Homework 3

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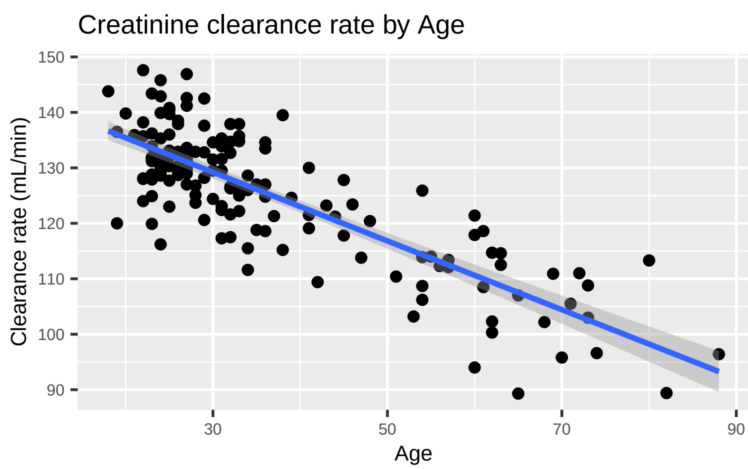
Github Link

Problem 1: Creatinine Clearance Rates



Part A

A 55-year old is expected to have a creatinine clearance rate of 113.72 mL/minute. I calculated this by creating a linear regression model for the creatinine data. After using the coef() function, I found that the equation was y=147.8-0.62x where y=creatinine clearance rate and x=age. Using this equation, I predicted that the rate for a 55-year old is 113.72 mL/minute.

Part B

For every one year increase in age, the expected creatinine clearance rate decreases by 0.62 mL/minute. This is because the slope of the linear regression line is -0.62, so every time x (age) increases by one, y (clearance rate) decreases by 0.62.

Part C

A 40-year old with a rate of 135 has a healthier creatinine clearance rate than a 60-year old with a rate of 112. Because some of the variation in rates is due to difference in age, it is not fair to simply compare the rates to determine who is healthier; instead, the residuals (actual - predicted) must be compared. Using the linear regression model from above (y=147.8-0.62x), I determined that the predicted rate for the 40-year old was 123.02 and 110.62 for the 60-year old. Subtracting the predicted values from the actual values,the 40-year old had a residual of 11.98 (135 - 123.02) and the 60-year old had a residual of 1.38 (112 - 110.62). Because the 40-year old had a larger residual and thus a higher rate for her age, they had a healthier creatinine clearance rate compared to the 60-year old.

Problem 2: Capital Asset Pricing Model

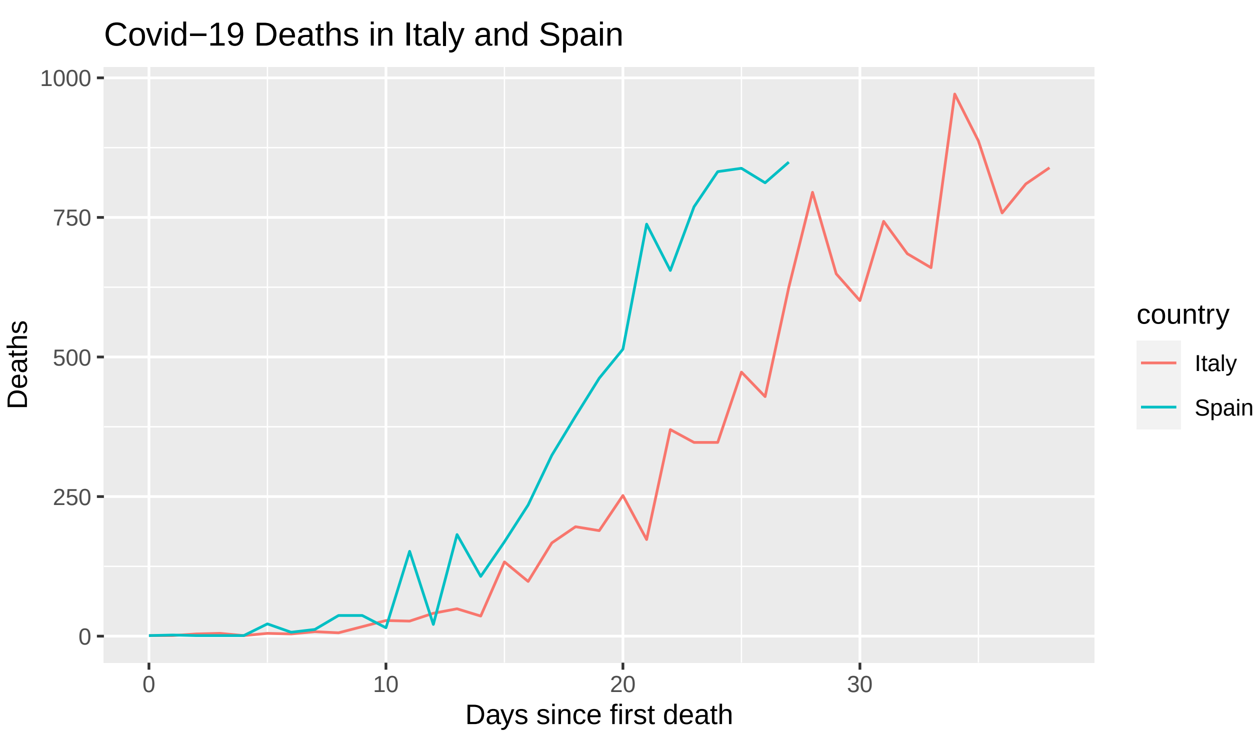
Beta is a measure of systematic risk for firms. When firms have a beta greater than one, they have higher systematic risk than the average firm, while firms with a beta less than one have less systematic risk. Beta can be found from the equation $\mathrm{Y_t} = \beta_0 + \beta_1 \mathrm{X_t} + \mathrm{e_t}$, where $\mathrm{Y_t}$ is the rate of return of an individual stock and $\mathrm{X_t}$ is the rate of return of the entire stock market (measured by S&P 500). Thus, β_1 measures how much the rate of return of an individual stock changes when the rate of return of the entire stock market increases by 1. When β_1 is higher, a stock is more reactive to change and thus carries more systematic risk. If a firm had a β_1 of zero, it would carry no systematic risk, where the firm's return would not be affected by the return of the market portfolio at all. β_1 is calculated by graphing $\mathrm{X_t}$ and $\mathrm{Y_t}$ for each firm and finding the slope of the linear regression line.

ticker_symbol	intercept	slope	R^2
AAPL	0.0091893	1.0656012	0.0133625
GOOG	0.0002330	0.9967746	0.6483015
MRK	-0.0001540	0.7136141	0.4837010
JNJ	-0.0000241	0.6771930	0.5019430
WMT	0.0006781	0.5189811	0.2853233
TGT	0.0015833	0.7076485	0.2478813

The table shows the intercept, slope, and R^2 of linear regression models for 6 individual stocks: Apple, Google, Merck, Johnson and Johnson, Walmart, and Target. The intercept term represents β_0 (alpha), the slope represents β_1 (systematic risk risk), and R^2 represents the strength of the linear association between the individual stocks and the overall market portfolio.

In conclusion, Walmart has the lowest systematic risk because it has the smallest β_1 (slope) of 0.52. Apple has the highest systematic risk because it has the largest β_1 of 1.07.

Problem 3: COVID-19 Deaths



The line graph shows the daily Covid-19 deaths in Spain and Italy. The red line represents the deaths in Italy and the blue line represents the deaths in Spain. Italy had a growth rate of 0.183 (18.3%) while Spain had a growth rate of 0.276 (27.6%). In addition, Italy had a doubling time of approximately 4 days while Spain had a doubling time of approximately 3 days. These statistics along with the graph indicate that the number of Covid-19 deaths increased at a faster rate in Spain than Italy.

Problem 4: Milk

The estimated price elasticity of demand (PED) is -1.62. The power law is $Q=KP^{\beta}$, where Q is the number of sales, P is the price, and β is PED. To find β, I took the natural log of both sides of the equation: $\log(Q) = \log(K) + \beta\log(P)$. Then, I created a linear regression model where $x=\log(P)$ and $y=\log(Q)$. The slope of this line was -1.62, which corresponded to a β of -1.62. This indicated that as the price of milk increased, the quantity demanded decreased.