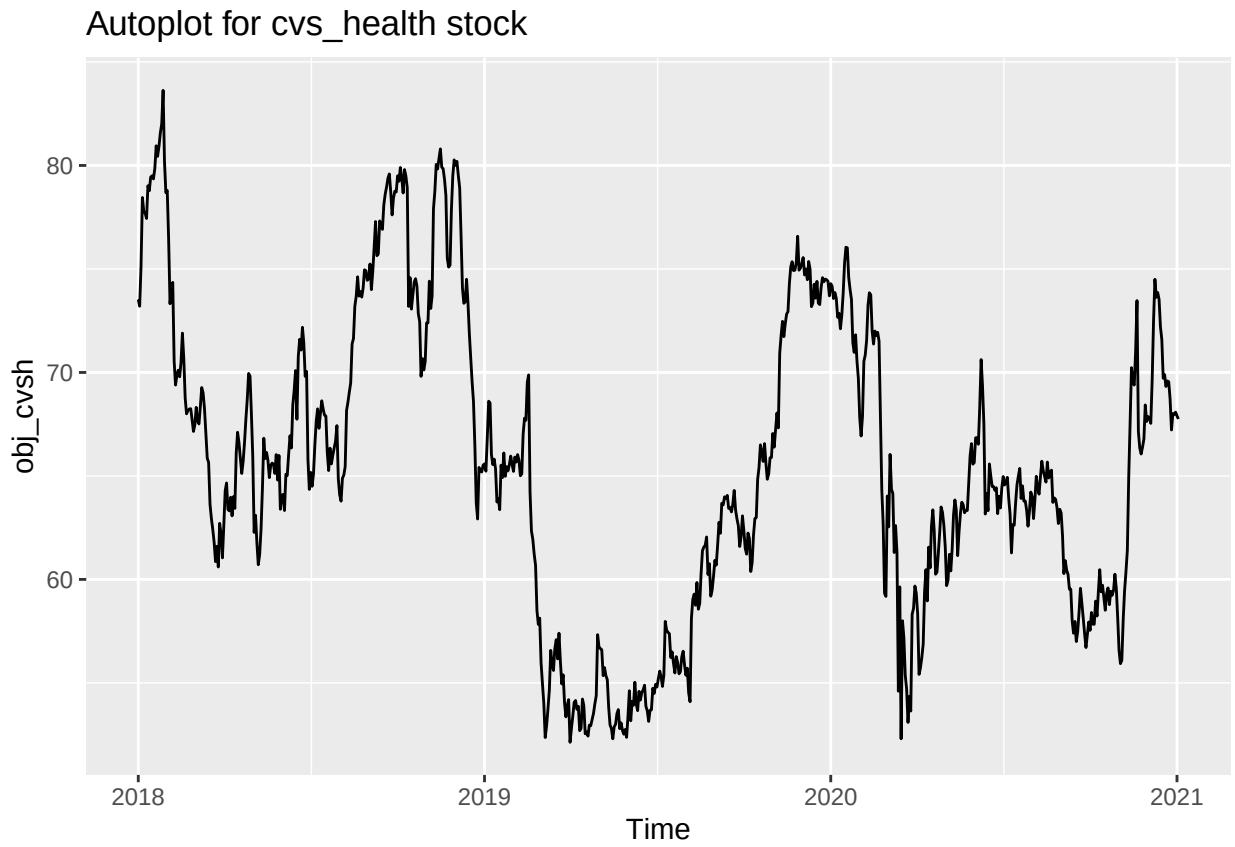
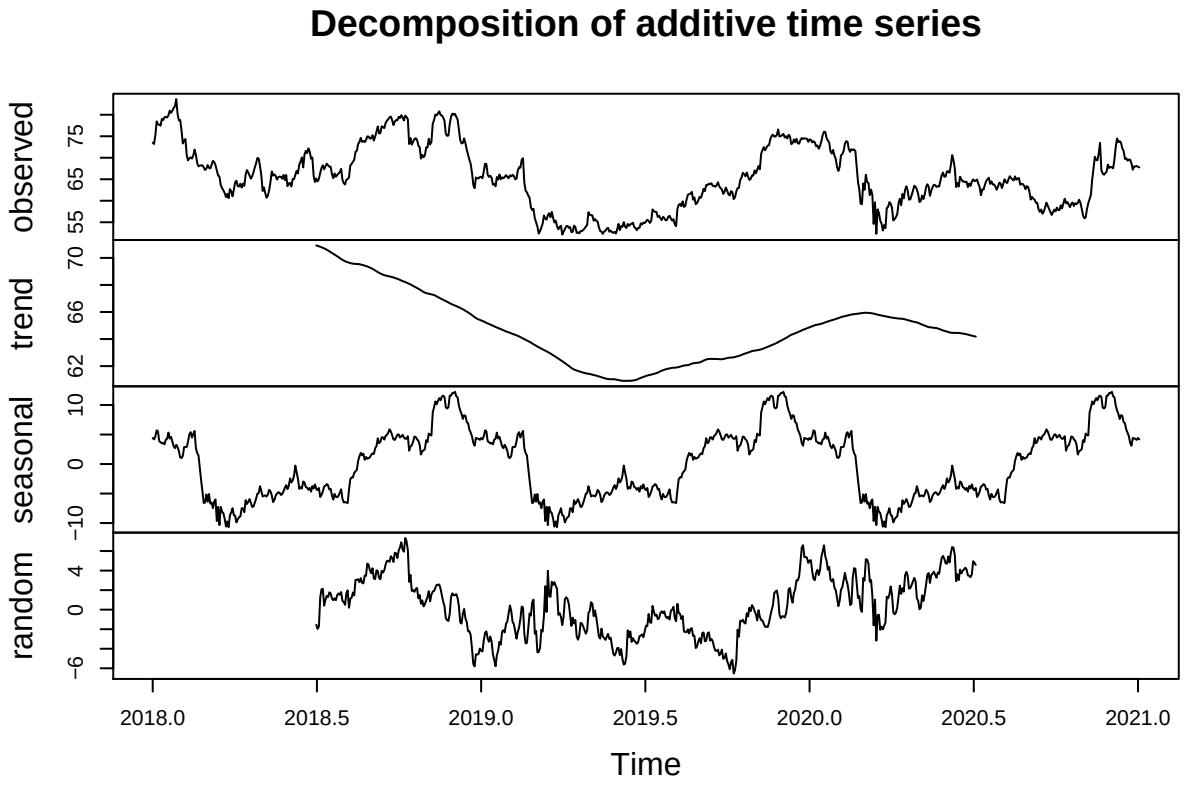
APPENDIX

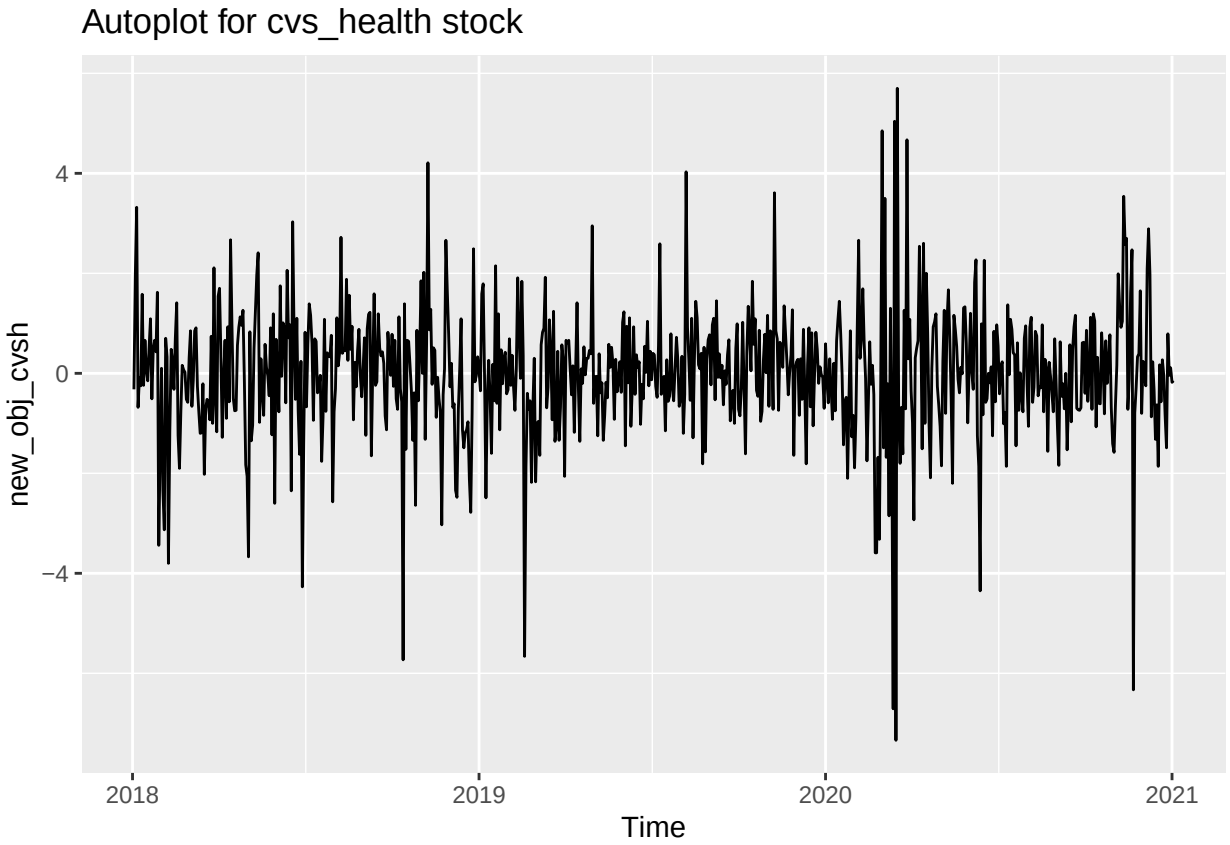
GROUP 16 PROJECT

10/04/2021

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.0 --
## v ggplot2 3.3.3     v purrr   0.3.4
## v tibble  3.0.4     v dplyr   1.0.3
## v tidyr   1.1.2     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.0
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## Warning: package 'forecast' was built under R version 4.0.4
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
## Warning: package 'xts' was built under R version 4.0.4
## Loading required package: zoo
##
## Attaching package: 'zoo'
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
##
## Attaching package: 'xts'
## The following objects are masked from 'package:dplyr':
##
##     first, last
## Warning: package 'urca' was built under R version 4.0.4
## Warning: package 'tseries' was built under R version 4.0.4
## Warning: package 'TTR' was built under R version 4.0.4
##
##  Augmented Dickey-Fuller Test
##
## data:  obj_cvsh
## Dickey-Fuller = -2.831, Lag order = 9, p-value = 0.2266
## alternative hypothesis: stationary
```

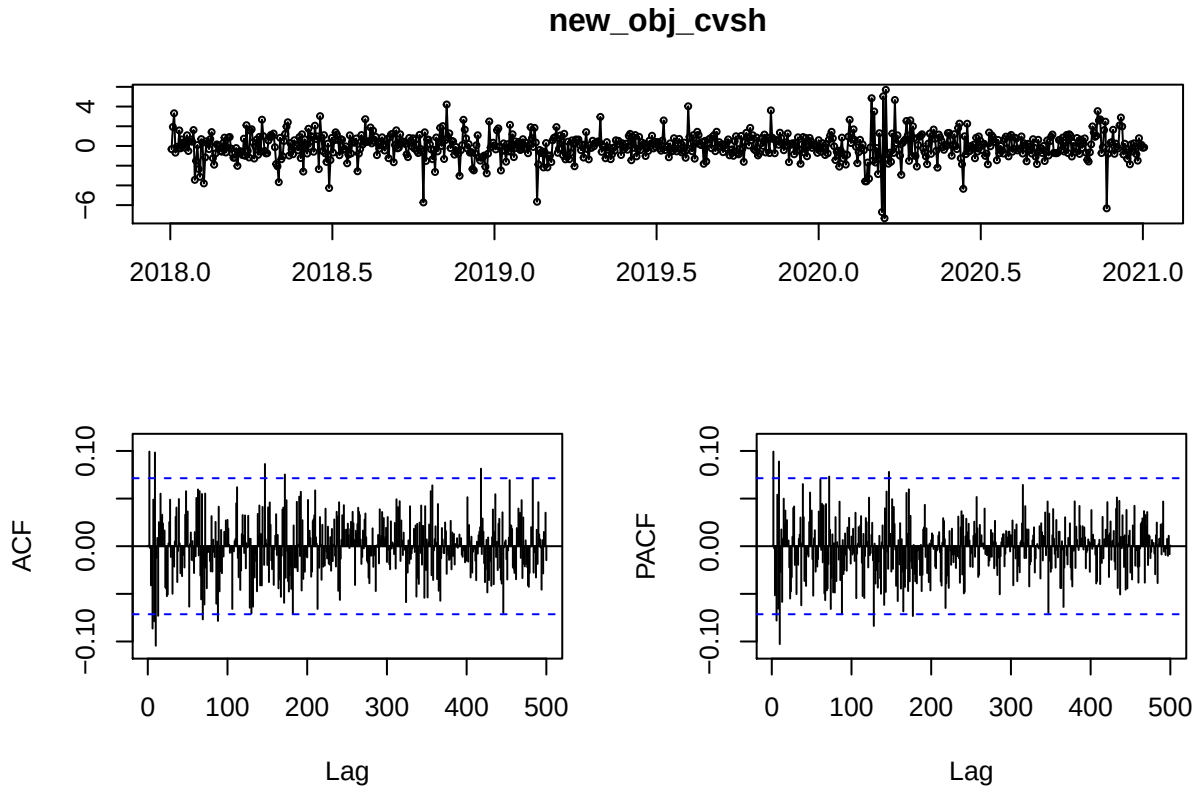

Autoplot for cvs_health stock
obj_cvsh
80
70
60
2018
2019
2020
2021
Time


Decomposition of additive time series
observed
trend
seasonal
random
55
65
75
62
66
70
−10
0
10
−6
0
4
2018.0
2018.5
2019.0
2019.5
2020.0
2020.5
2021.0
Time

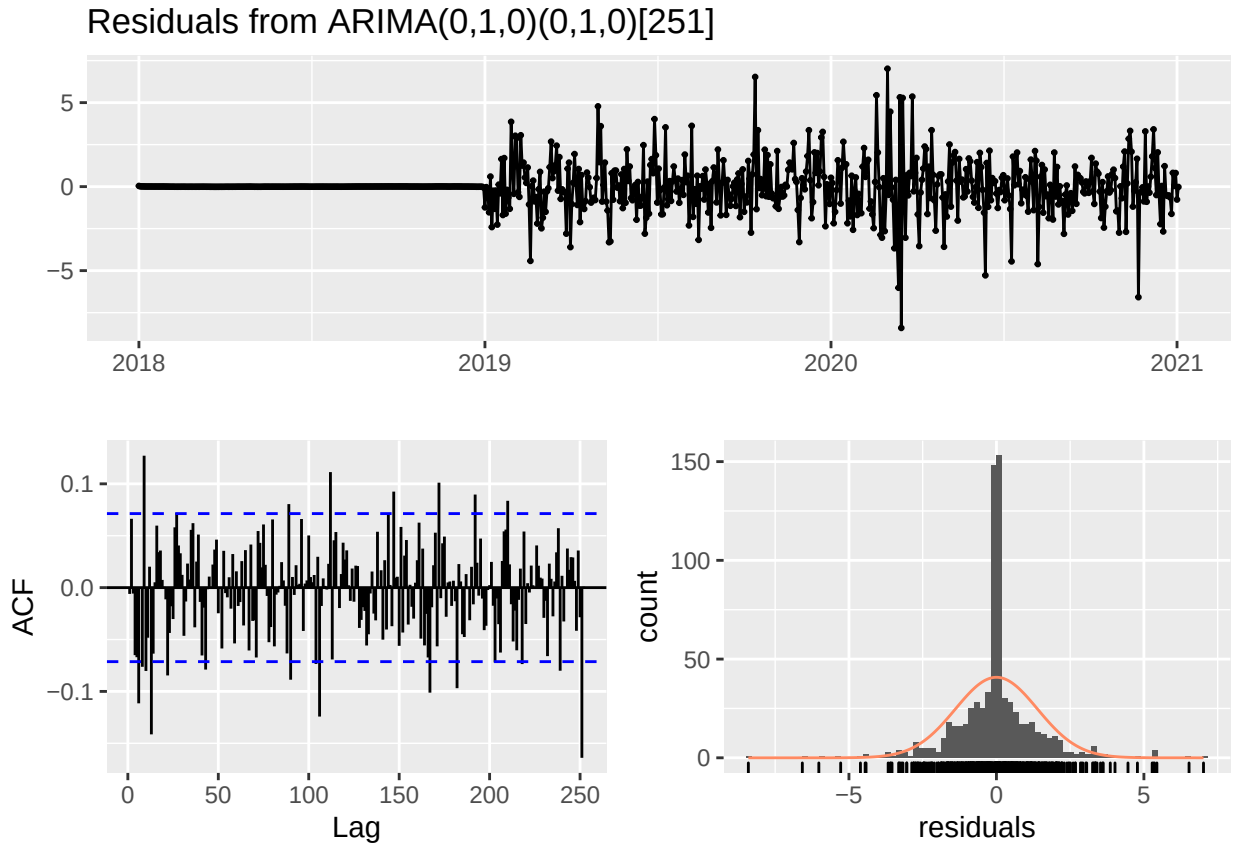



```
## Warning in adf.test(new_obj_cvsh): p-value smaller than printed p-value
```

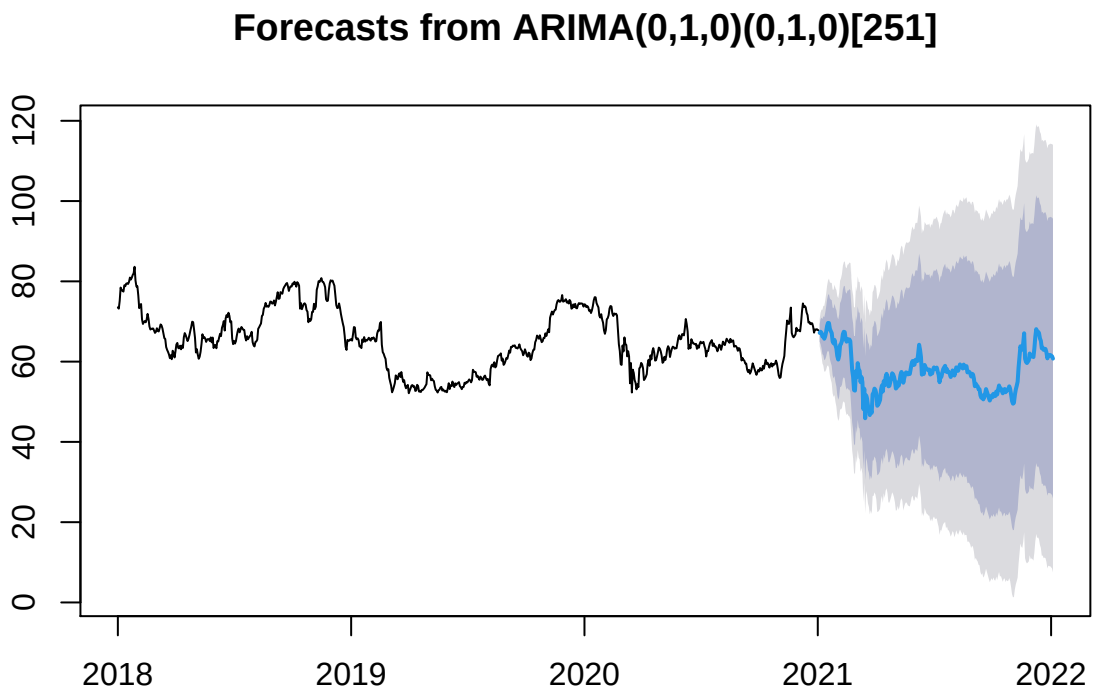
```
##
##  Augmented Dickey-Fuller Test
##
## data:  new_obj_cvsh
## Dickey-Fuller = -9.5082, Lag order = 9, p-value = 0.01
## alternative hypothesis: stationary
```

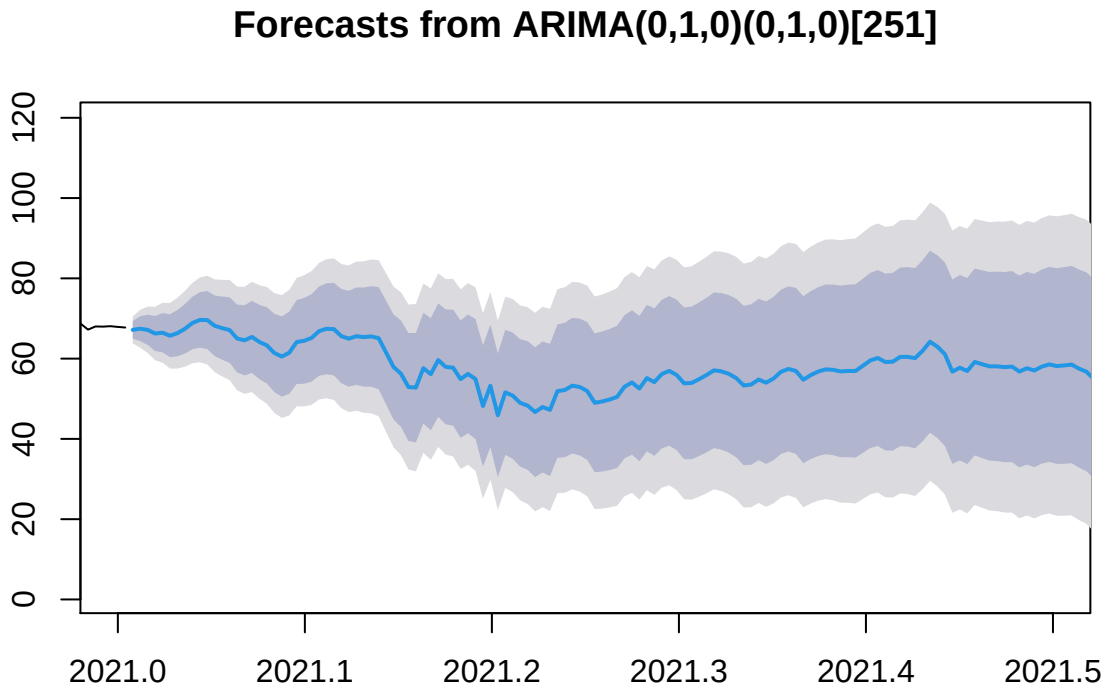



```
## Series: obj_cvsh
## ARIMA(0,1,0)(0,1,0)[251]
##
## sigma^2 estimated as 2.896:  log likelihood=-984.81
## AIC=1971.63   AICc=1971.64   BIC=1975.85
```

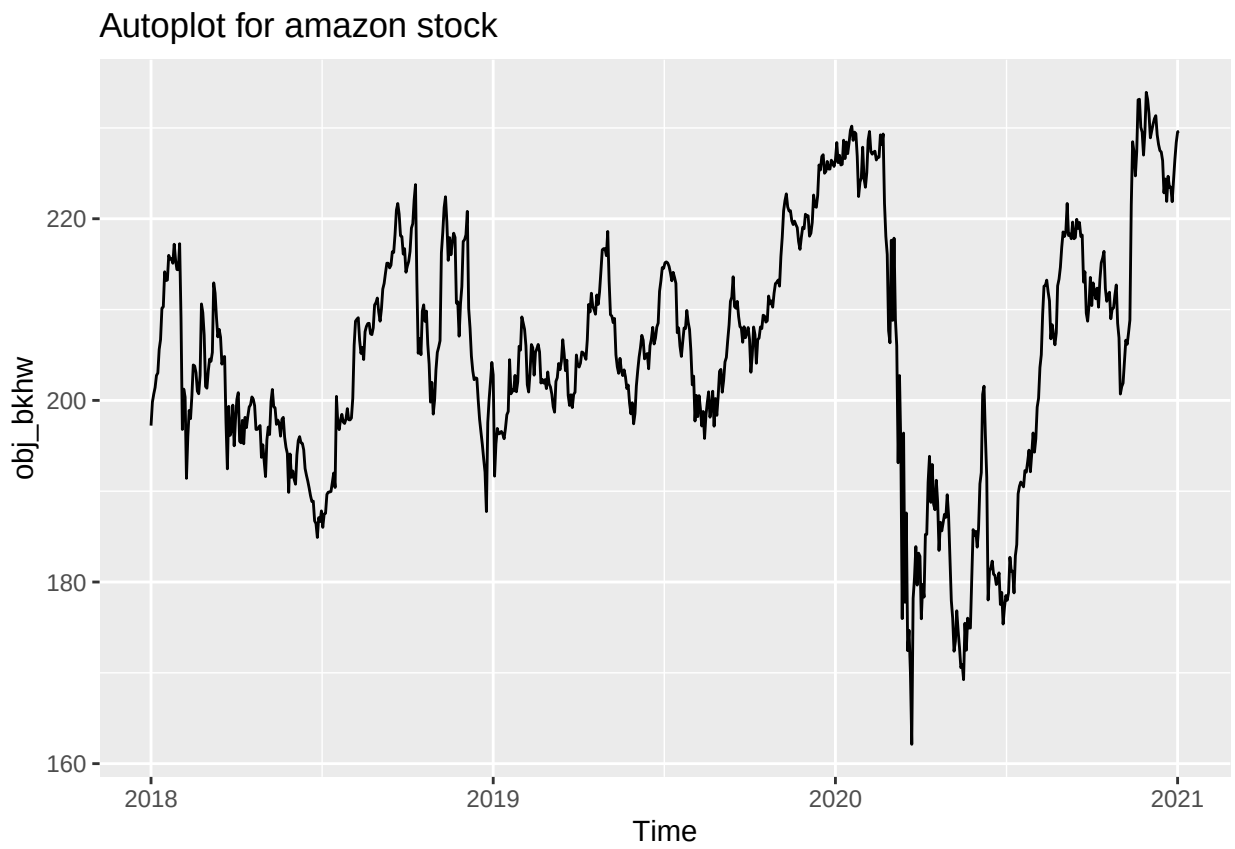


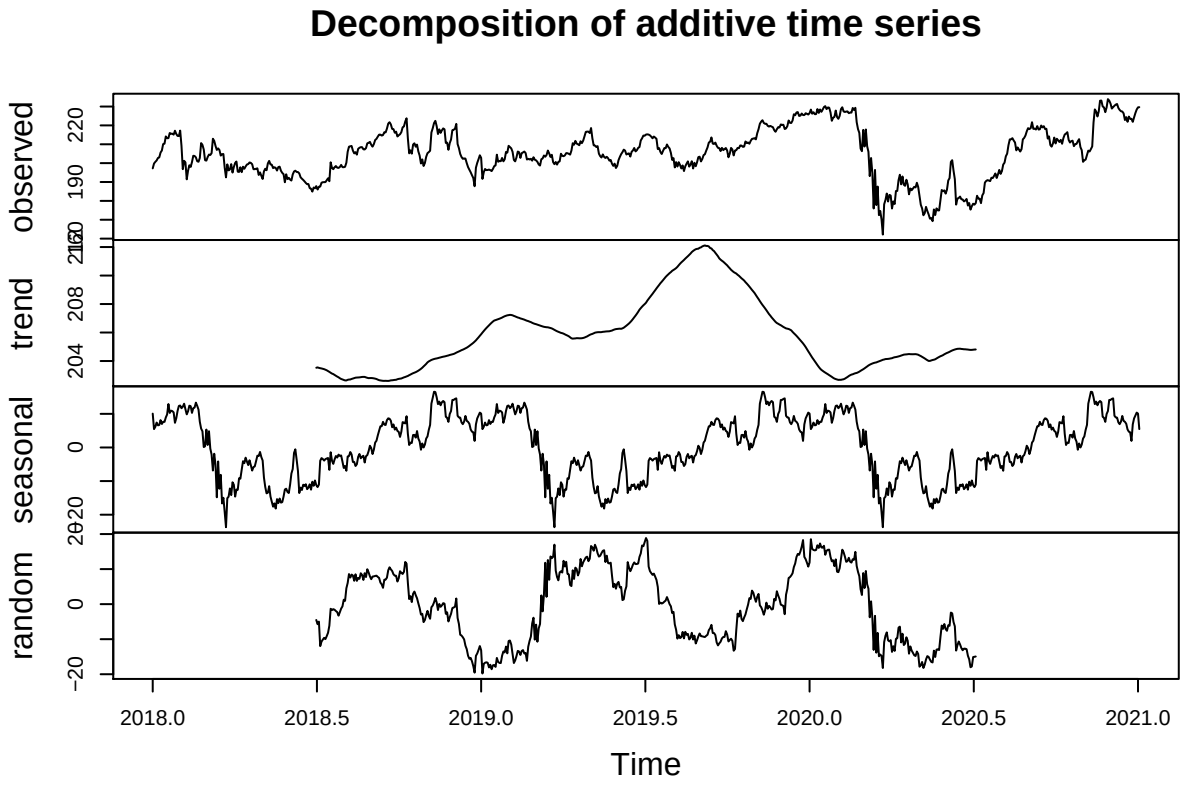

```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(0,1,0)(0,1,0)[251]
## Q* = 254.21, df = 151, p-value = 2.985e-07
##
## Model df: 0.   Total lags used: 151
```

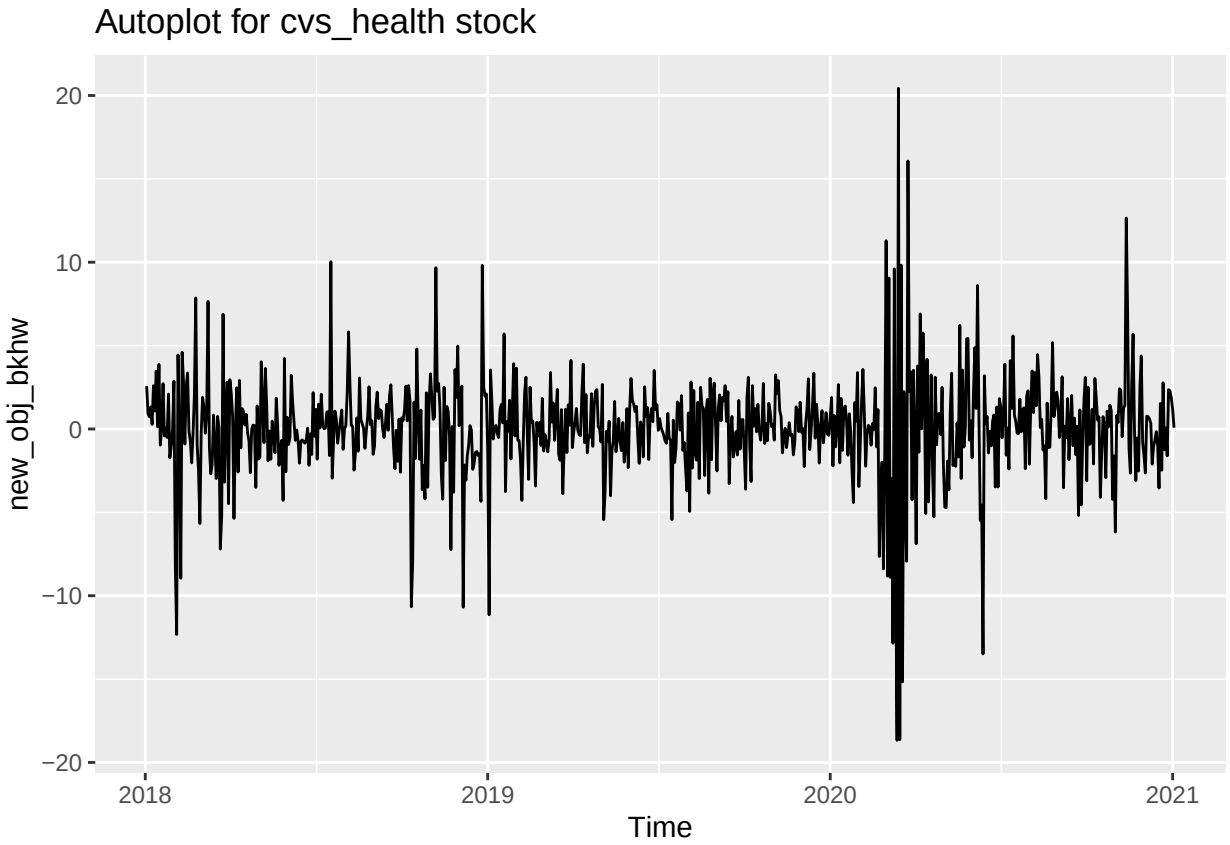

Forecasts from ARIMA(0,1,0)(0,1,0)[251]
0
20
40
60
80
100
120
2018
2019
2020
2021
2022




```
##
##  Augmented Dickey-Fuller Test
##
## data:  obj_bkhw
## Dickey-Fuller = -2.9626, Lag order = 9, p-value = 0.1709
## alternative hypothesis: stationary
```

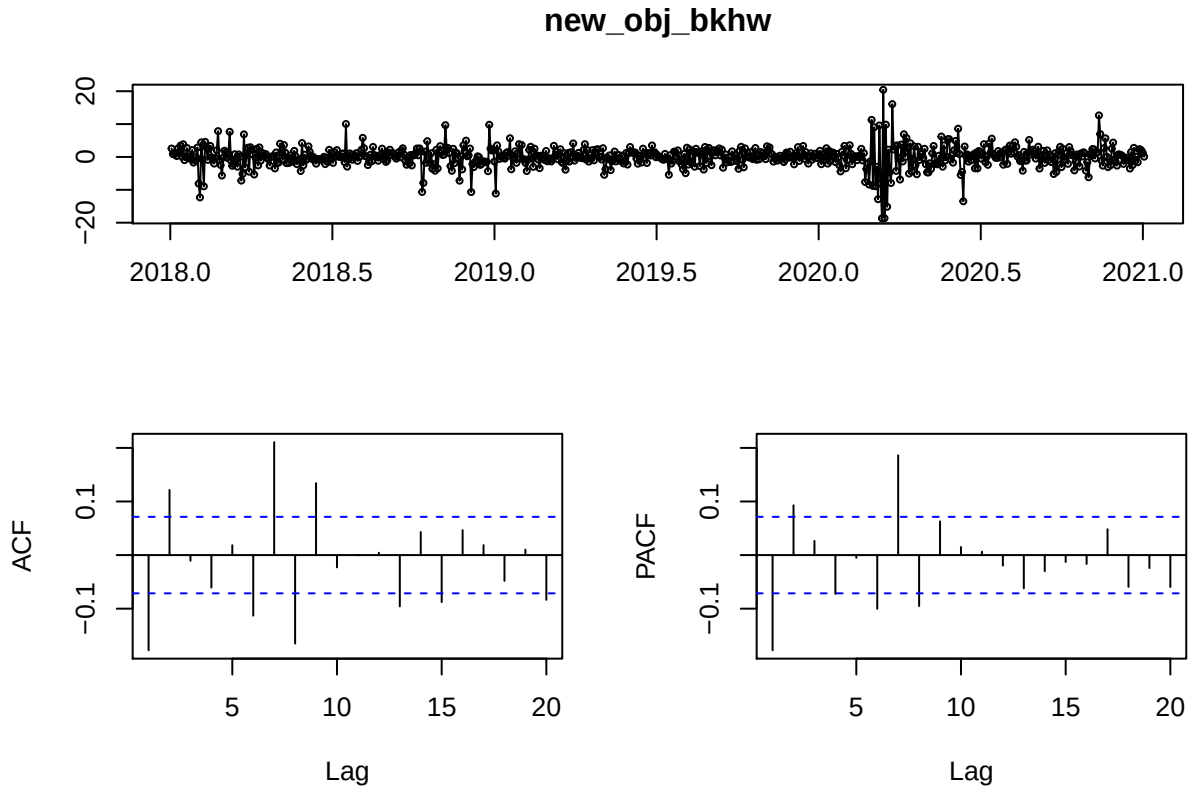

Autoplot for amazon stock
obj_bkhw
220
200
180
160
2018
2019
2020
2021
Time


Decomposition of additive time series
observed
trend
seasonal
random
190
220
204
208
0
−20
2018.0
2018.5
2019.0
2019.5
2020.0
2020.5
2021.0
Time

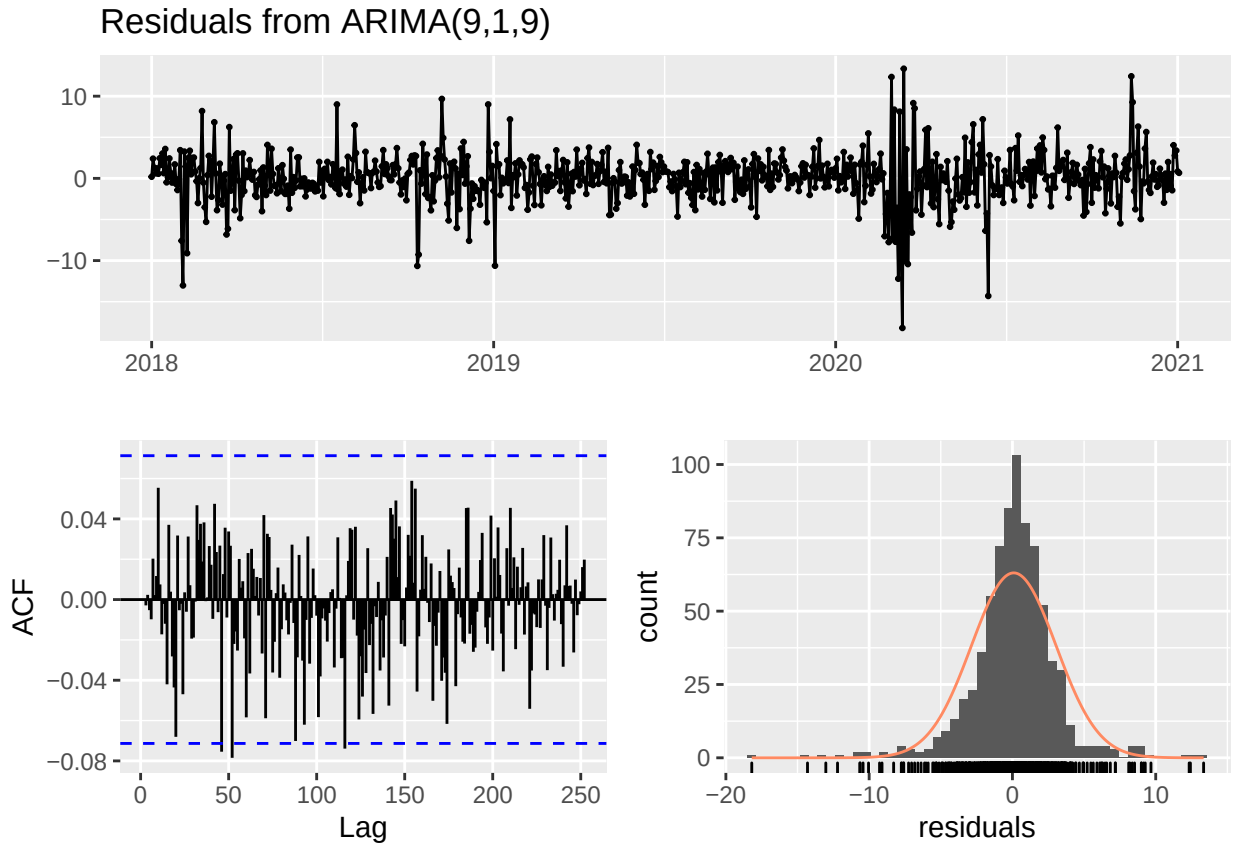



```
## Warning in adf.test(new_obj_bkhw): p-value smaller than printed p-value
```

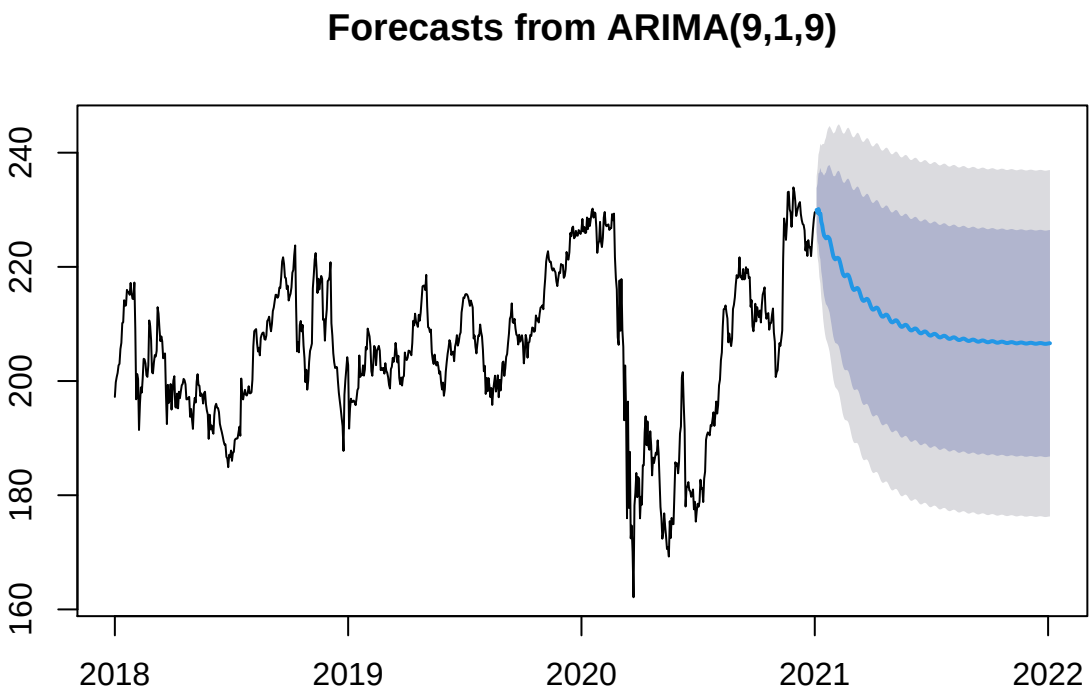
```
##
##  Augmented Dickey-Fuller Test
##
## data:  new_obj_bkhw
## Dickey-Fuller = -8.3158, Lag order = 9, p-value = 0.01
## alternative hypothesis: stationary
```

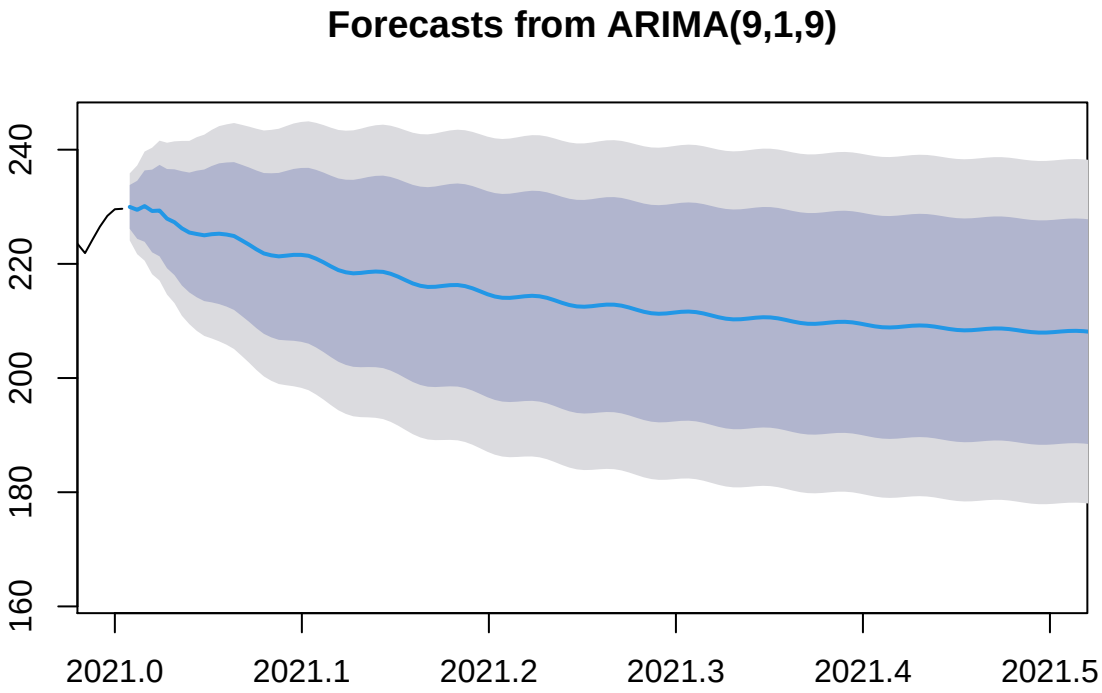



```
## Series: obj_bkhw
## ARIMA(9,1,9)
##
## Coefficients:
##           ar1     ar2     ar3      ar4      ar5     ar6     ar7     ar8     ar9
##       -0.1229  1.0117  0.2022  -0.7229  -0.1200  0.0899  0.0479  0.3213  0.1951
## s.e.   0.6843  0.1926  0.7993   0.2770   0.7318  0.2847  0.3830  0.2100  0.2054
##           ma1      ma2      ma3     ma4      ma5      ma6     ma7      ma8
##       -0.0136  -0.9488  -0.0500  0.6082  -0.0158  -0.0332  0.1488  -0.4682
## s.e.   0.6823   0.2410   0.7285  0.2578   0.6359   0.2397  0.3324   0.1416
##           ma9
##       -0.2272
## s.e.   0.2735
##
## sigma^2 estimated as 8.949:  log likelihood=-1890.59
## AIC=3819.18   AICc=3820.21   BIC=3907.06
```




```
##
##  Ljung-Box test
##
## data:  Residuals from ARIMA(9,1,9)
## Q* = 109.28, df = 133, p-value = 0.9344
##
## Model df: 18.   Total lags used: 151
```


Forecasts from ARIMA(9,1,9)
240
220
200
180
160
2018
2019
2020
2021
2022


Forecasts from ARIMA(9,1,9)
240
220
200
180
160
2021.0
2021.1
2021.2
2021.3
2021.4
2021.5