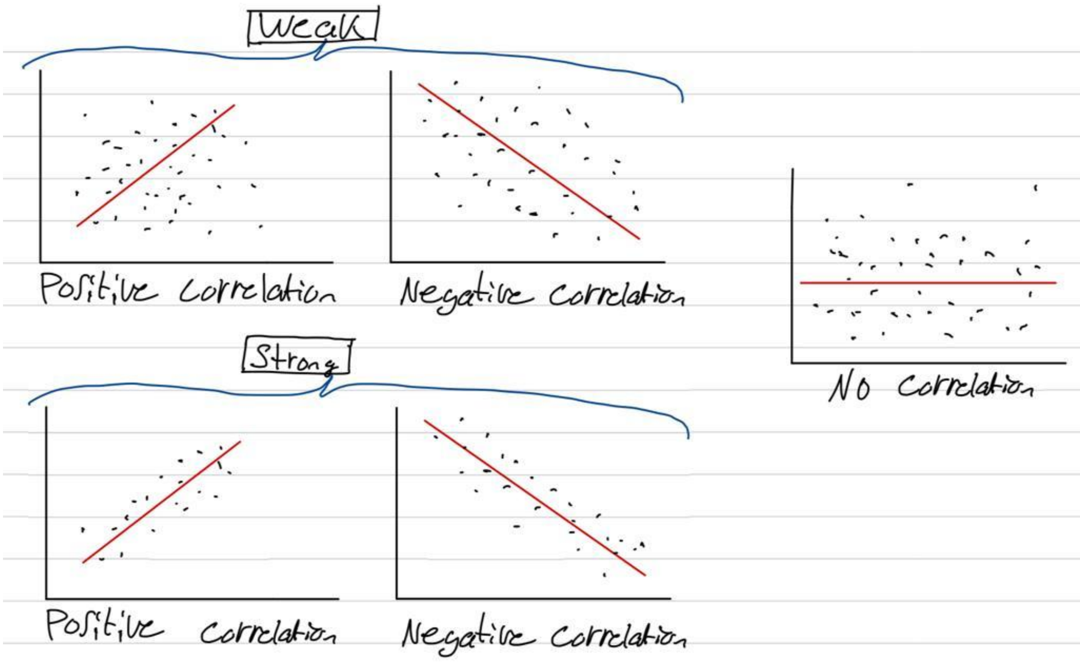
For $\beta_1 = 0$, $\beta_1 \neq 0$



4) A correlation coefficient between x and y is a multivariate statistical measure for the degrees and direction of a linear relationship.

$$PXY := \frac{\sigma\, xy}{\sigma\, x * \sigma\, y}$$

This model tries to conceptualize it by displaying the negative or positive direction of correlation, and the relationship of correlation as strong or weak. Its values span from -1< PXY < 1.



For model 1, the correlation coefficient is 1.34232, and for model 2, the correlation coefficient is 1.35297. The standard deviation for X and Y can never be zero, so there must exist a correlation between the excess returns on TESLA and excess market returns for the value to be greater than 0 in both models 1 and 2. Additionally, by looking at the R-Square value (0.0256), we can confirm that some level of correlation exists between the two variables.

5) The results stay consistent no matter if we consider the intercept or not. We consider the value of β_0 to be zero, and β_1 to be not equal to 0, and greater than 1. Since, the null hypothesis tests for both models 1 and 2 give the same results, and the values for the coefficient of models 1 and 2 are pretty close and greater than 1, 1.34232 and 1.35297 respectively. We can say that the results of the estimation without an intercept are consistent with those when the intercept is included.

6) If the β_0 was significant, "not equal to zero", we would conclude that TESLA is mispriced on the market. However, since we accept the null hypothesis that intercept is equal to 0, it shows that it is not statistically significant. The results resemble the CML line as it does not have any intercept. Therefore, we can conclude that the Capital Asset Pricing Model (CAPM) holds for TESLA and TESLA is not mispriced on the market.

7) Yes, the data provides sufficient evidence for Model 1, where an intercept is included, the CAPM holds, given the **statistically insignificant** intercept and a **statistically significant** coefficient. In addition, for Model 2, where an intercept is not included, the coefficient is not 0 and is **statistically significant,** which also implies that the CAPM holds. This provides evidence that, according to the data and the regression model, the CAPM holds for TESLA.