STA 750 - Project

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1 Data Analysis

Advanced Micro Devices (AMD) and Intel are both companies that are known for developing and producing microchips for computers. In early 2020, with the development of the Ryzen 5000 processor, AMD was favored by consumers and hailed as the new market leader for processors. As another consequence of this achievement, the market share price for AMD increased. We will attempt to analyze the rise of this stock price and compare it with the corresponding stock prices for Intel. For this purpose, we consider the financial time series data of AMD from April 2020 to April 2021. In particular, we consider the market close prices. These market close prices were recorded at the end of every trading day (Monday through Friday). See Figure 1 and 2 for a plot of the AMD financial data and its corresponding ACF/PACF plot. In addition, we shall also consider the same data for Intel (INTC) during the same year and perform a cross-spectral analysis with the AMD data.

2 Predictive Model

From Figure 1 and 2, we see that the series is non-stationary. Then we take differences on the data. We find that by taking one difference, i.e. $d = 1$ (see Figure 3), we find that the ACF/PACF plots decrease rapidly (see Figure 4). We also find from the PACF/ACF plots that there is no seasonal component, which implies $P = D = Q = 0$. Thus, we choose our model to be ARIMA$(1, 1, 1)$.

Using R, we calculate the diagnostics, which are summarized in Figure 5. Figure 5 shows that the residuals come from a normal distribution. So the assumptions for regression hold here. The estimated coefficients and their standard errors are given by

$$\hat{\phi} = -0.1826, \quad se = 0.9581$$
$$\hat{\theta} = 0.0765, \quad se = 0.9749.$$

Furthermore, we provide a forecast for the market close price for the next 5-day period along with a 95% confidence band in Figure 6.

3 Spectral Analysis

We find the periodogram of the time series. Figure 7 shows the estimated periodogram of the series. From the plot of the periodogram, we note that the maximum density occurs when $\omega = 0$, i.e. there is no periodic behavior.

4 Cross-Spectrum

A plot of the Intel financial series is given in Figure 8.

Along with a plot of the financial series, we also plot the squared coherency (and a 95% confidence band) between AMD and INTC as seen in Figure 9. For the estimation of the squared coherency, we did smoothing using the Daniell kernel with $m = 3$. The effect that we see is that the squared coherency peaks near very low frequencies. This suggests that there is a stronger linear relationship between the two market close prices at lower frequencies, i.e. over longer periods.

Figure 1: Plot of Market Close Price of AMD from 4/2020 - 4/2021

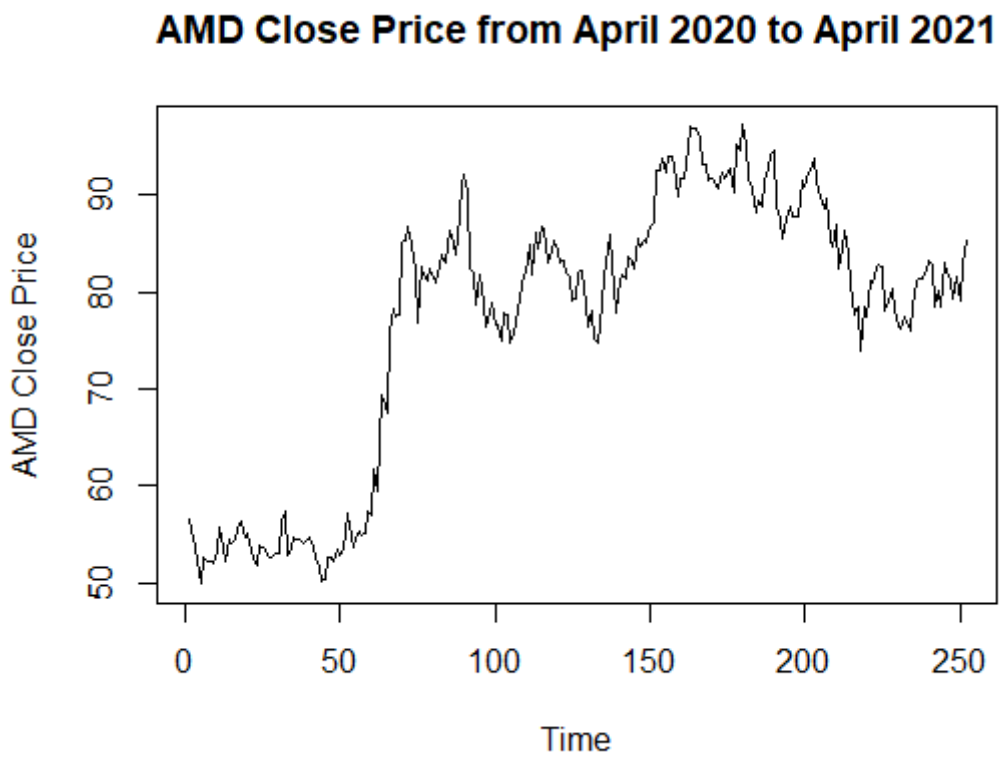

Figure 2: Plots of ACF and PACF of AMD from 4/2020 - 4/2021

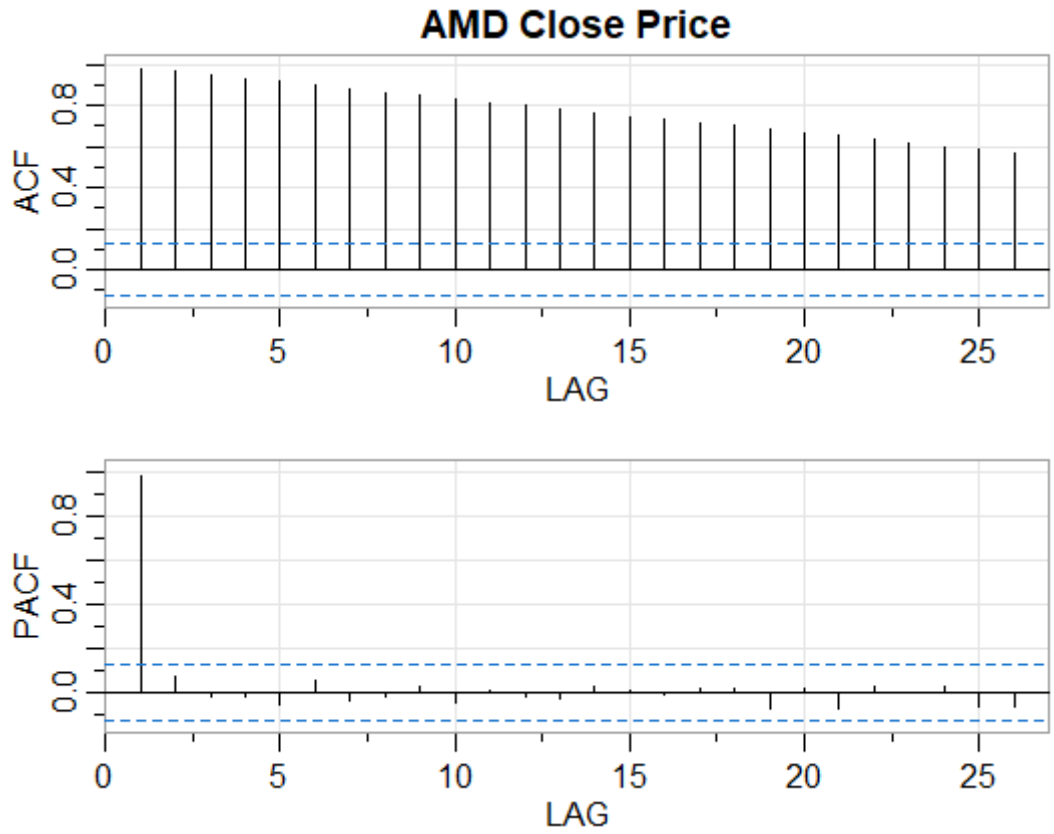

Figure 3: Plot of Market Close Price of AMD from 4/2020 - 4/2021 with d = 1

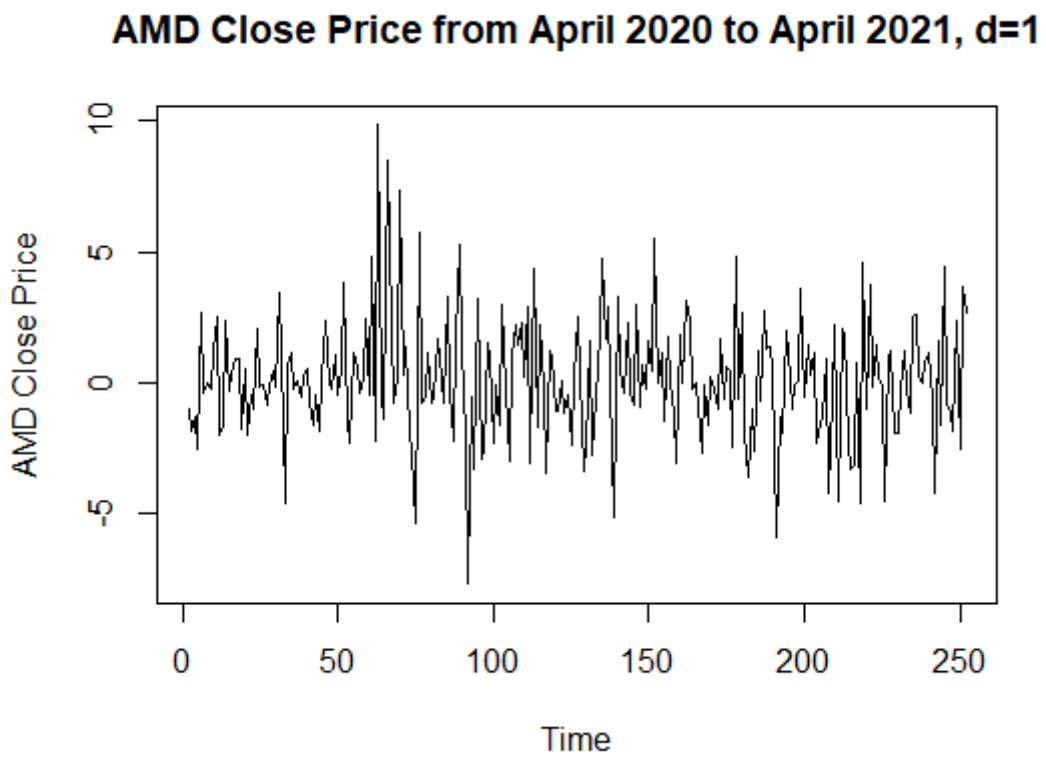

Figure 4: ACF/PACF Plot of Market Close Price of AMD from 4/2020 - 4/2021, d= 1

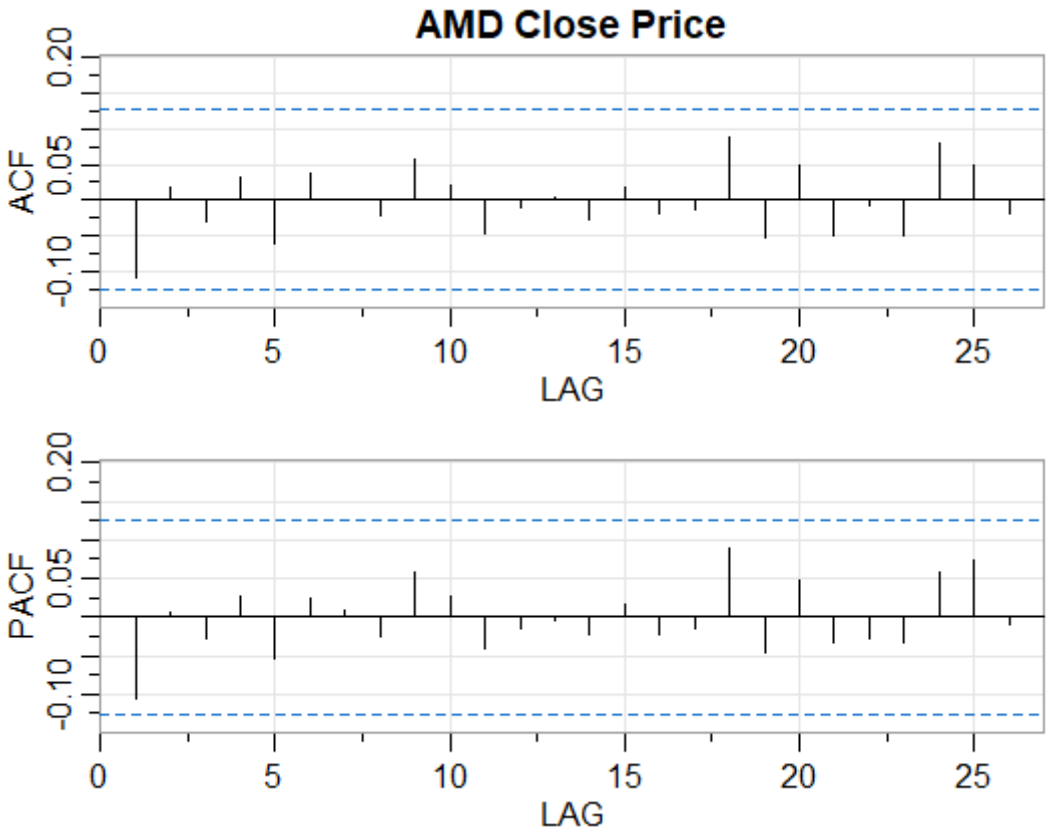

Figure 5: Fit Diagnostics

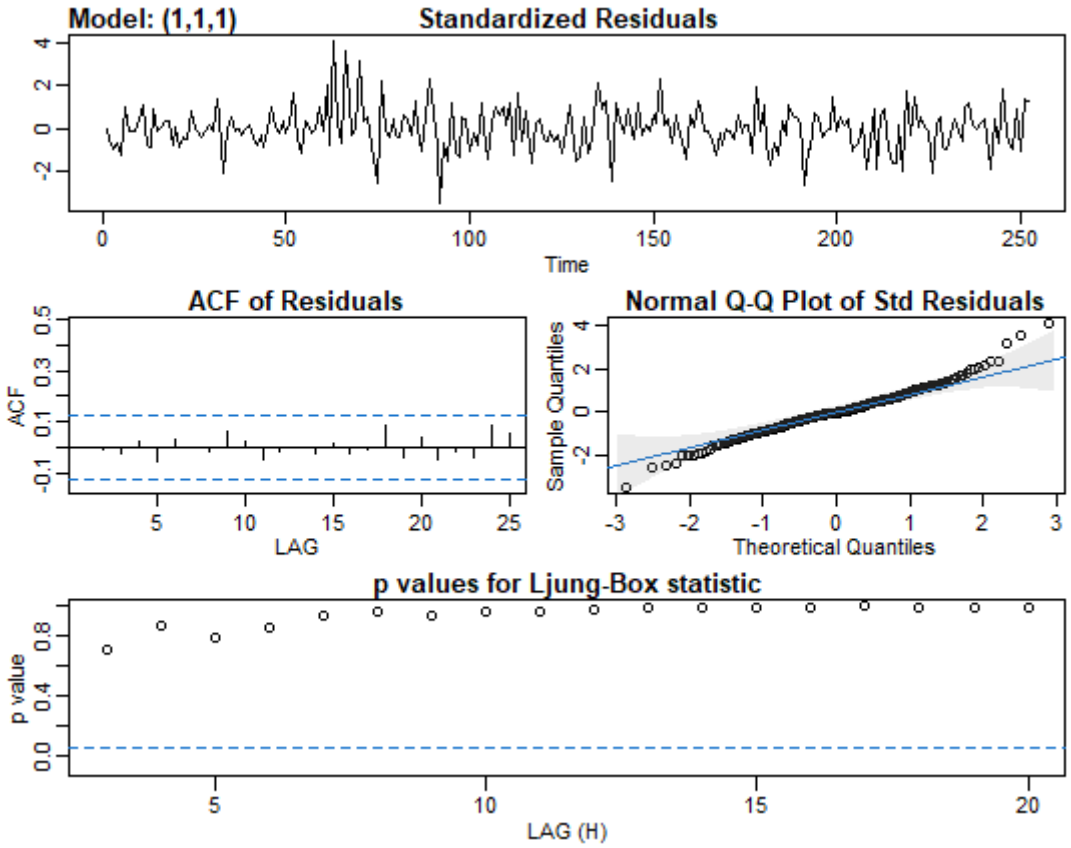

Figure 6: Plot of 5-day Forecast for AMD Market Close Price

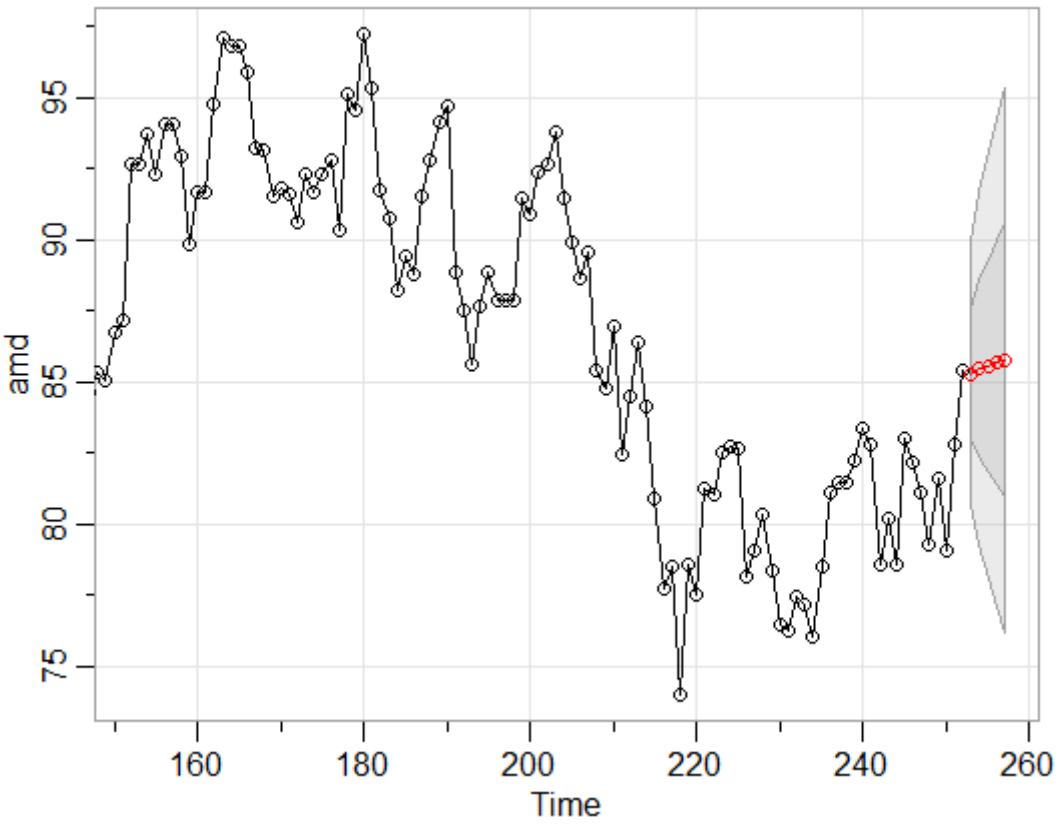

Figure 7: Periodogram

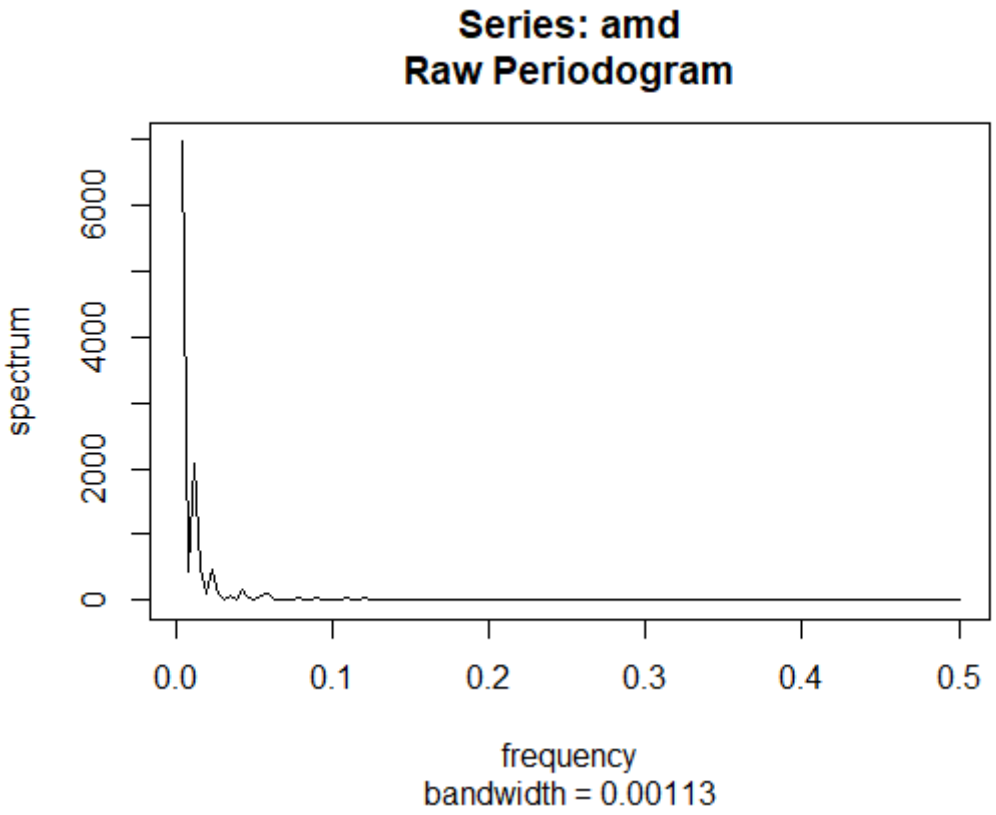

Figure 8: Plot of Market Close Price of INTC from 4/2020 - 4/2021

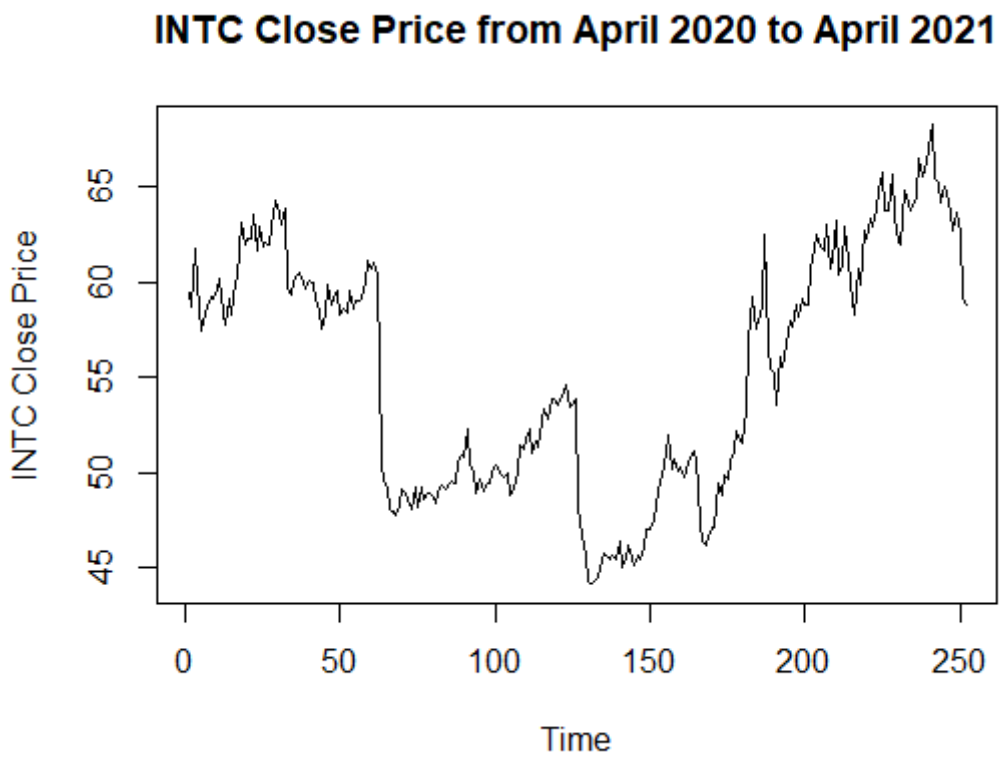

Figure 9: Plot of Squared Coherency between AMD and INTC