Assignment 1 ~ TESLA

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Econ 4140 Section B ~ Financial Econometrics
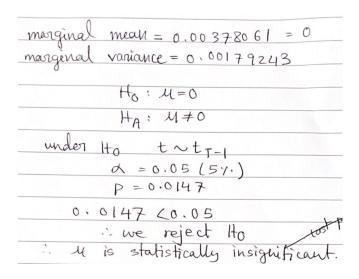
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Answer to assignment 1:

1. The *'Random Walk'* process is a stochastic process, which is a statistical model that is used to describe the sequence of data points of 'Independent and Identically Distributed' random variables. The stochastic process represents the unpredictable nature of a time series. Thus, due to the unpredictable nature, the trends and stock prices of a market cannot predict future movements.

2. Yes, the time series of daily TESLA prices display a trend. Overall, there is a positive growth, while at t=600 to t=700 is a marginal dip, which indicates an exponential growth over time.

3. The daily prices of the TESLA behave like a random walk. Indicating it is a non-stationary process since the daily log prices of TESLA display a trend. In a random walk, the prices show a long-term trend shifted either upward or downward. However, looking at the short-term data it appears as random fluctuations. Within this time series, we can indicate there is an upward trend in the log prices. Thus, indicating that the log prices for TESLA are a random walk and are non-stationary.

4. No, the TESLA return series does not have a trend. The time series displays volatility at times which are either large or small fluctuations, while hovering around a constant level. Thus, making the return series stationary with zero correlation.

5. When comparing the differences between the behaviour of prices and returns concerning the TESLA stock it is quite varied. The prices show a trend whereas the returns display no trend. Therefore, the prices are non-stationary, and the returns are stationary. This indicates that the returns are unpredictable because it is serially uncorrelated, i.e., they have no memory. The prices, conversely, are serially correlated and hence can be predictable.

6. *'Volatility clustering'* describes a time series in periods of high and low volatility in stages. This occurrence is where volatility tends to shift in different periods that persists either in a stable market or in heightened market conditions. This indicates a pattern where extreme market movements are more likely to be followed by similar movements in the near future.

7. Shown in this allotted time frame for the patterns in returns and prices. Within the daily log price, it shows that there is an increase in prices. While, for the daily returns it's hard to identify due to the high volatility of the returns being a white noise.

8. First, by looking at the tests of normality, we can see that the p-values are not significant (lower than 5%). Secondly, the negative skewness (-0.30) and the large kurtosis (4.83), show deviations from normality in TESLA returns. The large kurtosis value suggests that TESLA returns may exhibit heavy tails (outlier prone) and a distribution that deviates from a normal distribution. In addition, by looking at the qq-plot, we see that the points deviate at the tails which suggests non-normality returns. Therefore, we reject the null hypothesis that the TESLA returns are normally distributed.

9. Formula of the AR (1) Process displayed below:

$$y_t - \mu = \emptyset(y_{t-1} - \mu) - \epsilon_t \quad \epsilon_t \sim WN\ (r_\epsilon^2)$$

10.1: The marginal mean is 0.00378 and the variance is 0.00179.

marginal mean = 0.00378061 = 0
margenal variance = 0.00179243

$H_0 : \mu = 0$
$H_A : \mu \neq 0$
under H_0 $t \sim t_{T-1}$
      $\alpha = 0.05 \ (5\%)$
      $P = 0.0147$

0.0147 < 0.05
∴ we reject H_0 test P
∴ μ is statistically insignificant.

10.2:

2) returns are not serially correlated.
the coefficient is not statistically significant
$H_0 :$ ~~cons~~coefficient = 0
$H_A :$ co-efficient ≠ 0
~~P = p-value~~
t-value = 2.45 > 1.96
So, we reject H_0
∴ Tesla does not follow AR(1) as ∅ is insignificant,
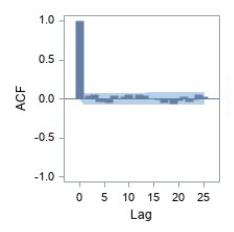so it is a white noise.

The variance of the error term:

$$\sigma^2 = MSE * DFE$$

$$\sigma^2 = 0.00179 * 749$$

$$\approx 1.34071$$

In addition, by looking at the ACF graph below, we can see that the points sharply get close to 0. This supports the evidence that the returns of the time series are serially uncorrelated.

10.3: The Efficient Market Hypothesis suggests that market prices fully reflect all available information. In order for a stock to be market efficient, it must display a random walk, indicating unpredictable price movements, and its returns should be uncorrelated. Implying that past performance does not predict future gains.

10.4: Yes, based on the AR(1) estimation results, TESLA stock fully reflects all available information. Additionally, as demonstrated earlier, TESLA prices follow a random walk, and have uncorrelated returns which are aligned with the market efficiency theory.