Final Project

Nina Sun and Jeanny Zhang

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Data

For this project, we are interested in the stock price of Snap.Inc. We accessed our data from the Nasdaq database (https://www.nasdaq.com/market-activity/stocks/snap/historical). The dataset includes the stock prices of each day starting from March 2nd, 2017, which is the first day of its IPO obtained, to May 17, 2022, when we accessed the data. The variables included in the dataset are dates, stocking holding price, traded volume, opening price, high price and low price. We choose to use the closing price of each day to fit a time series model. We are also interested in predicting the closing stock price in the next few days using the best fitted model.

EDA

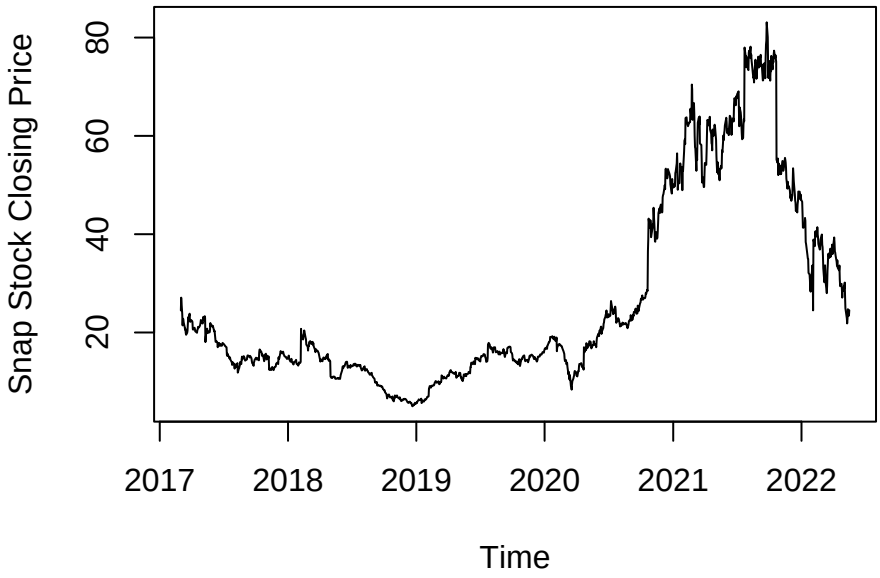
In order to fit a time series model to the closing price of the Snap.Inc stock, we first generated the time series plot of the data. As shown in Plot 1, the time series data does not appear to be stationary. Its mean and variability are not constant over time as there is a sharp increase in the middle of 2020 and a sharp decrease in the middle of 2021. The five-number summary in Table 1 and the boxplot in Plot 2 also show that the distribution of the data is highly right-skewed with prices higher than approximately $70 being unusual.

Given the current situation, we decided to make the data more stationary by taking first and second differences and taking the log and square root of the data and compare which transformation produces the most stationary result. The results can be found in Plot 3 - 8. We think Plot 5 and Plot 6 appear to be the most stationary. We cannot decide which one is substantially better, and we decide to further investigate these two transformations by doing model specification and discover which one is better. It would be great if Andy can give us some advice.

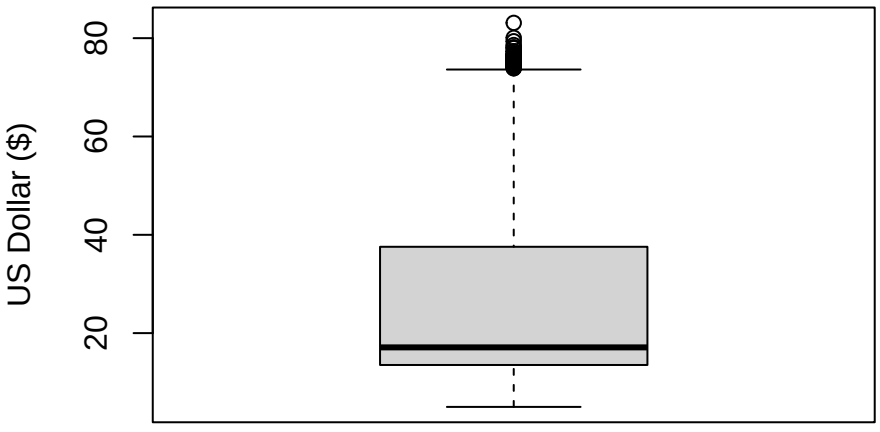
Table 1: Five-Number Summary

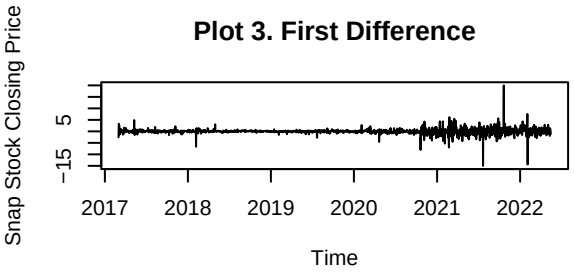
Var1	Freq
Min.	4.99000
1st Qu.	13.52000
Median	17.10000
Mean	26.45655
3rd Qu.	37.56000
Max.	83.11000

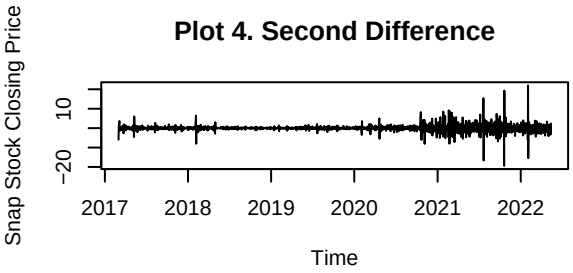
Plot 1. Snap.Inc Stock Closing Price

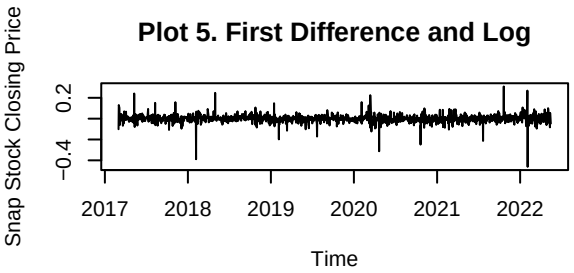


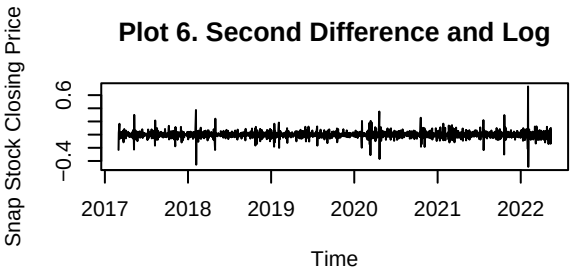
Plot 2. Boxplot of Snap.Inc Stock Closing Price

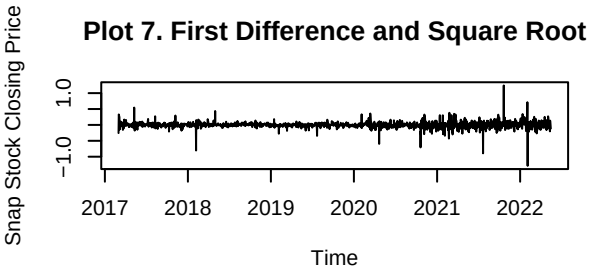


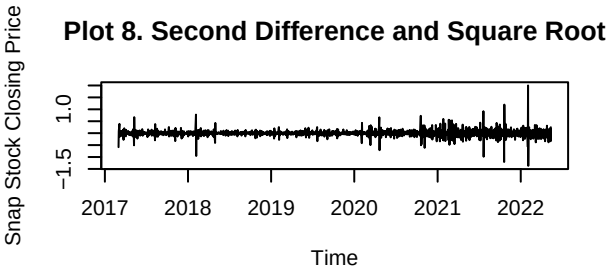












Modeling Specification

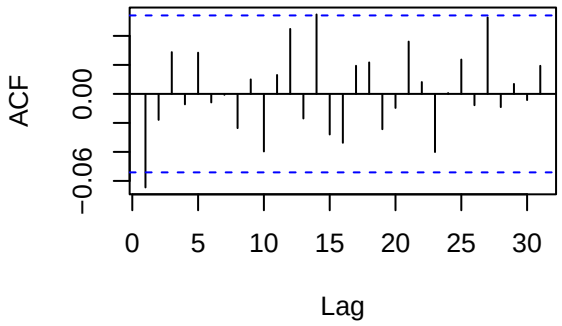
We try to conduct model specification on the data after performing log transformation and taking the first and second differences. For the data with the first difference, the ACF and PACF plots look odd and they only have one short significant peak at lag 1. The EACF probably suggests a MA(1) model. For the data with the second difference, the ACF, PACF, and EACF suggest an AR(1) model.

We further investigate these two models. As shown in Plot 15 and 16, the residuals of the AR(1) model look terrible. The Ljung-Box Plot also shows that there are a lot of significant p-values and there are definitely better model for this data. As shown in Plot 18 and 19, the residuals of the MA(1) model look great. The Ljung-Box Plot also does not show any badness about the model.

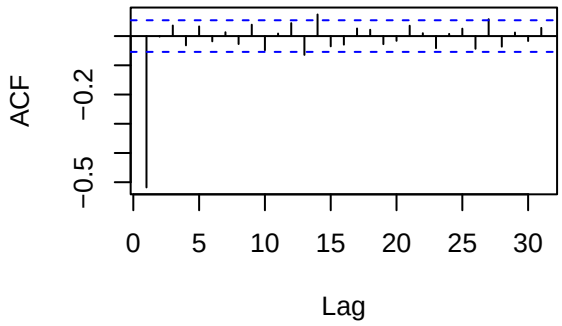
Our future analysis would include comparisons of periodograms of potential models and the predictions using the fitted model that we find to be the most adequate.

ACF, PACF and EACF

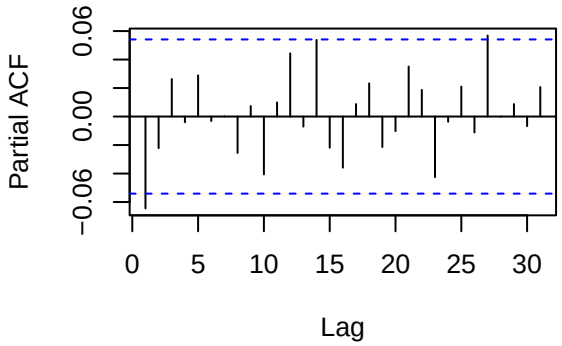
Plot 9. ACF of diff(log(df$Close.Last2)



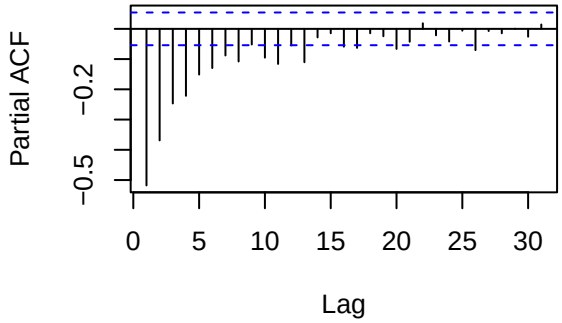
Plot 10. ACF of diff(diff(log(df$Close.Last



Plot 11. PACF of diff(log(df$Close.Last2



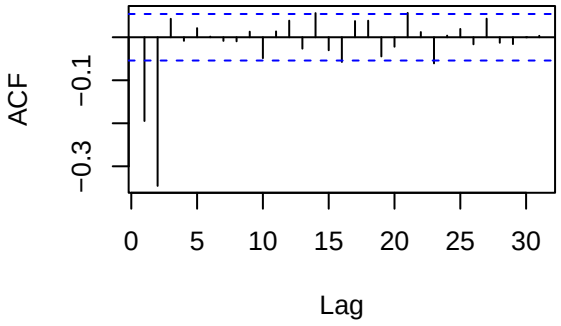
Plot 12. PACF of diff(diff(log(df$Close.Las



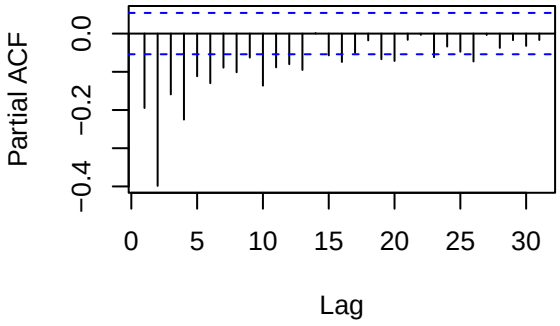

```
## AR/MA
##   0 1 2 3 4 5 6 7 8 9 10 11 12 13
## 0 x o o o o o o o o o o  o  o  o
## 1 x o o o o o o o o o o  o  o  o
## 2 x x o o o o o o o o o  o  o  o
## 3 x x x o o o o o o o o  o  o  o
## 4 x x x x o o o o o o o  o  o  o
## 5 x o x x x o o o o o o  o  o  o
## 6 o o x x x o o o o o o  o  o  o
## 7 o x x x x o o o o o o  o  o  o
```

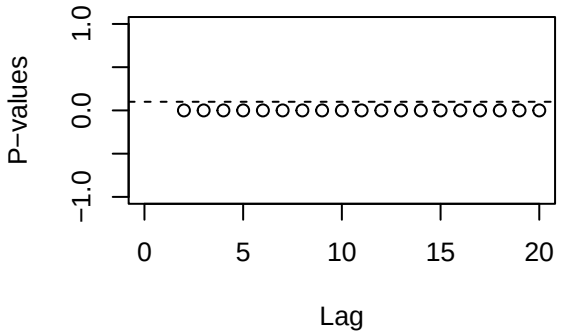
```
## AR/MA
##   0 1 2 3 4 5 6 7 8 9 10 11 12 13
## 0 x o o o o o o o o o o  o  x  x
## 1 x o o o o o o o o o o  o  o  x
## 2 x x x o o o o o o o o  o  o  o
## 3 x x x x o o o o o o o  o  o  o
## 4 x x x x x o o o o o o  o  o  o
## 5 x x x x x x o o o o o  o  o  x
## 6 x x x x x x x o o o o  o  o  o
## 7 x x x o x x x o o o o  o  o  o
```

Plot 15. ACF of Residual Plot of AR(1)

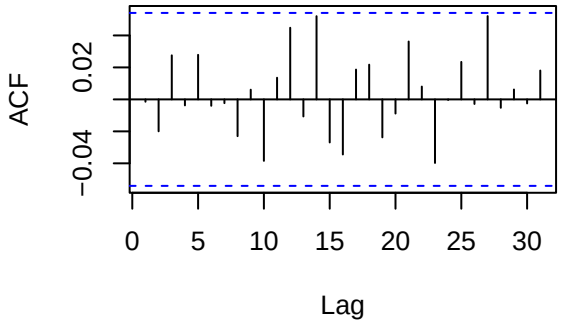


Plot 16. PACF of Residual Plot of AR(1





Plot 18. ACF of Residual Plot of MA(1)



Plot 19. PACF of Residual Plot of MA(1