CCSP Sem 2 Data Science Project

Neeraj Appari

1)Topic-Prediction Model For the stocks of HDFC using Of Nifty-50 Stock Market

2)Objective-

Using the Original Value Stock and making a model to predict future value

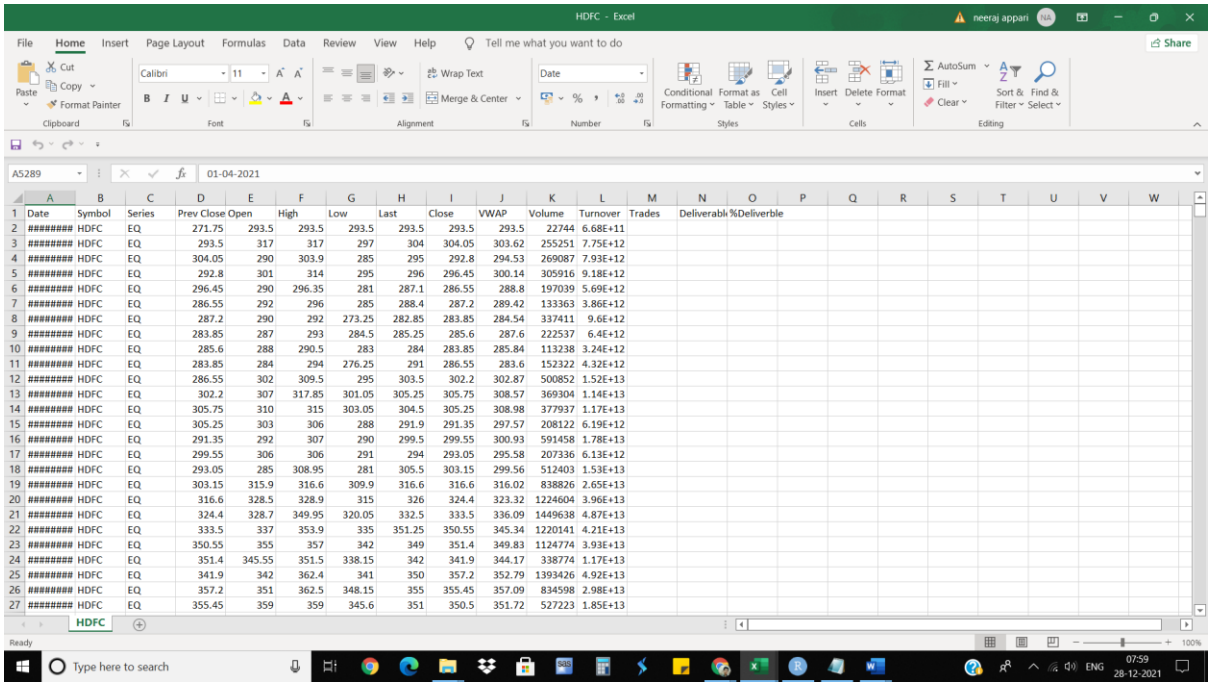
3)Dataset-

Stocks of HDFC from 3rd 2000 to 31st April 2021

It contains

- Previous Close-Previous close is a security's closing price on the preceding time period of the one being referenced.
- High- Highest closing price of a stock.
- Low- Lowest closing price of a stock.
- Open- It is the price at which the financial security opens in the market when trading begins.
- Close- It is the price at which the financial security closes in the market when trading begins.
- Last- The price at which the last trade occurred

- Volume- Volume measures the number of shares traded in a stock or contracts traded in futures or options.
- VWAP- The volume-weighted average price (VWAP) is a measurement that shows the average price of a security, adjusted for its volume.
- Turnover Value- The total number of shares traded during some period by the average number of shares outstanding for the same period.



Date	Symbol	Series	Prev Close	Open	High	Low	Last	Close	VWAP	Volume	Turnover	Trades	Deliverable	%Deliverble
########	HDFC	EQ	271.75	293.5	293.5	293.5	293.5	293.5	293.5	22744	6.68E+11			
########	HDFC	EQ	293.5	317	317	297	304	304.05	303.62	255251	7.75E+12			
########	HDFC	EQ	304.05	290	303.9	285	295	292.8	294.53	269087	7.93E+12			
########	HDFC	EQ	292.8	301	314	295	296	296.45	300.14	305916	9.18E+12			
########	HDFC	EQ	296.45	290	296.35	281	287.1	286.55	288.8	197039	5.69E+12			
########	HDFC	EQ	286.55	292	296	285	288.4	287.2	289.42	133363	3.86E+12			
########	HDFC	EQ	287.2	290	292	273.25	282.85	283.85	284.54	337411	9.6E+12			
########	HDFC	EQ	283.85	287	293	284.5	285.25	285.6	287.6	222537	6.4E+12			
########	HDFC	EQ	285.6	288	290.5	283	284	283.85	285.84	113238	3.24E+12			
########	HDFC	EQ	283.85	284	294	276.25	291	286.55	283.6	152322	4.32E+12			
########	HDFC	EQ	286.55	302	309.5	295	303.5	302.2	302.87	500852	1.52E+13			
########	HDFC	EQ	302.2	307	317.85	301.05	305.25	305.75	308.57	369304	1.14E+13			
########	HDFC	EQ	305.75	310	315	303.05	304.5	305.25	308.98	377937	1.17E+13			
########	HDFC	EQ	305.25	303	306	288	291.9	291.35	297.57	208122	6.19E+12			
########	HDFC	EQ	291.35	292	307	290	299.5	299.55	300.93	591458	1.78E+13			
########	HDFC	EQ	299.55	306	306	291	294	293.05	295.58	207336	6.13E+12			
########	HDFC	EQ	293.05	285	308.95	281	305.5	303.15	299.56	512403	1.53E+13			
########	HDFC	EQ	303.15	315.9	316.6	309.9	316.6	316.6	316.02	838826	2.65E+13			
########	HDFC	EQ	316.6	328.5	328.9	315	326	324.4	323.32	1224604	3.96E+13			
########	HDFC	EQ	324.4	328.7	349.95	320.05	332.5	333.5	336.09	1449638	4.87E+13			
########	HDFC	EQ	333.5	337	353.9	335	351.25	350.55	345.34	1220141	4.21E+13			
########	HDFC	EQ	350.55	355	357	342	349	351.4	349.83	1124774	3.93E+13			
########	HDFC	EQ	351.4	345.55	351.5	338.15	342	341.9	344.17	338774	1.17E+13			
########	HDFC	EQ	341.9	342	362.4	341	350	357.2	352.79	1393426	4.92E+13			
########	HDFC	EQ	357.2	351	362.5	348.15	355	355.45	357.09	834598	2.98E+13			
########	HDFC	EQ	355.45	359	359	345.6	351	350.5	351.72	527223	1.85E+13			

Linear Regression

1)Code-

```
#library

library(ggplot2)

library(rgl)

library(readxl)
```

```
library(caTools)


#Dataset and Descirption of Dataset

st <- read.csv("E://fffiiles//college pracs and projects//ai ccsp//pro//HDFC.csv")

head(st)
```

```
     Date Symbol Series Prev.Close  Open   High   Low  Last  Close
VWAP Volume     Turnover Trades

1 2000-01-03   HDFC     EQ     271.75 293.5 293.50 293.5 293.5 293.50
293.50  22744 6.675364e+11     NA

2 2000-01-04   HDFC     EQ     293.50 317.0 317.00 297.0 304.0 304.05
303.62 255251 7.749972e+12     NA

3 2000-01-05   HDFC     EQ     304.05 290.0 303.90 285.0 295.0 292.80
294.53 269087 7.925368e+12     NA

4 2000-01-06   HDFC     EQ     292.80 301.0 314.00 295.0 296.0 296.45
300.14 305916 9.181669e+12     NA

5 2000-01-07   HDFC     EQ     296.45 290.0 296.35 281.0 287.1 286.55
288.80 197039 5.690481e+12     NA

6 2000-01-10   HDFC     EQ     286.55 292.0 296.00 285.0 288.4 287.20
289.42 133363 3.859779e+12     NA

  Deliverable.Volume X.Deliverble
1                 NA           NA
2                 NA           NA
3                 NA           NA
4                 NA           NA
5                 NA           NA
```

6 NA NA

summary(st)

Date Symbol Series Prev.Close Open High Low

2000-01-03: 1 HDFC:5306 EQ:5306 Min. : 271.8 Min. : 284.0 Min. : 290.5 Min. : 273.2

2000-01-04: 1 1st Qu.: 668.6 1st Qu.: 669.7 1st Qu.: 677.5 1st Qu.: 660.0

2000-01-05: 1 Median :1136.3 Median :1135.4 Median :1156.7 Median :1119.0

2000-01-06: 1 Mean :1283.7 Mean :1284.4 Mean :1304.3 Mean :1263.3

2000-01-07: 1 3rd Qu.:1811.5 3rd Qu.:1813.8 3rd Qu.:1835.0 3rd Qu.:1783.1

2000-01-10: 1 Max. :3180.2 Max. :3148.0 Max. :3262.0 Max. :3100.6

(Other) :5300

Last Close VWAP Volume Turnover Trades

Min. : 282.9 Min. : 283.9 Min. : 283.6 Min. : 2919 Min. :1.835e+11 Min. : 973

1st Qu.: 669.0 1st Qu.: 668.7 1st Qu.: 668.3 1st Qu.: 303497 1st Qu.:2.461e+13 1st Qu.: 62012

Median :1135.0 Median :1136.7 Median :1136.7 Median : 1337788 Median :1.684e+14 Median : 90405

Mean :1283.9 Mean :1284.1 Mean :1283.7 Mean : 1848187 Mean :2.621e+14 Mean :102159

3rd Qu.:1812.0 3rd Qu.:1811.8 3rd Qu.:1811.7 3rd Qu.: 2732310 3rd Qu.:3.419e+14 3rd Qu.:129755

Max. :3178.0 Max. :3180.2 Max. :3166.6 Max. :158414118 Max. :1.044e+16 Max. :538170

NA's :2850

Deliverable.Volume X.Deliverble

Min. : 1786 Min. :0.1190

1st Qu.: 268807 1st Qu.:0.5752

Median : 1021574 Median :0.6669

Mean : 1329440 Mean :0.6531

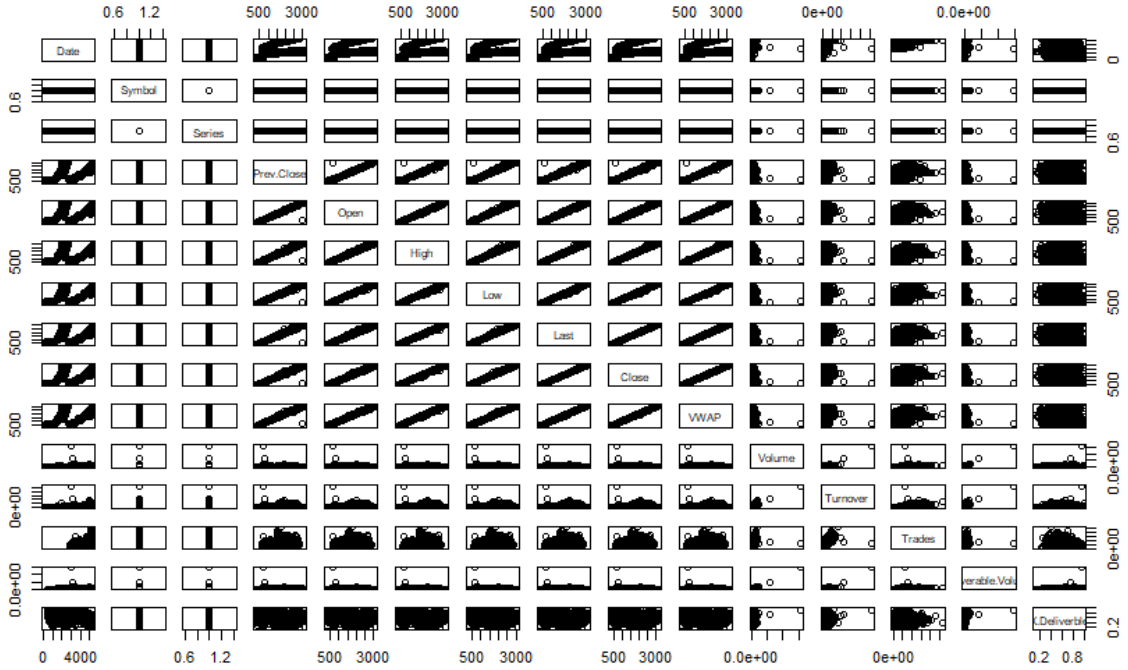
3rd Qu.: 1939101 3rd Qu.:0.7420

Max. :148313109 Max. :0.9894

NA's :509 NA's :509

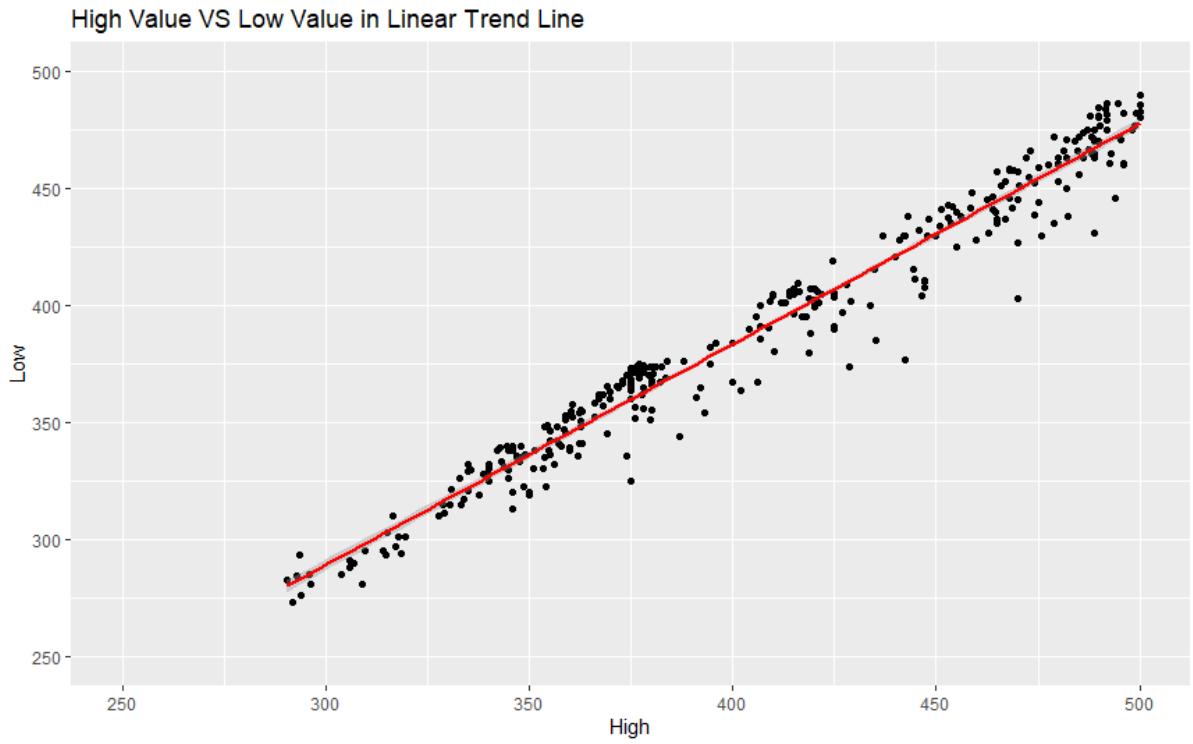
#pairplot

plot(st)

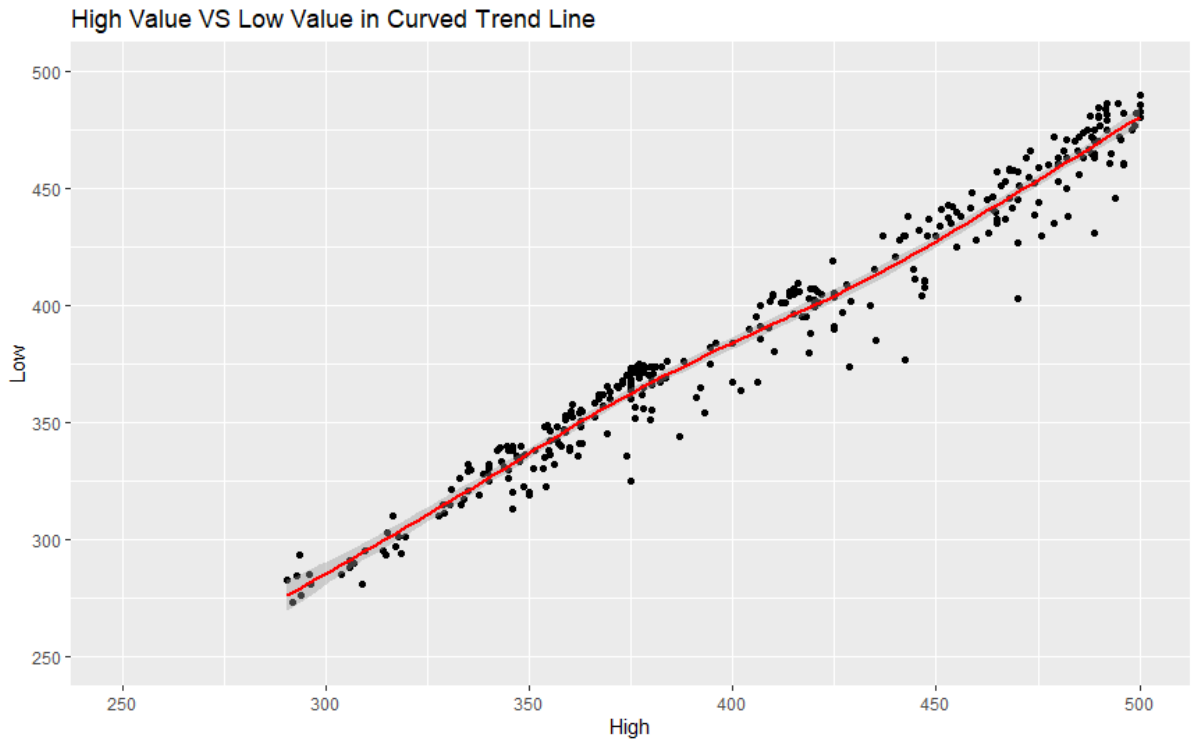


#relations of variables

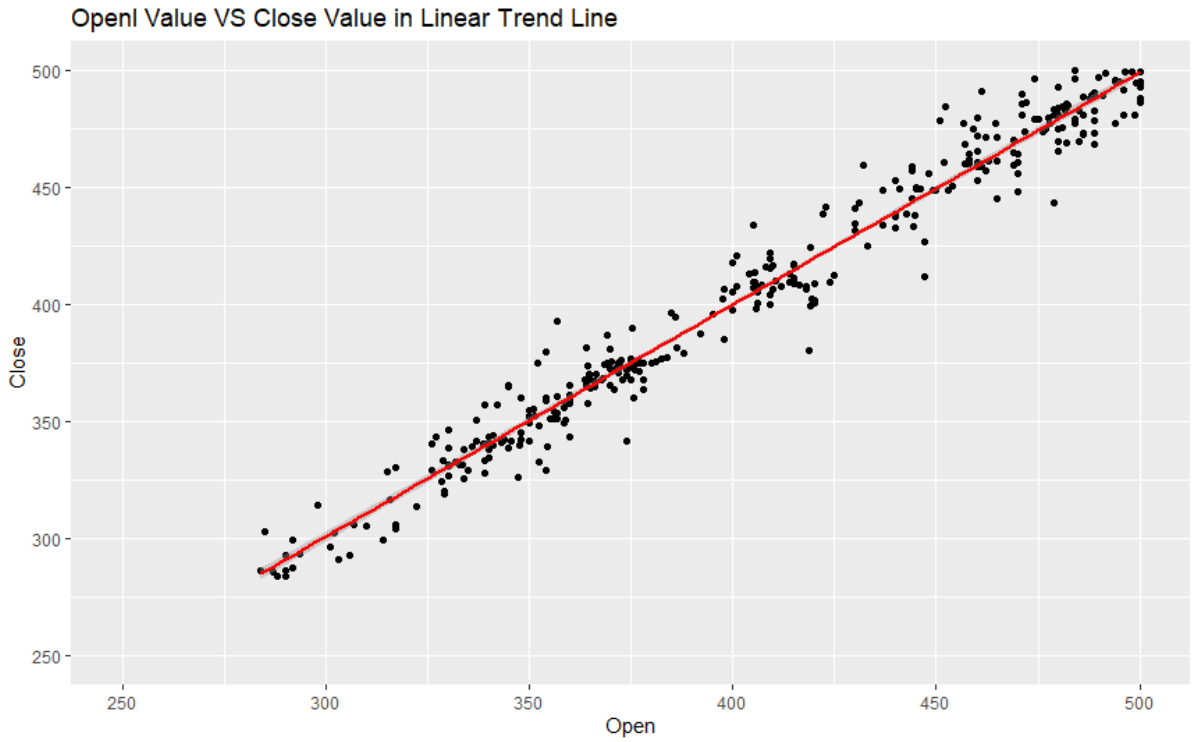
ggplot(st, aes(x=High, y=Low)) + geom_point() + geom_smooth(color="red",method = lm) +xlim(250,500)+ylim(250,500)+ ggtitle("High Value VS Low Value in Linear Trend Line")



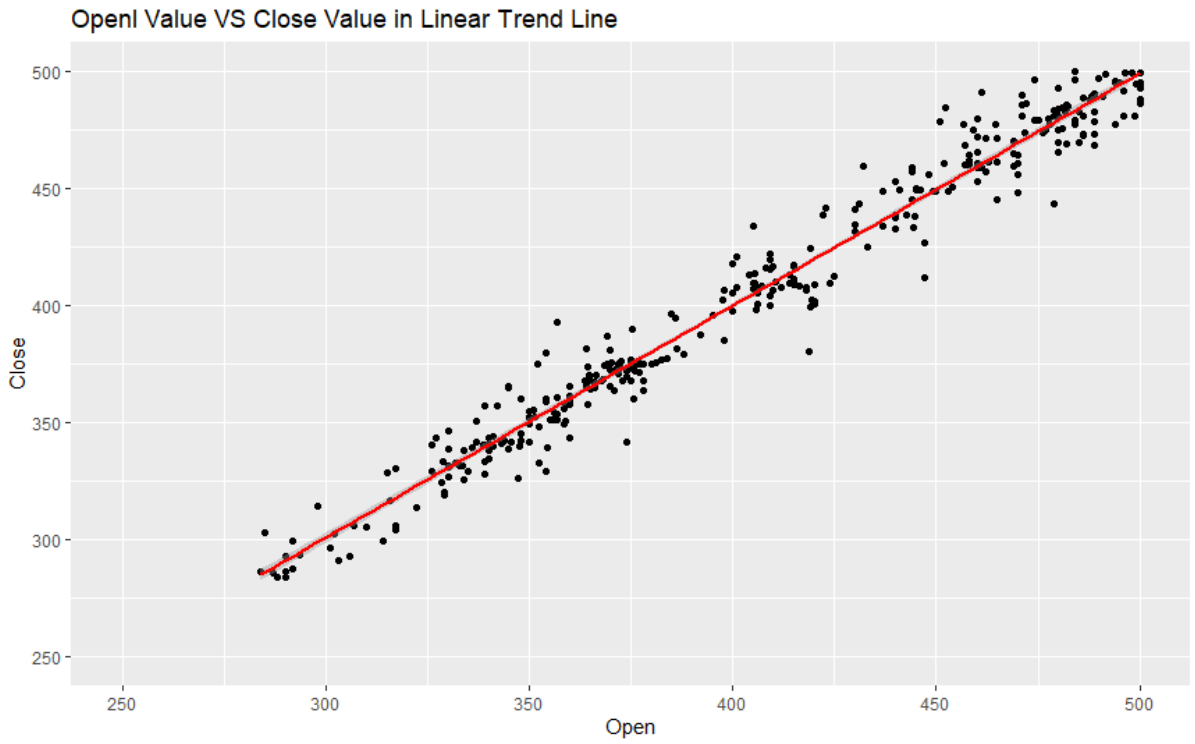

```
ggplot(st, aes(x=High, y=Low)) + geom_point() +
geom_smooth(color="red") +xlim(250,500)+ylim(250,500)+
ggtitle("High Value VS Low Value in Curved Trend Line")
```



```
ggplot(st, aes(x=Open, y=Close)) + geom_point() +
geom_smooth(color="red",method = lm)
+xlim(250,500)+ylim(250,500)+ ggtitle("Openl Value VS Close Value
in Linear Trend Line")
```




```
ggplot(st, aes(x=Close, y=Prev.Close)) + geom_point() +
geom_smooth(color="red",method = lm)
+xlim(250,500)+ylim(250,500)+ ggtitle("Open VS Prev.Close Value in
Linear Trend Line")
```




```
#set seeds
set.seed(2)

#spliting Data
split = sample.split(dataset$Salary, SplitRatio = 0.7)
split
function (x, f, drop = FALSE, ...)
UseMethod("split")
<bytecode: 0x000002d0f5c2af50>
<environment: namespace:base>
train = subset(st, split = TRUE)
test = subset(st, split = FALSE)
#training Data
Train
```

Date Symbol Series Prev.Close Open High Low Last Close VWAP Volume Turnover Trades

1 2000-01-03 HDFC EQ 271.75 293.50 293.50 293.50 293.50 293.50 293.50 22744 6.675364e+11 NA

2 2000-01-04 HDFC EQ 293.50 317.00 317.00 297.00 304.00 304.05 303.62 255251 7.749972e+12 NA

3 2000-01-05 HDFC EQ 304.05 290.00 303.90 285.00 295.00 292.80 294.53 269087 7.925368e+12 NA

4 2000-01-06 HDFC EQ 292.80 301.00 314.00 295.00 296.00 296.45 300.14 305916 9.181669e+12 NA

5 2000-01-07 HDFC EQ 296.45 290.00 296.35 281.00 287.10 286.55 288.80 197039 5.690481e+12 NA

6 2000-01-10 HDFC EQ 286.55 292.00 296.00 285.00 288.40 287.20 289.42 133363 3.859779e+12 NA

7 2000-01-11 HDFC EQ 287.20 290.00 292.00 273.25 282.85 283.85 284.54 337411 9.600617e+12 NA

8 2000-01-12 HDFC EQ 283.85 287.00 293.00 284.50 285.25 285.60 287.60 222537 6.400217e+12 NA

9 2000-01-13 HDFC EQ 285.60 288.00 290.50 283.00 284.00 283.85 285.84 113238 3.236741e+12 NA

10 2000-01-14 HDFC EQ 283.85 284.00 294.00 276.25 291.00 286.55 283.60 152322 4.319905e+12 NA

11 2000-01-17 HDFC EQ 286.55 302.00 309.50 295.00 303.50 302.20 302.87 500852 1.516925e+13 NA

12 2000-01-18 HDFC EQ 302.20 307.00 317.85 301.05 305.25 305.75 308.57 369304 1.139579e+13 NA

13 2000-01-19 HDFC EQ 305.75 310.00 315.00 303.05 304.50 305.25 308.98 377937 1.167765e+13 NA

14 2000-01-20 HDFC EQ 305.25 303.00 306.00 288.00 291.90 291.35 297.57 208122 6.193173e+12 NA

15 2000-01-21 HDFC EQ 291.35 292.00 307.00 290.00 299.50 299.55 300.93 591458 1.779895e+13 NA

16 2000-01-24 HDFC EQ 299.55 306.00 306.00 291.00 294.00 293.05 295.58 207336 6.128412e+12 NA

17 2000-01-25 HDFC EQ 293.05 285.00 308.95 281.00 305.50 303.15 299.56 512403 1.534937e+13 NA

18 2000-01-27 HDFC EQ 303.15 315.90 316.60 309.90 316.60 316.60 316.02 838826 2.650871e+13 NA

19 2000-01-28 HDFC EQ 316.60 328.50 328.90 315.00 326.00 324.40 323.32 1224604 3.959415e+13 NA

20 2000-01-31 HDFC EQ 324.40 328.70 349.95 320.05 332.50 333.50 336.09 1449638 4.872052e+13 NA

21 2000-02-01 HDFC EQ 333.50 337.00 353.90 335.00 351.25 350.55 345.34 1220141 4.213630e+13 NA

22 2000-02-02 HDFC EQ 350.55 355.00 357.00 342.00 349.00 351.40 349.83 1124774 3.934776e+13 NA

23 2000-02-03 HDFC EQ 351.40 345.55 351.50 338.15 342.00 341.90 344.17 338774 1.165951e+13 NA

24 2000-02-04 HDFC EQ 341.90 342.00 362.40 341.00 350.00 357.20 352.79 1393426 4.915800e+13 NA

25 2000-02-07 HDFC EQ 357.20 351.00 362.50 348.15 355.00 355.45 357.09 834598 2.980305e+13 NA

26 2000-02-08 HDFC EQ 355.45 359.00 359.00 345.60 351.00 350.50 351.72 527223 1.854333e+13 NA

27 2000-02-09 HDFC EQ 350.50 354.00 354.00 322.50 325.00 329.15 331.01 918950 3.041808e+13 NA

28 2000-02-10 HDFC EQ 329.15 329.00 329.00 311.60 321.00 320.35 320.55 406175 1.302008e+13 NA

29 2000-02-11 HDFC EQ 320.35 327.00 346.00 313.00 346.00 343.65 338.31 1361815 4.607194e+13 NA

30 2000-02-14 HDFC EQ 343.65 354.00 369.00 345.00 354.00 359.15 359.35 1457178 5.236361e+13 NA

31 2000-02-15 HDFC EQ 359.15 352.35 353.50 330.45 332.00 332.60 339.35 629569 2.136462e+13 NA

32 2000-02-16 HDFC EQ 332.60 350.00 354.80 338.10 342.20 341.60 343.80 252848 8.692924e+12 NA

33 2000-02-17 HDFC EQ 341.60 336.00 347.00 336.00 339.00 339.20 341.46 120854 4.126676e+12 NA

34 2000-02-18 HDFC EQ 339.20 339.00 340.00 325.00 326.50 327.90 330.18 161499 5.332294e+12 NA

35 2000-02-21 HDFC EQ 327.90 329.00 334.00 317.05 318.00 319.15 326.90 206189 6.740249e+12 NA

36 2000-02-22 HDFC EQ 319.15 317.00 319.40 301.20 305.00 305.95 311.71 285365 8.895014e+12 NA

37 2000-02-23 HDFC EQ 305.95 317.00 330.45 315.00 330.45 330.45 329.96 177171 5.845898e+12 NA

38 2000-02-24 HDFC EQ 330.45 349.85 356.00 332.00 354.00 351.70 347.16 385844 1.339479e+13 NA

39 2000-02-25 HDFC EQ 351.70 354.00 379.85 351.10 379.85 379.85 373.96 230532 8.620973e+12 NA

40 2000-02-28 HDFC EQ 379.85 405.50 410.25 380.50 410.25 409.70 400.35 643659 2.576883e+13 NA

41 2000-02-29 HDFC EQ 409.70 420.00 442.50 376.95 395.00 401.70 419.90 1014948 4.261754e+13 NA

42 2000-03-01 HDFC EQ 401.70 405.00 433.85 400.00 433.85 433.85 421.87 494473 2.086031e+13 NA

43 2000-03-02 HDFC EQ 433.85 456.90 468.60 442.00 468.60 468.60 465.74 542377 2.526070e+13 NA

44 2000-03-03 HDFC EQ 468.60 489.00 489.00 431.15 471.00 473.05 456.43 878831 4.011234e+13 NA

45 2000-03-06 HDFC EQ 473.05 479.00 479.00 435.25 438.50 443.50 452.36 670934 3.035044e+13 NA

46 2000-03-07 HDFC EQ 443.50 447.00 447.00 408.05 413.10 412.20 419.21 377112 1.580887e+13 NA

47 2000-03-08 HDFC EQ 412.20 415.00 425.00 391.05 415.00 416.70 414.88 370922 1.538894e+13 NA

48 2000-03-09 HDFC EQ 416.70 419.00 419.00 388.10 397.00 399.60 400.73 167704 6.720404e+12 NA

49 2000-03-10 HDFC EQ 399.60 400.00 408.90 390.30 395.00 397.55 399.83 181580 7.260169e+12 NA

50 2000-03-13 HDFC EQ 397.55 386.10 406.00 367.00 382.55 381.60 390.90 225462 8.813287e+12 NA

51 2000-03-14 HDFC EQ 381.60 385.00 400.00 367.00 397.00 396.65 389.14 207168 8.061767e+12 NA

52 2000-03-15 HDFC EQ 396.65 406.00 406.80 386.00 400.00 400.50 394.07 118712 4.678057e+12 NA

53 2000-03-16 HDFC EQ 400.50 405.85 405.85 395.10 399.00 398.20 398.10 90678 3.609856e+12 NA

54 2000-03-21 HDFC EQ 398.20 398.00 427.00 397.00 411.50 406.35 411.51 178957 7.364186e+12 NA

55 2000-03-22 HDFC EQ 406.35 414.00 428.80 374.00 415.50 413.25 412.46 192789 7.951852e+12 NA

56 2000-03-23 HDFC EQ 413.25 424.00 446.35 404.00 411.40 409.85 428.59 211811 9.078066e+12 NA

57 2000-03-24 HDFC EQ 409.85 409.95 420.00 402.60 416.00 416.80 413.23 71629 2.959896e+12 NA

58 2000-03-27 HDFC EQ 416.80 415.00 444.70 411.50 414.00 417.40 424.21 238780 1.012923e+13 NA

59 2000-03-28 HDFC EQ 417.40 424.85 424.85 405.15 413.90 412.70 412.29 130006 5.360057e+12 NA

60 2000-03-29 HDFC EQ 412.70 418.60 418.60 379.70 379.70 380.30 395.44 148043 5.854182e+12 NA

61 2000-03-30 HDFC EQ 380.30 378.00 378.00 356.10 362.00 363.85 363.38 93015 3.380024e+12 NA

62 2000-03-31 HDFC EQ 363.85 357.00 393.00 354.00 393.00 393.00 385.97 370725 1.430872e+13 NA

63 2000-04-03 HDFC EQ 393.00 419.00 424.45 419.00 424.45 424.45 424.34 31159 1.322195e+12 NA

64 2000-04-04 HDFC EQ 424.45 444.00 458.45 442.00 458.45 458.45 457.99 805679 3.689937e+13 NA

65 2000-04-05 HDFC EQ 458.45 480.00 482.40 438.00 467.95 469.80 459.85 514772 2.367193e+13 NA

66 2000-04-06 HDFC EQ 469.80 460.00 465.00 436.75 463.90 459.25 447.89 468924 2.100255e+13 NA

	Deliverable.Volume	X.Deliverble
1	NA	NA
2	NA	NA
3	NA	NA
4	NA	NA

5	NA	NA
6	NA	NA
7	NA	NA
8	NA	NA
9	NA	NA
10	NA	NA
11	NA	NA
12	NA	NA
13	NA	NA
14	NA	NA
15	NA	NA
16	NA	NA
17	NA	NA
18	NA	NA
19	NA	NA
20	NA	NA
21	NA	NA
22	NA	NA
23	NA	NA
24	NA	NA
25	NA	NA
26	NA	NA
27	NA	NA
28	NA	NA

29	NA	NA
30	NA	NA
31	NA	NA
32	NA	NA
33	NA	NA
34	NA	NA
35	NA	NA
36	NA	NA
37	NA	NA
38	NA	NA
39	NA	NA
40	NA	NA
41	NA	NA
42	NA	NA
43	NA	NA
44	NA	NA
45	NA	NA
46	NA	NA
47	NA	NA
48	NA	NA
49	NA	NA
50	NA	NA
51	NA	NA
52	NA	NA

53 NA NA

54 NA NA

55 NA NA

56 NA NA

57 NA NA

58 NA NA

59 NA NA

60 NA NA

61 NA NA

62 NA NA

63 NA NA

64 NA NA

65 NA NA

66 NA NA

[reached 'max' / getOption("max.print") -- omitted 5240 rows]

#Testing Data

test

Date Symbol Series Prev.Close Open High Low Last Close VWAP Volume Turnover Trades

1 2000-01-03 HDFC EQ 271.75 293.50 293.50 293.50 293.50 293.50 293.50 22744 6.675364e+11 NA

2 2000-01-04 HDFC EQ 293.50 317.00 317.00 297.00 304.00 304.05 303.62 255251 7.749972e+12 NA

3 2000-01-05 HDFC EQ 304.05 290.00 303.90 285.00 295.00 292.80 294.53 269087 7.925368e+12 NA

4 2000-01-06 HDFC EQ 292.80 301.00 314.00 295.00 296.00 296.45 300.14 305916 9.181669e+12 NA

5 2000-01-07 HDFC EQ 296.45 290.00 296.35 281.00 287.10 286.55 288.80 197039 5.690481e+12 NA

6 2000-01-10 HDFC EQ 286.55 292.00 296.00 285.00 288.40 287.20 289.42 133363 3.859779e+12 NA

7 2000-01-11 HDFC EQ 287.20 290.00 292.00 273.25 282.85 283.85 284.54 337411 9.600617e+12 NA

8 2000-01-12 HDFC EQ 283.85 287.00 293.00 284.50 285.25 285.60 287.60 222537 6.400217e+12 NA

9 2000-01-13 HDFC EQ 285.60 288.00 290.50 283.00 284.00 283.85 285.84 113238 3.236741e+12 NA

10 2000-01-14 HDFC EQ 283.85 284.00 294.00 276.25 291.00 286.55 283.60 152322 4.319905e+12 NA

11 2000-01-17 HDFC EQ 286.55 302.00 309.50 295.00 303.50 302.20 302.87 500852 1.516925e+13 NA

12 2000-01-18 HDFC EQ 302.20 307.00 317.85 301.05 305.25 305.75 308.57 369304 1.139579e+13 NA

13 2000-01-19 HDFC EQ 305.75 310.00 315.00 303.05 304.50 305.25 308.98 377937 1.167765e+13 NA

14 2000-01-20 HDFC EQ 305.25 303.00 306.00 288.00 291.90 291.35 297.57 208122 6.193173e+12 NA

15 2000-01-21 HDFC EQ 291.35 292.00 307.00 290.00 299.50 299.55 300.93 591458 1.779895e+13 NA

16 2000-01-24 HDFC EQ 299.55 306.00 306.00 291.00 294.00 293.05 295.58 207336 6.128412e+12 NA

17 2000-01-25 HDFC EQ 293.05 285.00 308.95 281.00 305.50 303.15 299.56 512403 1.534937e+13 NA

18 2000-01-27 HDFC EQ 303.15 315.90 316.60 309.90 316.60 316.60 316.02 838826 2.650871e+13 NA

19 2000-01-28 HDFC EQ 316.60 328.50 328.90 315.00 326.00 324.40 323.32 1224604 3.959415e+13 NA

20 2000-01-31 HDFC EQ 324.40 328.70 349.95 320.05 332.50 333.50 336.09 1449638 4.872052e+13 NA

21 2000-02-01 HDFC EQ 333.50 337.00 353.90 335.00 351.25 350.55 345.34 1220141 4.213630e+13 NA

22 2000-02-02 HDFC EQ 350.55 355.00 357.00 342.00 349.00 351.40 349.83 1124774 3.934776e+13 NA

23 2000-02-03 HDFC EQ 351.40 345.55 351.50 338.15 342.00 341.90 344.17 338774 1.165951e+13 NA

24 2000-02-04 HDFC EQ 341.90 342.00 362.40 341.00 350.00 357.20 352.79 1393426 4.915800e+13 NA

25 2000-02-07 HDFC EQ 357.20 351.00 362.50 348.15 355.00 355.45 357.09 834598 2.980305e+13 NA

26 2000-02-08 HDFC EQ 355.45 359.00 359.00 345.60 351.00 350.50 351.72 527223 1.854333e+13 NA

27 2000-02-09 HDFC EQ 350.50 354.00 354.00 322.50 325.00 329.15 331.01 918950 3.041808e+13 NA

28 2000-02-10 HDFC EQ 329.15 329.00 329.00 311.60 321.00 320.35 320.55 406175 1.302008e+13 NA

29 2000-02-11 HDFC EQ 320.35 327.00 346.00 313.00 346.00 343.65 338.31 1361815 4.607194e+13 NA

30 2000-02-14 HDFC EQ 343.65 354.00 369.00 345.00 354.00 359.15 359.35 1457178 5.236361e+13 NA

31 2000-02-15 HDFC EQ 359.15 352.35 353.50 330.45 332.00 332.60 339.35 629569 2.136462e+13 NA

32 2000-02-16 HDFC EQ 332.60 350.00 354.80 338.10 342.20 341.60 343.80 252848 8.692924e+12 NA

33 2000-02-17 HDFC EQ 341.60 336.00 347.00 336.00 339.00 339.20 341.46 120854 4.126676e+12 NA

34 2000-02-18 HDFC EQ 339.20 339.00 340.00 325.00 326.50 327.90 330.18 161499 5.332294e+12 NA

35 2000-02-21 HDFC EQ 327.90 329.00 334.00 317.05 318.00 319.15 326.90 206189 6.740249e+12 NA

36 2000-02-22 HDFC EQ 319.15 317.00 319.40 301.20 305.00 305.95 311.71 285365 8.895014e+12 NA

37 2000-02-23 HDFC EQ 305.95 317.00 330.45 315.00 330.45 330.45 329.96 177171 5.845898e+12 NA

38 2000-02-24 HDFC EQ 330.45 349.85 356.00 332.00 354.00 351.70 347.16 385844 1.339479e+13 NA

39 2000-02-25 HDFC EQ 351.70 354.00 379.85 351.10 379.85 379.85 373.96 230532 8.620973e+12 NA

40 2000-02-28 HDFC EQ 379.85 405.50 410.25 380.50 410.25 409.70 400.35 643659 2.576883e+13 NA

41 2000-02-29 HDFC EQ 409.70 420.00 442.50 376.95 395.00 401.70 419.90 1014948 4.261754e+13 NA

42 2000-03-01 HDFC EQ 401.70 405.00 433.85 400.00 433.85 433.85 421.87 494473 2.086031e+13 NA

43 2000-03-02 HDFC EQ 433.85 456.90 468.60 442.00 468.60 468.60 465.74 542377 2.526070e+13 NA

44 2000-03-03 HDFC EQ 468.60 489.00 489.00 431.15 471.00 473.05 456.43 878831 4.011234e+13 NA

45 2000-03-06 HDFC EQ 473.05 479.00 479.00 435.25 438.50 443.50 452.36 670934 3.035044e+13 NA

46 2000-03-07 HDFC EQ 443.50 447.00 447.00 408.05 413.10 412.20 419.21 377112 1.580887e+13 NA

47 2000-03-08 HDFC EQ 412.20 415.00 425.00 391.05 415.00 416.70 414.88 370922 1.538894e+13 NA

48 2000-03-09 HDFC EQ 416.70 419.00 419.00 388.10 397.00 399.60 400.73 167704 6.720404e+12 NA

49 2000-03-10 HDFC EQ 399.60 400.00 408.90 390.30 395.00 397.55 399.83 181580 7.260169e+12 NA

50 2000-03-13 HDFC EQ 397.55 386.10 406.00 367.00 382.55 381.60 390.90 225462 8.813287e+12 NA

51 2000-03-14 HDFC EQ 381.60 385.00 400.00 367.00 397.00 396.65 389.14 207168 8.061767e+12 NA

52 2000-03-15 HDFC EQ 396.65 406.00 406.80 386.00 400.00 400.50 394.07 118712 4.678057e+12 NA

53 2000-03-16 HDFC EQ 400.50 405.85 405.85 395.10 399.00 398.20 398.10 90678 3.609856e+12 NA

54 2000-03-21 HDFC EQ 398.20 398.00 427.00 397.00 411.50 406.35 411.51 178957 7.364186e+12 NA

55 2000-03-22 HDFC EQ 406.35 414.00 428.80 374.00 415.50 413.25 412.46 192789 7.951852e+12 NA

56 2000-03-23 HDFC EQ 413.25 424.00 446.35 404.00 411.40 409.85 428.59 211811 9.078066e+12 NA

57 2000-03-24 HDFC EQ 409.85 409.95 420.00 402.60 416.00 416.80 413.23 71629 2.959896e+12 NA

58 2000-03-27 HDFC EQ 416.80 415.00 444.70 411.50 414.00 417.40 424.21 238780 1.012923e+13 NA

59 2000-03-28 HDFC EQ 417.40 424.85 424.85 405.15 413.90 412.70 412.29 130006 5.360057e+12 NA

60 2000-03-29 HDFC EQ 412.70 418.60 418.60 379.70 379.70 380.30 395.44 148043 5.854182e+12 NA

61 2000-03-30 HDFC EQ 380.30 378.00 378.00 356.10 362.00 363.85 363.38 93015 3.380024e+12 NA

62 2000-03-31 HDFC EQ 363.85 357.00 393.00 354.00 393.00 393.00 385.97 370725 1.430872e+13 NA

63 2000-04-03 HDFC EQ 393.00 419.00 424.45 419.00 424.45 424.45 424.34 31159 1.322195e+12 NA

64 2000-04-04 HDFC EQ 424.45 444.00 458.45 442.00 458.45 458.45 457.99 805679 3.689937e+13 NA

65 2000-04-05 HDFC EQ 458.45 480.00 482.40 438.00 467.95 469.80 459.85 514772 2.367193e+13 NA

66 2000-04-06 HDFC EQ 469.80 460.00 465.00 436.75 463.90 459.25 447.89 468924 2.100255e+13 NA

	Deliverable.Volume	X.Deliverble
1	NA	NA
2	NA	NA
3	NA	NA
4	NA	NA
5	NA	NA
6	NA	NA
7	NA	NA
8	NA	NA
9	NA	NA

10	NA	NA
11	NA	NA
12	NA	NA
13	NA	NA
14	NA	NA
15	NA	NA
16	NA	NA
17	NA	NA
18	NA	NA
19	NA	NA
20	NA	NA
21	NA	NA
22	NA	NA
23	NA	NA
24	NA	NA
25	NA	NA
26	NA	NA
27	NA	NA
28	NA	NA
29	NA	NA
30	NA	NA
31	NA	NA
32	NA	NA
33	NA	NA

34	NA	NA
35	NA	NA
36	NA	NA
37	NA	NA
38	NA	NA
39	NA	NA
40	NA	NA
41	NA	NA
42	NA	NA
43	NA	NA
44	NA	NA
45	NA	NA
46	NA	NA
47	NA	NA
48	NA	NA
49	NA	NA
50	NA	NA
51	NA	NA
52	NA	NA
53	NA	NA
54	NA	NA
55	NA	NA
56	NA	NA
57	NA	NA

58 NA NA

59 NA NA

60 NA NA

61 NA NA

62 NA NA

63 NA NA

64 NA NA

65 NA NA

66 NA NA

#creating the model

Model <-
lm(High~Open+Low+Close+Prev.Close+Volume+Last+VWAP,data=tra
in)

summary(Model)

Call:

lm(formula = High ~ Open + Low + Close + Prev.Close + Volume +

Last + VWAP, data = train)

Residuals:

Min 1Q Median 3Q Max

-297.814 -4.206 -0.973 2.495 257.266

Coefficients:

Estimate Std. Error t value Pr(>|t|)

```
(Intercept) -3.811e-01  3.715e-01  -1.026  0.30504
Open         4.215e-01  9.684e-03  43.529  < 2e-16 ***
Low         -7.094e-01  9.803e-03 -72.365  < 2e-16 ***
Close        2.822e-01  3.158e-02   8.937  < 2e-16 ***
Prev.Close   1.491e-02  4.796e-03   3.110  0.00188 **
Volume       3.401e-09  5.930e-08   0.057  0.95427
Last        -6.087e-02  2.791e-02  -2.181  0.02923 *
VWAP         1.056e+00  2.125e-02  49.703  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 12.82 on 5298 degrees of freedom
Multiple R-squared:  0.9997,        Adjusted R-squared:  0.9997
F-statistic: 2.397e+06 on 7 and 5298 DF,  p-value: < 2.2e-16
```

```
#predicting Values
pred <- predict(Model,test)
pred
```

```
     1       2       3       4       5       6       7       8       9      10      11
12      13
294.1947 314.9719 300.0310 304.3017 295.4190 294.0359 295.7760
290.0605 289.2948 290.3409 308.6808 313.6462 313.8827
    14      15      16      17      18      19      20      21      22      23
24      25      26
```

306.3913 305.5306 303.6925 308.1931 321.3767 332.6127 344.8939 351.3641 359.3599 349.8834 359.1640 361.8560 360.1840

27 28 29 30 31 32 33 34 35 36 37 38 39

348.0709 331.6550 353.5059 368.6478 351.2212 351.0264 343.7939 338.4823 334.3213 321.3964 336.0534 360.9406 384.1384

40 41 42 43 44 45 46 47 48 49 50 51 52

419.8640 448.2635 434.2573 480.8548 493.8778 476.1585 439.2173 433.9013 419.0687 407.8362 405.2985 406.1056 407.8153

53 54 55 56 57 58 59 60 61 62 63 64 65

405.0226 416.0368 441.9268 441.2921 421.7672 429.5764 424.3297 414.8173 376.5290 399.1252 427.0774 464.8440 487.9531

66 67 68 69 70 71 72 73 74 75 76 77 78

465.2130 498.0302 500.8708 474.3882 463.7976 467.4657 447.9542 452.7128 465.2364 484.9462 470.7470 463.5451 473.7982

79 80 81 82 83 84 85 86 87 88 89 90 91

468.8915 475.6586 488.6725 466.1111 470.8474 456.4068 444.9254 436.8493 449.0170 456.2484 471.2998 464.7386 475.1973

92 93 94 95 96 97 98 99 100 101 102 103 104

467.7866 468.4109 482.2010 492.3541 505.6480 499.6497 493.4756 489.4209 545.2061 573.2468 525.7842 511.7203 528.1319

105 106 107 108 109 110 111 112 113 114 115 116 117

561.7262 550.6979 527.5209 532.3829 526.3086 519.3661 504.2678 499.6309 487.0121 508.0006 507.4210 513.8505 528.3934

118 119 120 121 122 123 124 125 126 127 128 129 130

538.7799 540.6393 552.6135 566.9697 577.2825 558.7667 558.2049 559.5988 543.5851 498.5178 517.4487 514.2137 507.2562

131 132 133 134 135 136 137 138 139 140 141 142 143

490.1240 497.7861 501.0299 493.2074 485.3176 486.3628 486.9330 517.4046 521.1716 506.8527 508.6525 506.2333 504.7419

144 145 146 147 148 149 150 151 152 153 154 155 156

504.8573 509.5958 509.7621 500.4059 493.2957 507.4632 506.2780 506.9469 505.7522 501.0147 509.8738 505.2529 535.4856

157 158 159 160 161 162 163 164 165 166 167 168 169

522.7279 510.8293 502.0001 487.5213 494.9244 500.4541 501.8487 504.7708 508.1995 523.9002 529.7782 533.3262 549.8339

170 171 172 173 174 175 176 177 178 179 180 181 182

547.2515 541.8723 543.5263 539.4125 527.7799 519.7553 516.9629 515.0428 504.8083 505.3837 511.9367 505.3589 506.8079

183 184 185 186 187 188 189 190 191 192 193 194 195

481.5394 465.2579 449.1288 451.3454 448.2711 443.1508 446.7743 443.5041 450.5573 453.3506 456.9515 456.4156 453.1539

196 197 198 199 200 201 202 203 204 205 206 207 208

453.7081 463.9590 462.2715 466.4364 478.6916 483.3269 470.4793
468.4516 463.4525 469.3857 467.5158 474.6073 473.4658

209 210 211 212 213 214 215 216 217
218 219 220 221

488.7502 495.3898 494.9019 488.5947 489.7397 494.0998 491.8402
502.5768 516.1604 518.4729 513.5254 502.4051 494.3981

222 223 224 225 226 227 228 229 230
231 232 233 234

487.3236 483.4258 479.5325 485.8022 515.4936 536.0238 533.5316
528.0082 535.9576 528.9845 526.0216 525.9571 536.5577

235 236 237 238 239 240 241 242 243
244 245 246 247

542.9073 550.0974 562.5866 564.4459 564.1577 559.6446 568.4413
560.5753 560.3993 559.5722 555.0179 555.0008 554.6228

248 249 250 251 252 253 254 255 256
257 258 259 260

540.9471 543.3403 547.6020 542.7985 544.9005 555.2585 566.3966
590.5496 597.8699 600.7474 598.8008 564.0280 561.2449

261 262 263 264 265 266 267 268 269
270 271 272 273

553.0676 543.0640 544.6292 536.5734 538.7743 522.5097 509.4125
523.9622 544.2962 593.5360 588.0639 565.6106 560.4413

274 275 276 277 278 279 280 281 282
283 284 285 286

579.9750 582.6039 562.6092 568.6957 581.6666 600.5468 598.6378
583.2479 575.9123 584.0658 583.1717 582.3248 579.1304

287 288 289 290 291 292 293 294 295
296 297 298 299

573.3743 578.2031 573.3790 579.4989 591.9129 614.4044 614.2678 605.8712 562.8626 551.9504 549.8460 546.7498 549.5852

300 301 302 303 304 305 306 307 308 309 310 311 312

550.7307 592.5172 590.4138 581.3768 576.8515 570.2706 579.9756 589.5835 590.0833 587.7620 589.6250 588.6283 575.0535

313 314 315 316 317 318 319 320 321 322 323 324 325

565.4779 566.2379 585.0421 574.7373 572.3818 561.8806 556.9067 561.3121 557.9891 591.1769 599.9961 586.6398 590.2102

326 327 328 329 330 331 332 333 334 335 336 337 338

595.7300 587.1950 589.0581 599.7848 599.1066 591.2579 586.1938 606.8388 597.2495 610.0151 618.3433 623.7124 613.5877

339 340 341 342 343 344 345 346 347 348 349 350 351

595.1776 596.5012 594.0914 609.6147 615.8509 678.3331 699.2294 663.6512 656.5081 654.7165 664.9027 667.7434 671.2580

352 353 354 355 356 357 358 359 360 361 362 363 364

684.4270 674.5392 673.3755 674.5114 675.2311 670.6863 665.8168 657.6401 664.0204 678.8610 676.6488 662.1536 657.4630

365 366 367 368 369 370 371 372 373 374 375 376 377

655.1161 663.2012 687.1299 695.3327 673.8113 670.0847 680.4266 698.9924 703.6236 687.7184 697.4674 683.2676 669.0974

378 379 380 381 382 383 384 385 386 387 388 389 390

687.6584 671.2490 666.2128 667.8556 657.9326 664.8934 656.8199
670.6614 673.1706 664.9328 665.1719 660.9178 660.6880

391 392 393 394 395 396 397 398 399
400 401 402 403

639.0716 639.5584 649.8547 661.3045 666.2073 662.5860 675.6002
687.7039 682.5695 682.6258 676.0708 667.2910 666.7878

404 405 406 407 408 409 410 411 412
413 414 415 416

674.1437 686.2103 676.2593 669.3696 671.3408 686.8857 693.4754
704.3959 718.8862 711.6145 693.9150 680.7770 687.9668

417 418 419 420 421 422 423 424 425
426 427 428 429

702.2050 710.3403 704.7604 696.6324 704.7342 710.9920 716.0213
727.3678 737.7081 696.3202 691.2355 681.6994 634.9015

430 431 432 433 434 435 436 437 438
439 440 441 442

629.0369 665.7795 666.3372 661.6729 640.4682 692.6286 666.4270
646.0609 643.9063 660.8061 654.6548 704.1419 691.1927

443 444 445 446 447 448 449 450 451
452 453 454 455

683.2085 687.7704 676.9290 681.7463 675.7272 666.2867 672.1555
687.8527 668.6538 653.3721 653.3291 658.9228 694.3347

456 457 458 459 460 461 462 463 464
465 466 467 468

680.6677 685.3171 698.8153 705.3135 705.5225 709.3051 712.6573
704.0013 712.0254 708.2112 703.3883 693.8493 698.0003

469 470 471 472 473 474 475 476 477
478 479 480 481

698.3057 695.1036 697.6512 701.4198 717.4453 707.8970 711.5339 705.0324 704.1569 706.7107 700.3462 697.3751 699.5020

482 483 484 485 486 487 488 489 490 491 492 493 494

695.0982 704.2296 703.6458 697.9942 695.8165 694.6727 698.9130 696.0624 697.8004 690.3000 692.6253 674.9032 678.4851

495 496 497 498 499 500 501 502 503 504 505 506 507

677.0577 673.6353 675.3173 673.3265 667.4464 668.4032 660.2312 656.2685 639.5633 630.5553 650.7583 652.7975 660.6130

508 509 510 511 512 513 514 515 516 517 518 519 520

657.4305 652.7850 644.6625 638.8098 635.7479 631.8461 631.8028 629.9563 634.0329 641.0674 649.8010 641.8016 635.6834

521 522 523 524 525 526 527 528 529 530 531 532 533

642.1010 655.2681 644.8269 642.0526 638.5696 642.3696 641.7052 640.1537 648.0079 659.0906 691.9006 688.9003 685.0906

534 535 536 537 538 539 540 541 542 543 544 545 546

693.0968 677.2716 669.9814 675.1114 680.6774 686.0912 687.3667 693.7191 686.8158 693.9841 696.9796 678.2519 676.8282

547 548 549 550 551 552 553 554 555 556 557 558 559

679.9629 672.9918 669.8991 671.8378 670.5318 673.8925 678.8237 676.5973 690.9079 685.7579 673.2759 670.9270 672.7640

560 561 562 563 564 565 566 567 568 569 570 571 572

698.2737 681.6561 681.3050 669.2293 668.0367 666.5018 663.8124 665.5855 671.2631 662.9376 668.1250 666.0541 667.0242

573 574 575 576 577 578 579 580 581 582 583 584 585

659.6944 664.7215 662.2617 627.3812 615.8657 625.1374 630.4115 648.8966 650.1246 659.7481 668.9882 654.7630 659.9984

586 587 588 589 590 591 592 593 594 595 596 597 598

655.5780 653.0063 646.6937 646.7825 645.2296 657.5927 665.1649 661.9778 634.6400 634.7917 629.3975 625.9632 616.4203

599 600 601 602 603 604 605 606 607 608 609 610 611

614.6276 615.4987 606.2435 601.2248 620.0264 600.7791 609.5911 601.3677 634.2222 636.2700 632.7468 628.7844 643.1305

612 613 614 615 616 617 618 619 620 621 622 623 624

698.5800 649.4722 655.9262 656.0166 655.4741 652.6997 637.0762 638.5159 633.7713 635.7707 640.4403 666.9070 657.5232

625 626 627 628 629 630 631 632 633 634 635 636 637

650.0076 650.4141 629.1694 631.4109 649.6256 652.5496 641.5193 637.6899 628.9256 628.5082 626.5802 628.3971 622.5538

638 639 640 641 642 643 644 645 646 647 648 649 650

627.5455 622.7534 620.4945 621.8109 612.8569 616.8150 617.7197 614.4202 621.3894 644.6800 655.2762 650.3826 624.2672

651 652 653 654 655 656 657 658 659 660 661 662 663

625.5108 625.2049 616.5293 632.7822 634.7021 631.5456 618.6840
623.2601 617.8449 618.8172 609.0003 605.2808 598.3638

664 665 666 667 668 669 670 671 672
673 674 675 676

586.8231 574.8005 582.2634 581.6717 583.2260 601.8606 603.0681
599.5921 625.8973 593.6601 601.6404 598.2265 586.3369

677 678 679 680 681 682 683 684 685
686 687 688 689

588.1699 599.3619 596.6589 596.7420 597.5674 596.1525 607.8596
600.3247 594.8285 601.5568 603.7935 605.8427 606.5051

690 691 692 693 694 695 696 697 698
699 700 701 702

605.3100 611.8394 615.2597 617.2497 614.8869 612.1227 645.0433
627.2555 633.4176 643.5223 632.2093 622.7351 640.6915

703 704 705 706 707 708 709 710 711
712 713 714 715

645.0632 651.1151 640.8651 638.7089 634.4078 634.3931 636.3567
631.9178 636.9905 635.9762 636.3227 635.6355 642.7017

716 717 718 719 720 721 722 723 724
725 726 727 728

648.9311 650.1253 653.7855 671.1841 665.9667 669.2422 693.1557
699.8262 690.8920 694.1745 691.0003 749.9143 692.6904

729 730 731 732 733 734 735 736 737
738 739 740 741

693.7017 680.2948 670.6520 687.2728 697.4981 688.6718 686.5483
700.2619 360.5596 373.4956 383.5705 371.1588 363.5925

742 743 744 745 746 747 748 749 750
751 752 753 754

362.6951 368.3388 362.5681 358.7296 359.7247 366.6957 364.2664
363.8503 360.6252 362.6294 360.6841 363.0375 365.5861

755 756 757 758 759 760 761 762 763
764 765 766 767

368.8432 370.9900 392.6175 370.0446 373.2900 376.6523 375.4420
374.2115 371.5843 381.0359 375.8603 382.5762 374.6517

768 769 770 771 772 773 774 775 776
777 778 779 780

377.9941 379.1088 376.9314 379.0918 379.5422 375.8651 377.4771
381.4624 376.7734 378.2512 393.5180 397.4613 387.8826

781 782 783 784 785 786 787 788 789
790 791 792 793

380.1606 381.3263 377.8386 376.5171 380.0104 377.6170 377.9573
376.4414 377.5237 377.8683 378.9589 377.1334 376.6641

794 795 796 797 798 799 800 801 802
803 804 805 806

373.6522 372.5482 370.9334 374.6456 367.9315 366.8289 359.1053
351.8248 355.2494 357.1675 354.4645 352.4519 354.0735

807 808 809 810 811 812 813 814 815
816 817 818 819

358.4375 346.8601 345.9013 340.6844 336.2837 338.2017 359.1520
344.7885 342.6546 345.8911 341.5447 342.1886 342.2690

820 821 822 823 824 825 826 827 828
829 830 831 832

348.8974 347.2887 342.0888 337.2195 332.9932 332.2908 337.6335
324.0700 314.6962 318.2775 328.3286 343.1089 358.0998

833 834 835 836 837 838 839 840 841
842 843 844 845

358.1784 353.8226 345.1983 335.2919 334.3065 336.5218 335.0355 336.1101 343.0190 341.9663 346.7745 345.5441 344.7611

846 847 848 849 850 851 852 853 854 855 856 857 858

353.9879 361.2050 372.0662 370.1121 374.8324 379.0972 377.4176 381.1867 393.7638 378.8284 374.5903 371.0579 379.8977

859 860 861 862 863 864 865 866 867 868 869 870 871

383.9283 382.5351 374.8815 389.5246 396.6027 410.1387 407.7410 415.4613 415.5045 411.6253 411.3103 411.5331 416.2259

872 873 874 875 876 877 878 879 880 881 882 883 884

409.6514 414.7142 400.8063 395.4488 427.4839 418.2268 420.2215 415.5940 413.1553 414.9798 416.3875 415.9570 422.0819

885 886 887 888 889 890 891 892 893 894 895 896 897

409.3658 412.9407 417.6030 424.4510 418.1430 412.7520 413.9259 421.4292 420.3342 409.3928 416.0681 414.2177 425.4607

898 899 900 901 902 903 904 905 906 907 908 909 910

437.3235 444.0046 435.0910 434.0813 442.2110 454.0339 480.7041 480.0904 470.6506 479.2317 510.5285 522.9866 501.0574

911 912 913 914 915 916 917 918 919 920 921 922 923

491.2037 485.4320 477.3025 482.3904 491.2436 491.8619 506.9827 500.1397 490.6581 501.0195 503.4785 517.6887 509.0452

924 925 926 927 928 929 930 931 932 933 934 935 936

509.2067 505.2437 497.4544 487.5159 500.7817 499.0010 484.3647
484.0574 485.2793 486.0799 507.3463 506.6881 502.6270

937 938 939 940 941 942 943 944 945
946 947 948 949

509.3026 500.3967 515.4872 528.0545 553.0447 560.1706 540.9472
540.9819 548.5953 550.6755 544.2738 535.0390 560.4839

950 951 952 953 954 955 956 957 958
959 960 961 962

566.4526 545.4729 539.0576 531.4985 533.9272 532.9700 532.5011
543.4753 546.1630 544.2789 541.2473 537.2933 532.8535

963 964 965 966 967 968 969 970 971
972 973 974 975

533.4532 535.3973 534.3320 528.4439 528.1089 525.7763 536.6989
538.5733 529.3955 531.7317 532.4005 538.4038 530.6925

976 977 978 979 980 981 982 983 984
985 986 987 988

531.4200 526.6311 527.4118 524.1756 539.3164 561.4025 570.6063
570.4148 571.1372 602.5008 581.6657 583.4427 591.3282

989 990 991 992 993 994 995 996 997
998 999 1000

598.3757 617.9162 639.9835 642.4425 637.0536 640.6127 626.6874
623.6131 628.8511 630.1849 665.8559 670.5205

[reached getOption("max.print") -- omitted 4306 entries

prediction=data.frame(Date= test$Date,High = test$High,
stock_Predict = pred)

prediction

Date High stock_Predict

1	2000-01-03	293.50	294.1947
2	2000-01-04	317.00	314.9719
3	2000-01-05	303.90	300.0310
4	2000-01-06	314.00	304.3017
5	2000-01-07	296.35	295.4190
6	2000-01-10	296.00	294.0359
7	2000-01-11	292.00	295.7760
8	2000-01-12	293.00	290.0605
9	2000-01-13	290.50	289.2948
10	2000-01-14	294.00	290.3409
11	2000-01-17	309.50	308.6808
12	2000-01-18	317.85	313.6462
13	2000-01-19	315.00	313.8827
14	2000-01-20	306.00	306.3913
15	2000-01-21	307.00	305.5306
16	2000-01-24	306.00	303.6925
17	2000-01-25	308.95	308.1931
18	2000-01-27	316.60	321.3767
19	2000-01-28	328.90	332.6127
20	2000-01-31	349.95	344.8939
21	2000-02-01	353.90	351.3641
22	2000-02-02	357.00	359.3599
23	2000-02-03	351.50	349.8834
24	2000-02-04	362.40	359.1640

25	2000-02-07	362.50	361.8560
26	2000-02-08	359.00	360.1840
27	2000-02-09	354.00	348.0709
28	2000-02-10	329.00	331.6550
29	2000-02-11	346.00	353.5059
30	2000-02-14	369.00	368.6478
31	2000-02-15	353.50	351.2212
32	2000-02-16	354.80	351.0264
33	2000-02-17	347.00	343.7939
34	2000-02-18	340.00	338.4823
35	2000-02-21	334.00	334.3213
36	2000-02-22	319.40	321.3964
37	2000-02-23	330.45	336.0534
38	2000-02-24	356.00	360.9406
39	2000-02-25	379.85	384.1384
40	2000-02-28	410.25	419.8640
41	2000-02-29	442.50	448.2635
42	2000-03-01	433.85	434.2573
43	2000-03-02	468.60	480.8548
44	2000-03-03	489.00	493.8778
45	2000-03-06	479.00	476.1585
46	2000-03-07	447.00	439.2173
47	2000-03-08	425.00	433.9013
48	2000-03-09	419.00	419.0687

49	2000-03-10	408.90	407.8362
50	2000-03-13	406.00	405.2985
51	2000-03-14	400.00	406.1056
52	2000-03-15	406.80	407.8153
53	2000-03-16	405.85	405.0226
54	2000-03-21	427.00	416.0368
55	2000-03-22	428.80	441.9268
56	2000-03-23	446.35	441.2921
57	2000-03-24	420.00	421.7672
58	2000-03-27	444.70	429.5764
59	2000-03-28	424.85	424.3297
60	2000-03-29	418.60	414.8173
61	2000-03-30	378.00	376.5290
62	2000-03-31	393.00	399.1252
63	2000-04-03	424.45	427.0774
64	2000-04-04	458.45	464.8440
65	2000-04-05	482.40	487.9531
66	2000-04-06	465.00	465.2130
67	2000-04-07	496.00	498.0302
68	2000-04-10	504.00	500.8708
69	2000-04-11	470.05	474.3882
70	2000-04-12	464.00	463.7976
71	2000-04-13	476.00	467.4657
72	2000-04-17	444.55	447.9542

73	2000-04-18	453.75	452.7128
74	2000-04-19	463.00	465.2364
75	2000-04-20	494.00	484.9462
76	2000-04-24	475.00	470.7470
77	2000-04-25	459.90	463.5451
78	2000-04-26	474.00	473.7982
79	2000-04-27	464.00	468.8915
80	2000-04-28	477.70	475.6586
81	2000-05-02	492.45	488.6725
82	2000-05-03	468.00	466.1111
83	2000-05-04	470.00	470.8474
84	2000-05-05	453.00	456.4068
85	2000-05-08	449.75	444.9254
86	2000-05-09	434.90	436.8493
87	2000-05-10	447.00	449.0170
88	2000-05-11	467.00	456.2484
89	2000-05-12	462.50	471.2998
90	2000-05-15	466.00	464.7386
91	2000-05-16	475.00	475.1973
92	2000-05-17	468.00	467.7866
93	2000-05-18	468.00	468.4109
94	2000-05-19	480.00	482.2010
95	2000-05-22	494.90	492.3541
96	2000-05-23	509.00	505.6480

97	2000-05-24	502.00	499.6497
98	2000-05-25	493.00	493.4756
99	2000-05-26	487.50	489.4209
100	2000-05-29	541.30	545.2061
101	2000-05-30	582.25	573.2468
102	2000-05-31	564.60	525.7842
103	2000-06-01	509.00	511.7203
104	2000-06-02	531.90	528.1319
105	2000-06-05	567.00	561.7262
106	2000-06-06	558.00	550.6979
107	2000-06-07	532.50	527.5209
108	2000-06-08	525.00	532.3829
109	2000-06-09	525.00	526.3086
110	2000-06-12	520.00	519.3661
111	2000-06-13	505.00	504.2678
112	2000-06-14	501.00	499.6309
113	2000-06-15	487.80	487.0121
114	2000-06-16	510.00	508.0006
115	2000-06-19	509.00	507.4210
116	2000-06-20	512.00	513.8505
117	2000-06-21	531.85	528.3934
118	2000-06-22	538.50	538.7799
119	2000-06-23	545.00	540.6393
120	2000-06-26	546.95	552.6135

121	2000-06-27	570.50	566.9697
122	2000-06-28	580.00	577.2825
123	2000-06-29	560.00	558.7667
124	2000-06-30	556.00	558.2049
125	2000-07-03	566.00	559.5988
126	2000-07-04	543.00	543.5851
127	2000-07-05	501.00	498.5178
128	2000-07-06	521.00	517.4487
129	2000-07-07	514.00	514.2137
130	2000-07-10	509.00	507.2562
131	2000-07-11	492.00	490.1240
132	2000-07-12	499.00	497.7861
133	2000-07-13	510.00	501.0299
134	2000-07-14	492.00	493.2074
135	2000-07-17	489.00	485.3176
136	2000-07-18	488.00	486.3628
137	2000-07-19	479.90	486.9330
138	2000-07-20	521.20	517.4046
139	2000-07-21	535.00	521.1716
140	2000-07-24	509.95	506.8527
141	2000-07-25	503.00	508.6525
142	2000-07-26	505.00	506.2333
143	2000-07-27	503.00	504.7419
144	2000-07-28	504.50	504.8573

145	2000-07-31	511.00	509.5958
146	2000-08-01	510.00	509.7621
147	2000-08-02	502.65	500.4059
148	2000-08-03	491.50	493.2957
149	2000-08-04	509.50	507.4632
150	2000-08-07	504.90	506.2780
151	2000-08-08	509.00	506.9469
152	2000-08-09	508.00	505.7522
153	2000-08-10	501.90	501.0147
154	2000-08-11	506.00	509.8738
155	2000-08-14	505.00	505.2529
156	2000-08-16	529.00	535.4856
157	2000-08-17	525.50	522.7279
158	2000-08-18	512.00	510.8293
159	2000-08-21	505.00	502.0001
160	2000-08-22	492.00	487.5213
161	2000-08-23	494.50	494.9244
162	2000-08-24	500.00	500.4541
163	2000-08-25	503.00	501.8487
164	2000-08-28	505.00	504.7708
165	2000-08-29	508.00	508.1995
166	2000-08-30	524.60	523.9002
167	2000-08-31	526.85	529.7782
168	2000-09-04	530.00	533.3262

169	2000-09-05	548.00	549.8339
170	2000-09-06	541.90	547.2515
171	2000-09-07	546.00	541.8723
172	2000-09-08	545.90	543.5263
173	2000-09-11	540.00	539.4125
174	2000-09-12	525.00	527.7799
175	2000-09-13	517.95	519.7553
176	2000-09-14	516.00	516.9629
177	2000-09-15	515.00	515.0428
178	2000-09-18	505.00	504.8083
179	2000-09-19	506.00	505.3837
180	2000-09-20	515.00	511.9367
181	2000-09-21	515.00	505.3589
182	2000-09-22	496.00	506.8079
183	2000-09-25	482.00	481.5394
184	2000-09-26	474.00	465.2579
185	2000-09-27	447.00	449.1288
186	2000-09-28	455.15	451.3454
187	2000-09-29	445.90	448.2711
188	2000-10-03	441.90	443.1508
189	2000-10-04	448.00	446.7743
190	2000-10-05	443.00	443.5041
191	2000-10-06	451.00	450.5573
192	2000-10-09	452.90	453.3506

193	2000-10-10	458.75	456.9515
194	2000-10-11	455.00	456.4156
195	2000-10-12	451.25	453.1539
196	2000-10-13	454.00	453.7081
197	2000-10-16	469.90	463.9590
198	2000-10-17	465.00	462.2715
199	2000-10-18	464.55	466.4364
200	2000-10-19	480.00	478.6916
201	2000-10-20	488.00	483.3269
202	2000-10-23	472.00	470.4793
203	2000-10-24	467.00	468.4516
204	2000-10-25	464.80	463.4525
205	2000-10-26	468.90	469.3857
206	2000-10-27	468.00	467.5158
207	2000-10-30	472.80	474.6073
208	2000-10-31	473.00	473.4658
209	2000-11-01	484.90	488.7502
210	2000-11-02	495.50	495.3898
211	2000-11-03	500.00	494.9019
212	2000-11-06	496.00	488.5947
213	2000-11-07	489.90	489.7397
214	2000-11-08	500.00	494.0998
215	2000-11-09	489.75	491.8402
216	2000-11-10	502.90	502.5768

217	2000-11-13	515.00	516.1604
218	2000-11-14	518.00	518.4729
219	2000-11-15	508.00	513.5254
220	2000-11-16	503.50	502.4051
221	2000-11-17	492.00	494.3981
222	2000-11-20	487.00	487.3236
223	2000-11-21	482.00	483.4258
224	2000-11-22	479.00	479.5325
225	2000-11-23	490.00	485.8022
226	2000-11-24	518.40	515.4936
227	2000-11-27	542.90	536.0238
228	2000-11-28	532.00	533.5316
229	2000-11-29	526.90	528.0082
230	2000-11-30	535.80	535.9576
231	2000-12-01	528.00	528.9845
232	2000-12-04	525.00	526.0216
233	2000-12-05	528.00	525.9571
234	2000-12-06	533.05	536.5577
235	2000-12-07	545.00	542.9073
236	2000-12-08	548.90	550.0974
237	2000-12-11	557.90	562.5866
238	2000-12-12	564.90	564.4459
239	2000-12-13	565.00	564.1577
240	2000-12-14	559.85	559.6446

241	2000-12-15	565.00	568.4413
242	2000-12-18	559.00	560.5753
243	2000-12-19	560.00	560.3993
244	2000-12-20	556.95	559.5722
245	2000-12-21	553.00	555.0179
246	2000-12-22	553.00	555.0008
247	2000-12-26	560.00	554.6228
248	2000-12-27	540.00	540.9471
249	2000-12-28	543.00	543.3403
250	2000-12-29	544.00	547.6020
251	2001-01-01	543.90	542.7985
252	2001-01-02	544.90	544.9005
253	2001-01-03	554.85	555.2585
254	2001-01-04	568.00	566.3966
255	2001-01-05	589.00	590.5496
256	2001-01-08	599.00	597.8699
257	2001-01-09	599.00	600.7474
258	2001-01-10	595.00	598.8008
259	2001-01-11	565.10	564.0280
260	2001-01-12	562.00	561.2449
261	2001-01-15	552.60	553.0676
262	2001-01-16	545.00	543.0640
263	2001-01-17	542.80	544.6292
264	2001-01-18	541.00	536.5734

265	2001-01-19	538.00	538.7743
266	2001-01-22	523.75	522.5097
267	2001-01-23	515.20	509.4125
268	2001-01-24	523.90	523.9622
269	2001-01-25	554.00	544.2962
270	2001-01-29	588.90	593.5360
271	2001-01-30	592.00	588.0639
272	2001-01-31	577.00	565.6106
273	2001-02-01	563.00	560.4413
274	2001-02-02	580.00	579.9750
275	2001-02-05	582.90	582.6039
276	2001-02-06	570.00	562.6092
277	2001-02-07	568.00	568.6957
278	2001-02-08	583.00	581.6666
279	2001-02-09	605.00	600.5468
280	2001-02-12	600.00	598.6378
281	2001-02-13	582.00	583.2479
282	2001-02-14	579.00	575.9123
283	2001-02-15	587.80	584.0658
284	2001-02-16	584.00	583.1717
285	2001-02-19	579.00	582.3248
286	2001-02-20	578.00	579.1304
287	2001-02-21	574.00	573.3743
288	2001-02-22	572.00	578.2031

289	2001-02-23	571.75	573.3790
290	2001-02-26	575.80	579.4989
291	2001-02-27	597.00	591.9129
292	2001-02-28	621.00	614.4044
293	2001-03-01	609.00	614.2678
294	2001-03-02	608.00	605.8712
295	2001-03-05	574.00	562.8626
296	2001-03-07	550.00	551.9504
297	2001-03-08	548.00	549.8460
298	2001-03-09	550.00	546.7498
299	2001-03-12	559.00	549.5852
300	2001-03-13	553.00	550.7307
301	2001-03-14	603.20	592.5172
302	2001-03-15	600.00	590.4138
303	2001-03-16	588.00	581.3768
304	2001-03-19	574.00	576.8515
305	2001-03-20	569.50	570.2706
306	2001-03-21	579.90	579.9756
307	2001-03-22	589.00	589.5835
308	2001-03-23	590.00	590.0833
309	2001-03-26	586.00	587.7620
310	2001-03-27	589.00	589.6250
311	2001-03-28	591.90	588.6283
312	2001-03-29	574.90	575.0535

313 2001-03-30 569.00 565.4779

314 2001-04-02 574.00 566.2379

315 2001-04-03 586.90 585.0421

316 2001-04-04 574.00 574.7373

317 2001-04-06 580.00 572.3818

318 2001-04-09 563.50 561.8806

319 2001-04-10 560.50 556.9067

320 2001-04-11 558.00 561.3121

321 2001-04-12 575.00 557.9891

322 2001-04-16 587.80 591.1769

323 2001-04-17 600.00 599.9961

324 2001-04-18 595.00 586.6398

325 2001-04-19 590.00 590.2102

326 2001-04-20 579.90 595.7300

327 2001-04-23 586.00 587.1950

328 2001-04-24 593.00 589.0581

329 2001-04-25 600.00 599.7848

330 2001-04-26 599.25 599.1066

331 2001-04-27 587.00 591.2579

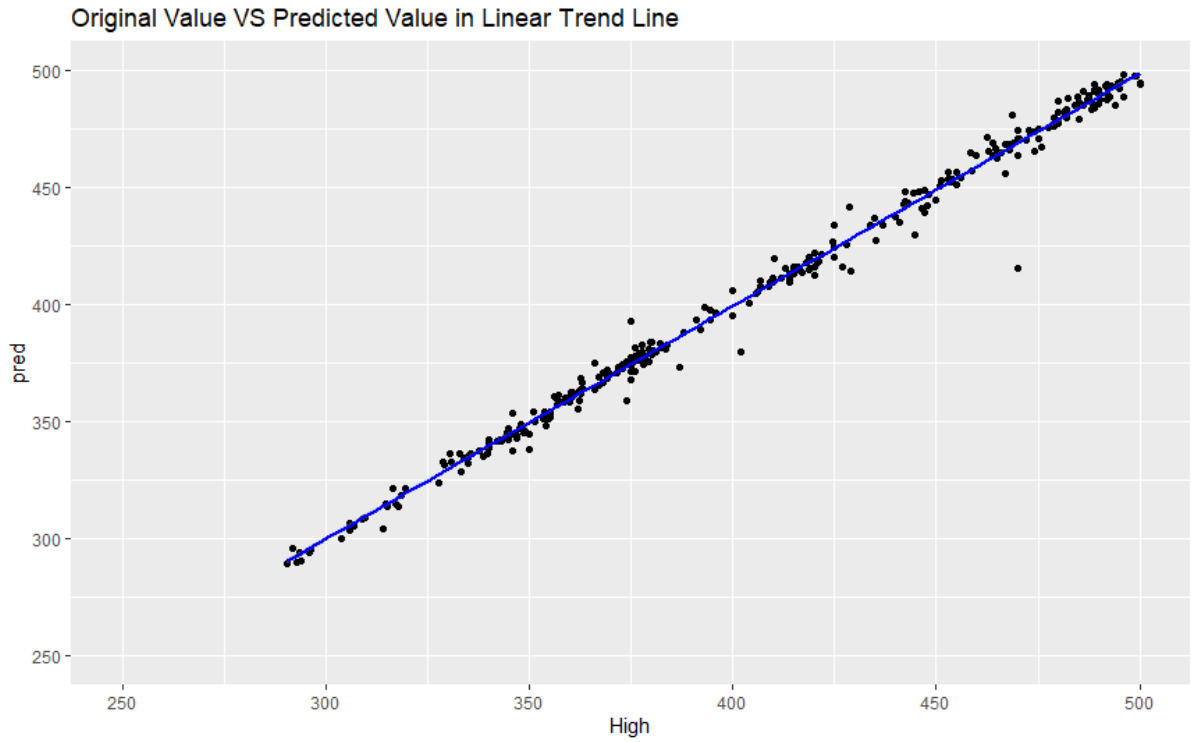
332 2001-04-30 589.10 586.1938

333 2001-05-02 592.00 606.8388

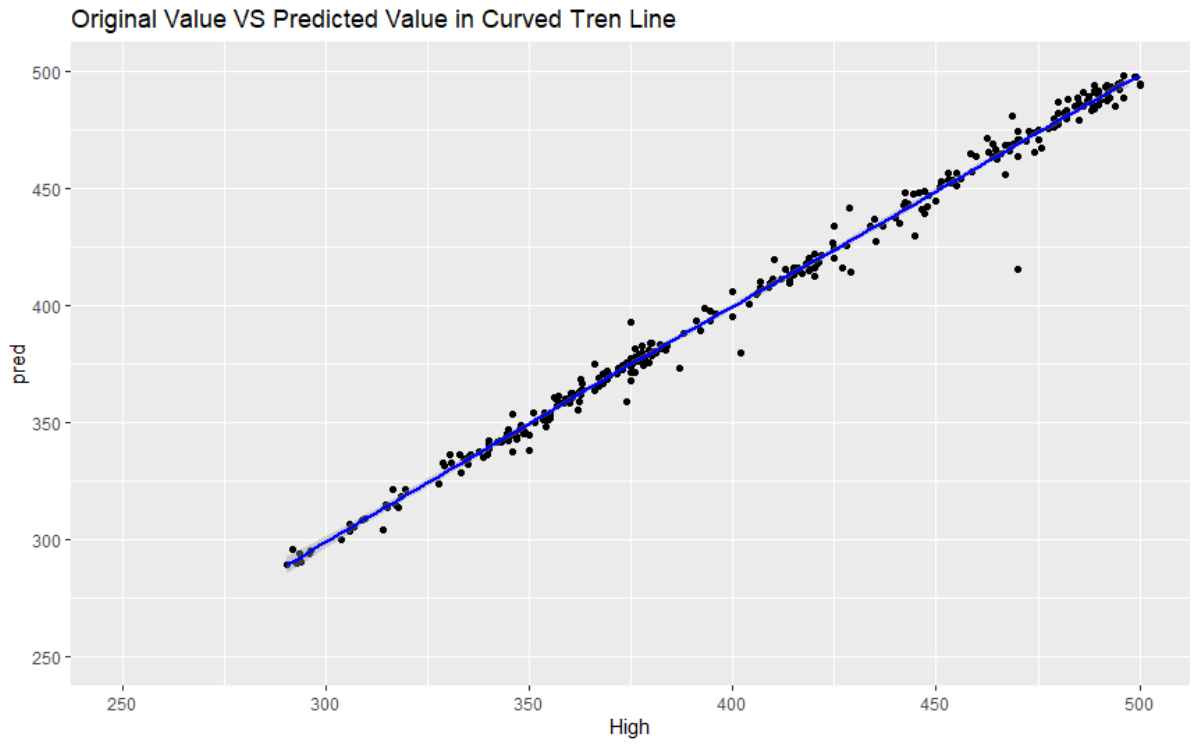
[reached 'max' / getOption("max.print") -- omitted 4973 rows]

#creating Graph

```
ggplot(st, aes(x=High, y=pred)) + geom_point() +
geom_smooth(color="blue",method = lm)
+xlim(250,500)+ylim(250,500)+ ggtitle("Original Value VS Predicted
Value in Linear Trend Line")
```




```
ggplot(st, aes(x=High, y=pred)) + geom_point() +
geom_smooth(color="blue") +xlim(250,500)+ylim(250,500)+
ggtitle("Original Value VS Predicted Value in Curved Tren Line")
```



#accuracy

acc <- sqrt(mean(pred-st$High)^2)

acc

[1] 5.935189e-12

2)Time Series Forecasting

library(forecast)

library(smooth)

library(ggplot2)

library(fpp2)

library(tseries)

library(imputeTS)

```
st <- read.csv("E://fffiiles//college pracs and projects//ai ccsp//pro//HDFC.csv")

dim(st)

[1] 5306   15

names(st)

[1] "Date"            "Symbol"          "Series"          "Prev.Close"
"Open"            "High"            "Low"

 [8] "Last"            "Close"           "VWAP"            "Volume"
"Turnover"        "Trades"          "Deliverable.Volume"

[15] "X.Deliverble"


#transforming raw data then plotting as well

st.ts=ts(st[,9],start = c(2000,1),end=c(2021,4),frequency=12)

st.ts

     Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov
Dec

2000 293.50 304.05 292.80 296.45 286.55 287.20 283.85 285.60 283.85 286.55 302.20 305.75

2001 305.25 291.35 299.55 293.05 303.15 316.60 324.40 333.50 350.55 351.40 341.90 357.20

2002 355.45 350.50 329.15 320.35 343.65 359.15 332.60 341.60 339.20 327.90 319.15 305.95

2003 330.45 351.70 379.85 409.70 401.70 433.85 468.60 473.05 443.50 412.20 416.70 399.60

2004 397.55 381.60 396.65 400.50 398.20 406.35 413.25 409.85 416.80 417.40 412.70 380.30
```

2005 363.85 393.00 424.45 458.45 469.80 459.25 490.95 477.70 464.30 453.25 448.70 433.10

2006 445.40 459.35 475.10 448.05 456.90 460.65 460.15 472.35 479.35 460.85 455.75 449.00

2007 437.55 424.95 441.75 448.65 461.05 460.40 471.75 461.35 465.45 477.65 486.15 501.90

2008 486.40 473.00 483.30 541.30 543.65 478.45 496.35 525.35 544.70 530.70 513.20 515.25

2009 509.35 503.60 495.35 488.20 484.85 499.85 504.10 509.20 525.10 525.35 536.25 541.15

2010 558.20 551.55 548.15 551.65 548.70 480.00 484.65 511.25 499.90 489.85 481.20 490.55

2011 487.65 478.55 480.95 475.55 475.30 511.65 509.25 501.00 498.40 499.75 500.30 500.05

2012 505.90 499.30 491.75 489.15 503.15 502.75 505.55 493.55 496.05 504.95 503.15 522.80

2013 513.00 501.10 490.40 482.90 489.60 495.35 500.50 500.70 505.00 520.15 524.05 528.25

2014 544.60 539.95 534.30 532.20 529.45 520.65 506.00 513.55 507.50 499.55 502.05 500.00

2015 499.70 481.00 474.95 445.15 426.55 441.05 437.85 433.90 439.00 439.00 449.45 449.25

2016 455.95 448.60 449.65 450.00 450.85 458.80 458.75 477.40 469.75 464.65 457.35 462.20

2017 461.30 464.10 471.45 470.25 480.00 489.85 488.50 482.90 485.60 489.00 488.20 496.85

2018 508.05 496.80 500.40 494.65 489.20 477.35 477.25 474.15 485.50 509.40 525.10 528.00

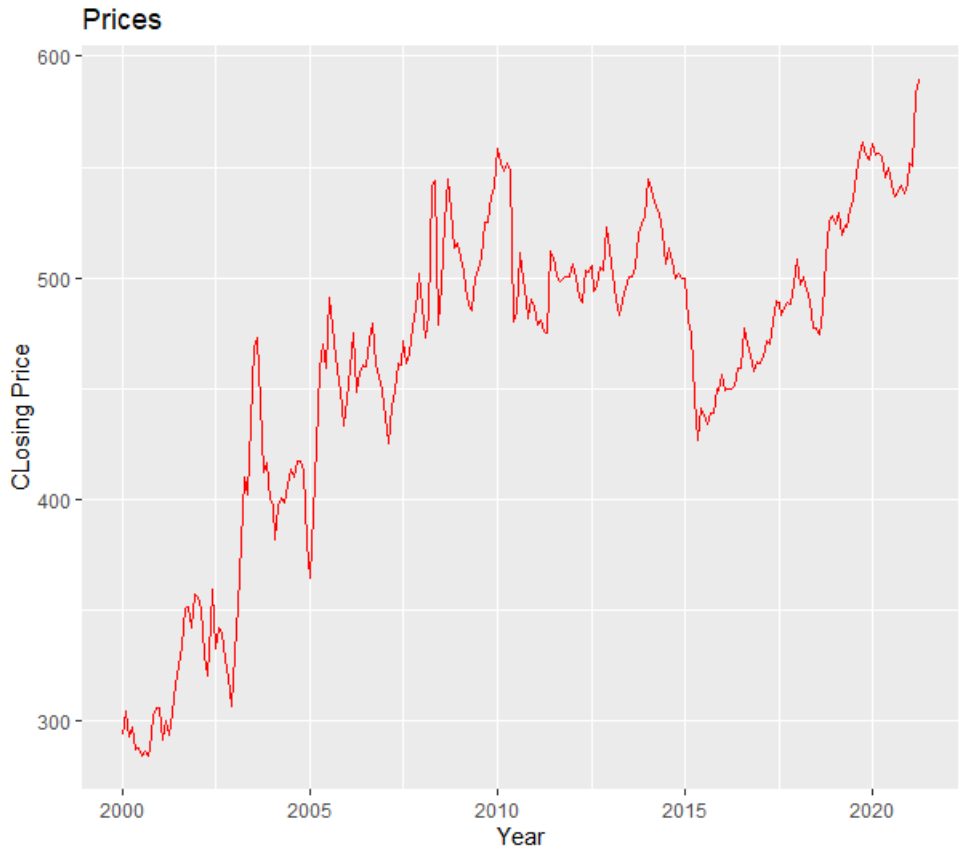
2019 524.65 529.20 519.50 523.40 522.55 530.75 535.30 546.70 555.60 561.55 555.35 553.30

2020 560.45 555.30 556.50 554.75 545.05 549.30 542.75 536.60 538.70 541.80 538.25 542.15

2021 552.15 550.60 583.30 589.35

#here is the plot

autoplot(st.ts)+ ggtitle("Prices")+xlab("Year")+ylab("CLosing Price")+geom_line(color="red")



#seeing frequency

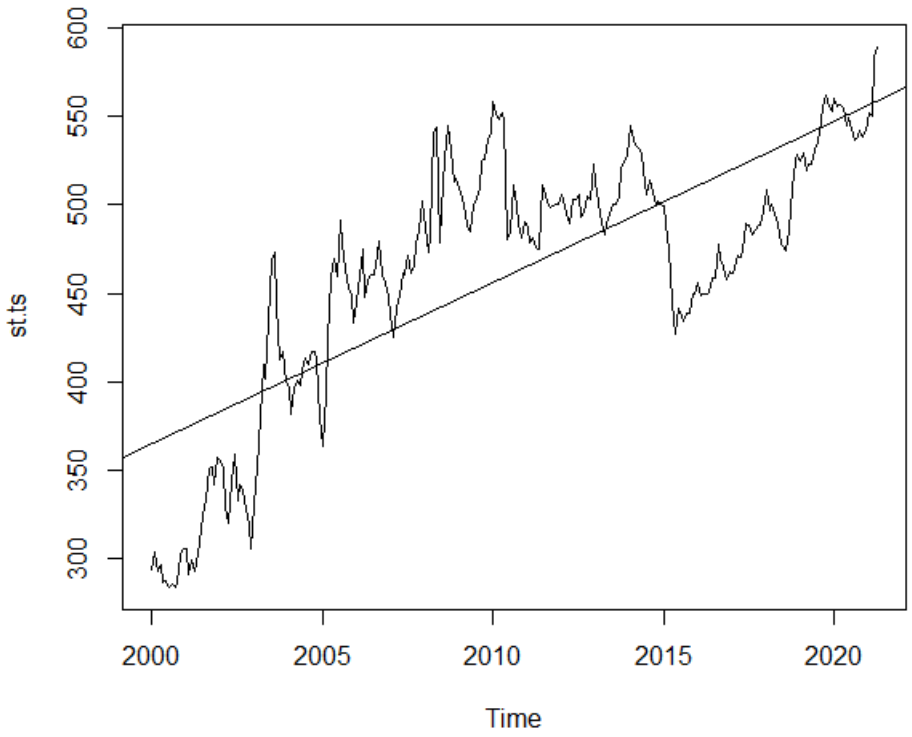
frequency(st)

[1] 1

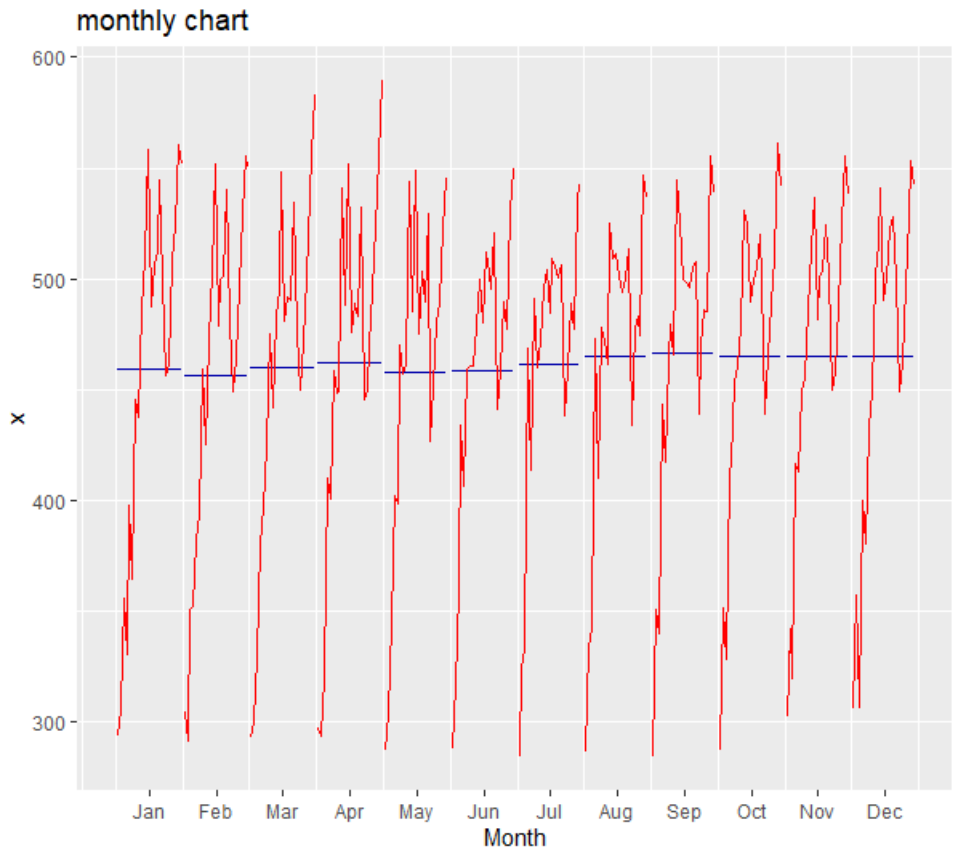
#with linear regression

plot(st.ts)

abline(reg=lm(st.ts~time(st.ts)))



ggmonthplot(st.ts)+geom_line(color="red")+ggtitle("monthly chart")



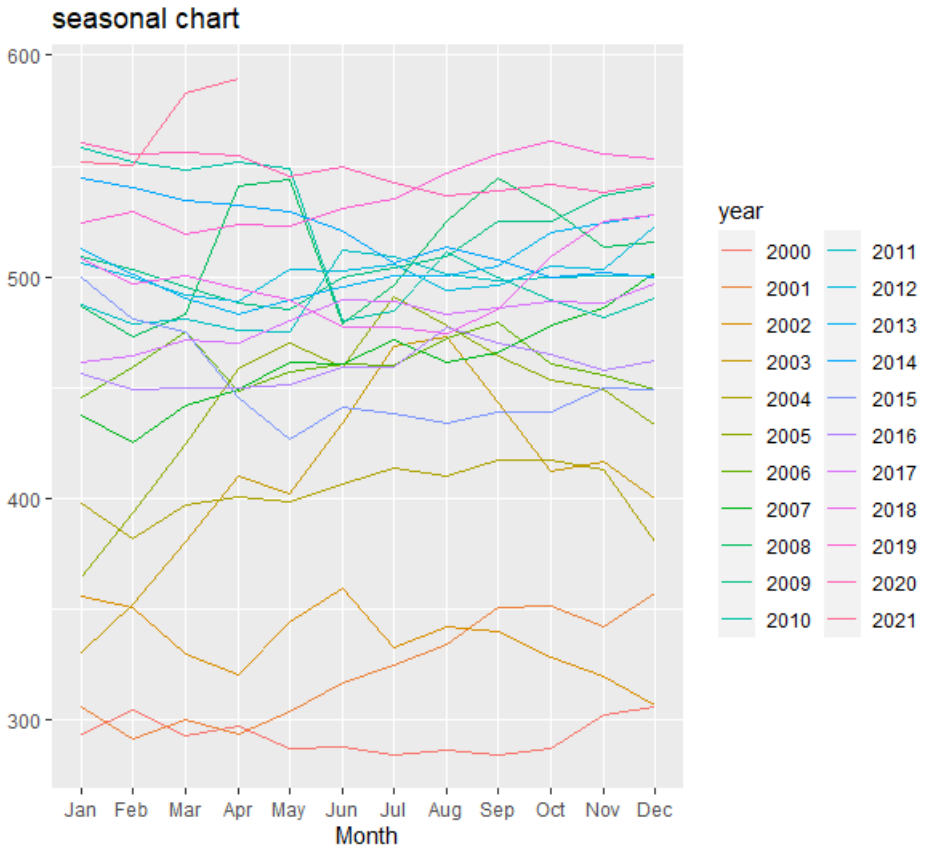

```
frequency(st.ts)
```

```
[1] 12
```

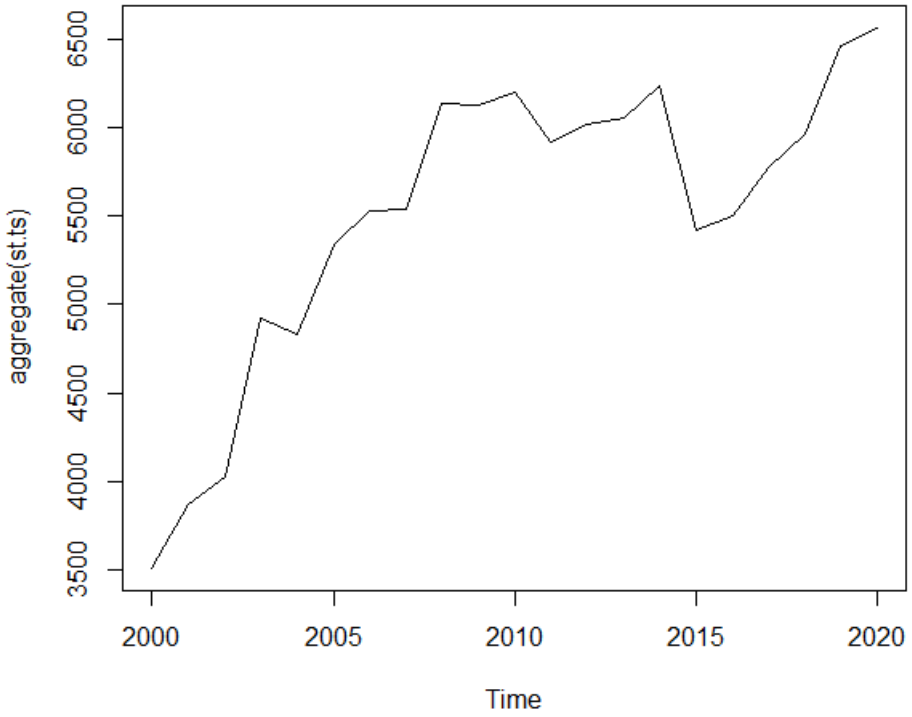
```
which.max(st.ts)
```

```
[1] 256
```

```
ggseasonplot(st.ts)+ggtitle("seasonal chart")
```

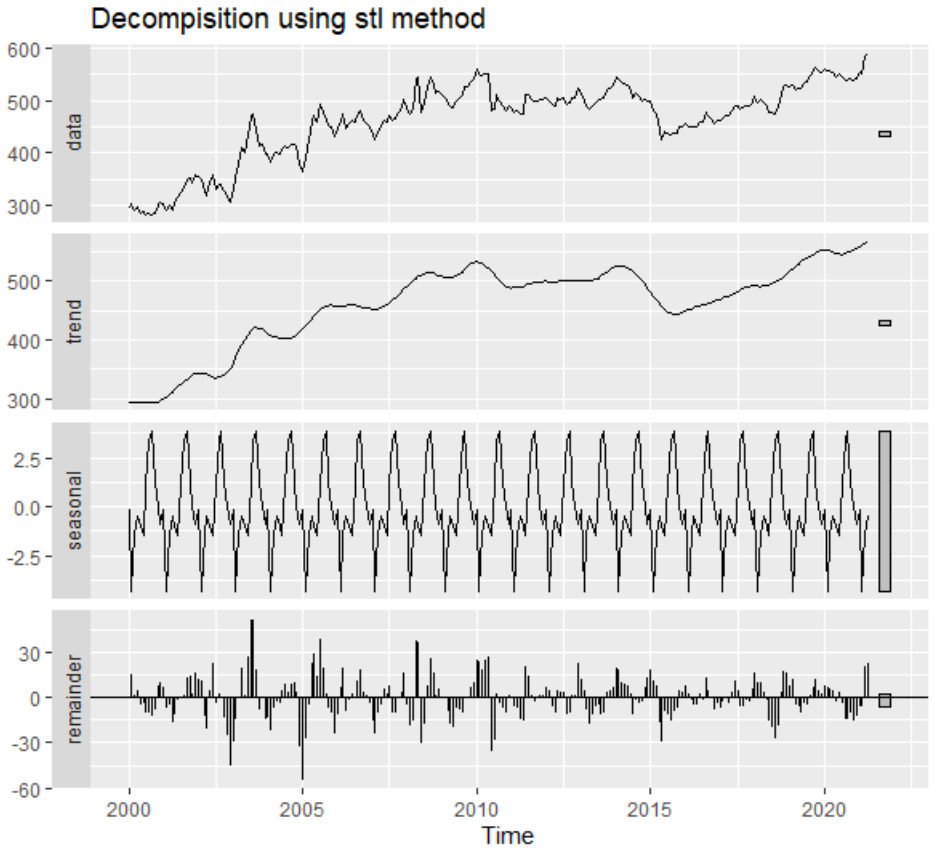


plot(aggregate(st.ts), FUN=mean)



st.ts.decomposition =stl(st.ts,s.window="periodic")

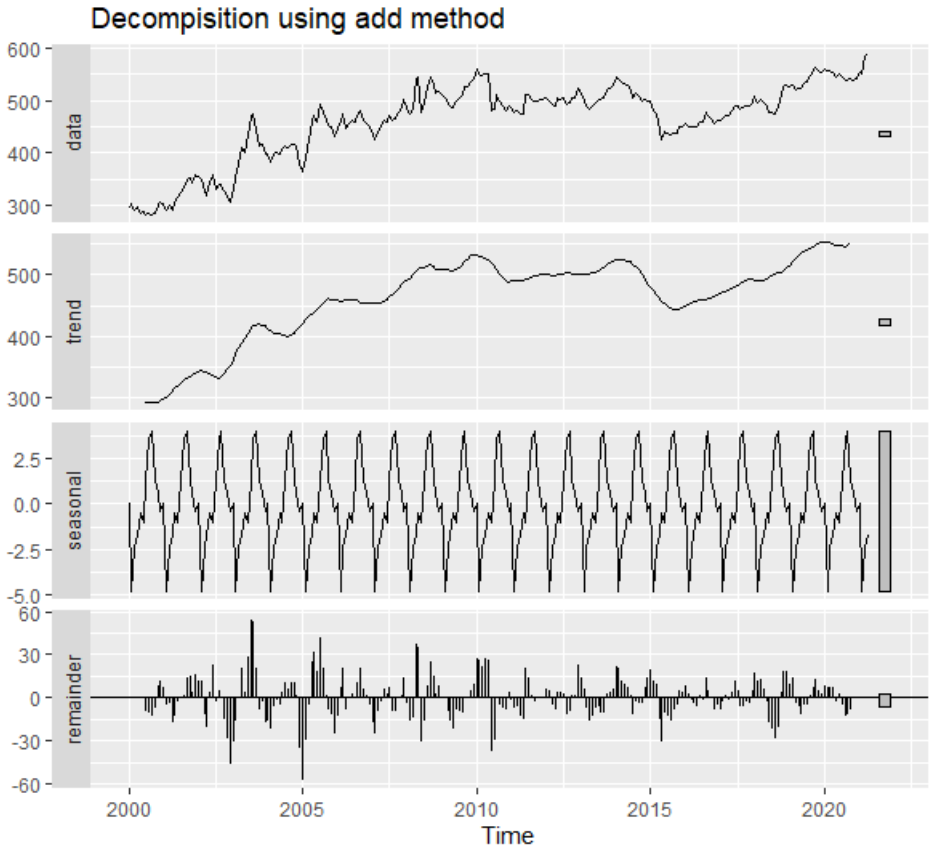
autoplot(st.ts.decomposition,main="Decompisition using stl method")



#additive

st.ts.add=decompose(st.ts,type = "additive")

autoplot(st.ts.add,main="Decompisition using add method")



#multiplicative

st.ts.multi=decompose(st.ts,type = "mutiplicative")

autoplot(st.ts.multi,main="Decompisition using mutiplicative method")

#values being formed

st.ts.decomposition$time.series

	seasonal	trend	remainder
Jan 2000	-0.162542548	293.7916	-0.12908551
Feb 2000	-4.360158686	293.4125	14.99762266
Mar 2000	-1.407773293	293.0334	1.17432931
Apr 2000	-0.497382334	292.8852	4.06213673

May 2000 -0.959766811 292.7370 -5.22728041

Jun 2000 -1.452507280 292.7440 -4.09147739

Jul 2000 1.090479341 292.7509 -9.99140146

Aug 2000 3.357076007 292.7346 -10.49169821

Sep 2000 3.892718823 292.7183 -12.76104111

Oct 2000 1.352252857 293.3576 -8.15981768

Nov 2000 0.009407083 293.9968 8.19378556

Dec 2000 -0.861802168 296.3105 10.30130049

Jan 2001 -0.162542548 298.6242 6.78834656

Feb 2001 -4.360158686 302.3988 -6.68867025

Mar 2001 -1.407773293 306.1735 -5.21568858

Apr 2001 -0.497382334 310.6095 -17.06209727

May 2001 -0.959766811 315.0455 -10.93573053

Jun 2001 -1.452507280 319.7031 -1.65059375

Jul 2001 1.090479341 324.3607 -1.05118407

Aug 2001 3.357076007 328.7523 1.39064228

Sep 2001 3.892718823 333.1439 13.51342248

Oct 2001 1.352252857 336.4131 13.63459850

Nov 2001 0.009407083 339.6824 2.20815433

Dec 2001 -0.861802168 341.4861 16.57566269

Jan 2002 -0.162542548 343.2898 12.32270218

Feb 2002 -4.360158686 343.3882 11.47196388

Mar 2002 -1.407773293 343.4865 -12.92877595

Apr 2002 -0.497382334 341.8008 -20.95343863

May 2002 -0.959766811 340.1151 4.49467413

Jun 2002 -1.452507280 337.9466 22.65589472

Jul 2002 1.090479341 335.7781 -4.26861178

Aug 2002 3.357076007 336.0129 2.23000978

Sep 2002 3.892718823 336.2477 -0.94041481

Oct 2002 1.352252857 340.3427 -13.79496640

Nov 2002 0.009407083 344.4377 -25.29713817

Dec 2002 -0.861802168 352.1903 -45.37846647

Jan 2003 -0.162542548 359.9428 -29.33026363

Feb 2003 -4.360158686 370.4404 -14.38025313

Mar 2003 -1.407773293 380.9380 0.31975584

Apr 2003 -0.497382334 391.1290 19.06835113

May 2003 -0.959766811 401.3200 1.33972185

Jun 2003 -1.452507280 408.4562 26.84628719

Jul 2003 1.090479341 415.5924 51.91712544

Aug 2003 3.357076007 418.1600 51.53296858

Sep 2003 3.892718823 420.7275 18.87976557

Oct 2003 1.352252857 419.3559 -8.50812582

Nov 2003 0.009407083 417.9842 -1.29363741

Dec 2003 -0.861802168 414.6051 -14.14329482

Jan 2004 -0.162542548 411.2260 -13.51342111

Feb 2004 -4.360158686 408.2212 -22.26103247

Mar 2004 -1.407773293 405.2164 -7.15864537

Apr 2004 -0.497382334 404.4166 -3.41921415

May 2004 -0.959766811 403.6168 -4.45700749

Jun 2004 -1.452507280 403.2588 4.54373383

Jul 2004 1.090479341 402.9008 9.25874807

Aug 2004 3.357076007 403.2488 3.24417124

Sep 2004 3.892718823 403.5967 9.31054825

Oct 2004 1.352252857 406.2962 9.75149828

Nov 2004 0.009407083 408.9958 3.69482811

Dec 2004 -0.861802168 414.0001 -32.83825053

Jan 2005 -0.162542548 419.0043 -54.99179804

Feb 2005 -4.360158686 424.7704 -27.41022313

Mar 2005 -1.407773293 430.5364 -4.67864974

Apr 2005 -0.497382334 436.0842 22.86316859

May 2005 -0.959766811 441.6320 29.12776236

Jun 2005 -1.452507280 446.5955 14.10698321

Jul 2005 1.090479341 451.5590 38.30047698

Aug 2005 3.357076007 454.8641 19.47880983

Sep 2005 3.892718823 458.1692 2.23809654

Oct 2005 1.352252857 458.5351 -6.63732723

Nov 2005 0.009407083 458.9010 -10.21037119

Dec 2005 -0.861802168 458.0650 -24.10315970

Jan 2006 -0.162542548 457.2290 -11.66641708

Feb 2006 -4.360158686 457.2151 6.49502757

Mar 2006 -1.407773293 457.2013 19.30647070

Apr 2006 -0.497382334 458.2128 -9.66538591

May 2006 -0.959766811 459.2242 -1.36446709

Jun 2006 -1.452507280 459.4200 2.68254045

Jul 2006 1.090479341 459.6157 -0.55617911

Aug 2006 3.357076007 458.2567 10.73617574

Sep 2006 3.892718823 456.8978 18.55948444

Oct 2006 1.352252857 455.5652 3.93259179

Nov 2006 0.009407083 454.2325 1.50807895

Dec 2006 -0.861802168 453.7226 -3.86078996

Jan 2007 -0.162542548 453.2127 -15.50012774

Feb 2007 -4.360158686 453.1761 -23.86592065

Mar 2007 -1.407773293 453.1395 -9.98171509

Apr 2007 -0.497382334 454.6803 -5.53288000

May 2007 -0.959766811 456.2210 5.78873053

Jun 2007 -1.452507280 459.8313 2.02116896

Jul 2007 1.090479341 463.4416 7.21788031

Aug 2007 3.357076007 467.8943 -9.90134798

Sep 2007 3.892718823 472.3469 -10.78962243

Oct 2007 1.352252857 477.3262 -1.02846218

Nov 2007 0.009407083 482.3055 3.83507787

Dec 2007 -0.861802168 486.8263 15.93554980

Jan 2008 -0.162542548 491.3470 -4.78444714

Feb 2008 -4.360158686 495.7643 -18.40416042

Mar 2008 -1.407773293 500.1816 -15.47387523

Apr 2008 -0.497382334 504.0841 37.71331884

May 2008 -0.959766811 507.9865 36.62328834

Jun 2008 -1.452507280 510.6077 -30.70519408

Jul 2008 1.090479341 513.2289 -17.96940359

Aug 2008 3.357076007 513.9938 7.99910212

Sep 2008 3.892718823 514.7587 26.04856168

Oct 2008 1.352252857 513.4595 15.88823373

Nov 2008 0.009407083 512.1603 1.03028559

Dec 2008 -0.861802168 510.4822 5.62956370

Jan 2009 -0.162542548 508.8042 0.70837295

Feb 2009 -4.360158686 507.5723 0.38785914

Mar 2009 -1.407773293 506.3404 -9.58265619

Apr 2009 -0.497382334 506.2676 -17.57018339

May 2009 -0.959766811 506.1947 -20.38493515

Jun 2009 -1.452507280 508.7489 -7.44639129

Jul 2009 1.090479341 511.3031 -8.29357452

Aug 2009 3.357076007 515.8821 -10.03920112

Sep 2009 3.892718823 520.4612 0.74612613

Oct 2009 1.352252857 525.2002 -1.20248844

Nov 2009 0.009407083 529.9393 6.30127679

Dec 2009 -0.861802168 531.7560 10.25581596

Jan 2010 -0.162542548 533.5727 24.78988626

Feb 2010 -4.360158686 532.1749 23.73525727

Mar 2010 -1.407773293 530.7771 18.78062675

Apr 2010 -0.497382334 526.8797 25.26765689

May 2010 -0.959766811 522.9823 26.67746246

Jun 2010 -1.452507280 517.4422 -35.98972921

Jul 2010 1.090479341 511.9022 -28.34264797

Aug 2010 3.357076007 505.9147 1.97822053

Sep 2010 3.892718823 499.9272 -3.91995712

Oct 2010 1.352252857 495.5235 -7.02577404

Nov 2010 0.009407083 491.1198 -9.92921116

Dec 2010 -0.861802168 489.8652 1.54658365

Jan 2011 -0.162542548 488.6106 -0.79809040

Feb 2011 -4.360158686 489.1201 -6.20990569

Mar 2011 -1.407773293 489.6295 -7.27172250

Apr 2011 -0.497382334 490.5769 -14.52955068

May 2011 -0.959766811 491.5244 -15.26460342

Jun 2011 -1.452507280 492.9703 20.13223850

Jul 2011 1.090479341 494.4162 13.74335333

Aug 2011 3.357076007 495.9346 1.70830845

Sep 2011 3.892718823 497.4531 -2.94578259

Oct 2011 1.352252857 498.4270 -0.02928335

Nov 2011 0.009407083 499.4010 0.88959570

Dec 2011 -0.861802168 499.5880 1.32384924

Jan 2012 -0.162542548 499.7749 6.28763391

Feb 2012 -4.360158686 499.5923 4.06784005

Mar 2012 -1.407773293 499.4097 -6.25195534

Apr 2012 -0.497382334 499.5165 -9.86915296

May 2012 -0.959766811 499.6233 4.48642486

Jun 2012 -1.452507280 500.2630 3.93948195

Jul 2012 1.090479341 500.9027 3.55681195

Aug 2012 3.357076007 501.4733 -11.28035967

Sep 2012 3.892718823 502.0439 -9.88657743

Oct 2012 1.352252857 501.8670 1.73077281

Nov 2012 0.009407083 501.6901 1.45050286

Dec 2012 -0.861802168 501.1746 22.48719017

Jan 2013 -0.162542548 500.6591 12.50340860

Feb 2013 -4.360158686 500.5598 4.90034991

Mar 2013 -1.407773293 500.4605 -8.65271031

Apr 2013 -0.497382334 500.9566 -17.55921838

May 2013 -0.959766811 501.4527 -10.89295102

Jun 2013 -1.452507280 503.1494 -6.34689374

Jul 2013 1.090479341 504.8461 -5.43656355

Aug 2013 3.357076007 508.2792 -10.93627384

Sep 2013 3.892718823 511.7123 -10.60503029

Oct 2013 1.352252857 515.6881 3.10965161

Nov 2013 0.009407083 519.6639 4.37671332

Dec 2013 -0.861802168 522.2681 6.84366606

Jan 2014 -0.162542548 524.8724 19.89014993

Feb 2014 -4.360158686 525.4147 18.89541621

Mar 2014 -1.407773293 525.9571 9.75068096

Apr 2014 -0.497382334 524.3676 8.32981587

May 2014 -0.959766811 522.7780 7.63172622

Jun 2014 -1.452507280 519.5324 2.57005785

Jul 2014 1.090479341 516.2869 -11.37733761

Aug 2014 3.357076007 511.7165 -1.52353612

Sep 2014 3.892718823 507.1461 -3.53878077

Oct 2014 1.352252857 501.1177 -2.91995060

Nov 2014 0.009407083 495.0893 6.95125938

Dec 2014 -0.861802168 488.3098 12.55199478

Jan 2015 -0.162542548 481.5303 18.33226130

Feb 2015 -4.360158686 474.8995 10.46062218

Mar 2015 -1.407773293 468.2688 8.08898152

Apr 2015 -0.497382334 462.3862 -16.73877168

May 2015 -0.959766811 456.5035 -28.99374944

Jun 2015 -1.452507280 452.1710 -9.66845032

Jul 2015 1.090479341 447.8384 -11.07887828

Aug 2015 3.357076007 445.8706 -15.32767561

Sep 2015 3.892718823 443.9028 -8.79551909

Oct 2015 1.352252857 444.3283 -6.68059923

Nov 2015 0.009407083 444.7539 4.68670043

Dec 2015 -0.861802168 446.6203 3.49154223

Jan 2016 -0.162542548 448.4866 7.62591516

Feb 2016 -4.360158686 450.8144 2.14576090

Mar 2016 -1.407773293 453.1422 -2.08439489

Apr 2016 -0.497382334 455.0153 -4.51796668

May 2016 -0.959766811 456.8885 -5.07876302

Jun 2016 -1.452507280 458.0618 2.19071798

Jul 2016 1.090479341 459.2350 -1.57552811

Aug 2016 3.357076007 460.4776 13.56534779

Sep 2016 3.892718823 461.7201 4.13717755

Oct 2016 1.352252857 463.4171 -0.11935545

Nov 2016 0.009407083 465.1141 -7.77350864

Dec 2016 -0.861802168 467.0469 -3.98513749

Jan 2017 -0.162542548 468.9798 -7.51723522

Feb 2017 -4.360158686 470.8567 -2.39654729

Mar 2017 -1.407773293 472.7336 0.12413911

Apr 2017 -0.497382334 474.9250 -4.17758484

May 2017 -0.959766811 477.1163 3.84346665

Jun 2017 -1.452507280 479.8851 11.41742776

Jul 2017 1.090479341 482.6539 4.75566178

Aug 2017 3.357076007 485.3697 -5.82682502

Sep 2017 3.892718823 488.0856 -6.37835796

Oct 2017 1.352252857 489.8103 -2.16252053

Nov 2017 0.009407083 491.5349 -3.34430328

Dec 2017 -0.861802168 491.8161 5.89572997

Jan 2018 -0.162542548 492.0972 16.11529436

Feb 2018 -4.360158686 491.7562 9.40398649

Mar 2018 -1.407773293 491.4151 10.39267710

Apr 2018 -0.497382334 491.8984 3.24901633

May 2018 -0.959766811 492.3816 -2.22186901

Jun 2018 -1.452507280 494.0489 -15.24642275

Jul 2018 1.090479341 495.7162 -19.55670358

Aug 2018 3.357076007 498.2783 -27.48541335

Sep 2018 3.892718823 500.8405 -19.23316927

Oct 2018 1.352252857 504.3103 3.73742559

Nov 2018 0.009407083 507.7802 17.31040026

Dec 2018 -0.861802168 512.2242 16.63757255

Jan 2019 -0.162542548 516.6683 8.14427598

Feb 2019 -4.360158686 521.3295 12.23069214

Mar 2019 -1.407773293 525.9907 -5.08289322

Apr 2019 -0.497382334 529.7257 -5.82827410

May 2019 -0.959766811 533.4606 -9.95087955

Jun 2019 -1.452507280 536.4222 -4.21968119

Jul 2019 1.090479341 539.3837 -5.17420993

Aug 2019 3.357076007 542.3745 0.96841193

Sep 2019 3.892718823 545.3653 6.34198764

Oct 2019 1.352252857 547.9586 12.23915984

Nov 2019 0.009407083 550.5519 4.78871185

Dec 2019 -0.861802168 551.7766 2.38524848

Jan 2020 -0.162542548 553.0012 7.61131623

Feb 2020 -4.360158686 552.4468 7.21334860

Mar 2020 -1.407773293 551.8924 6.01537944

Apr 2020 -0.497382334 550.3236 4.92374418

May 2020 -0.959766811 548.7549 -2.74511565

Jun 2020 -1.452507280 547.4009   3.35162937

Jul 2020 1.090479341 546.0469 -4.38735270

Aug 2020 3.357076007 547.6019 -14.35899965

Sep 2020 3.892718823 549.1570 -14.34969275

Oct 2020 1.352252857 551.3259 -10.87816048

Nov 2020 0.009407083 553.4948 -15.25424841

Dec 2020 -0.861802168 555.8688 -12.85701059

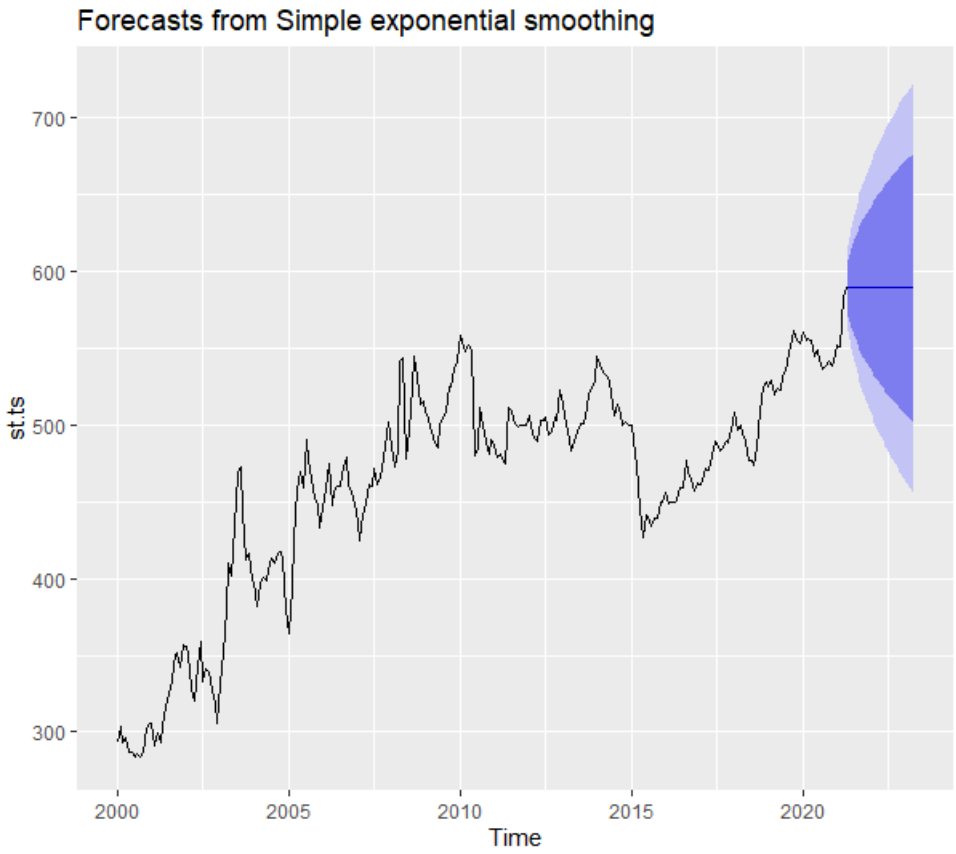
Jan 2021 -0.162542548 558.2428 -5.93024165

Feb 2021 -4.360158686 560.9754 -6.01522743

Mar 2021 -1.407773293 563.7080 20.99978527

Apr 2021 -0.497382334 566.8033 23.04412663

```
#single expo smoothing
stseas= ses(st.ts,h=24)
autoplot(stseas)
```



stseas$model

summary(stseas)

Simple exponential smoothing

Call:

ses(y = st.ts, h = 24)

Smoothing parameters:

alpha = 0.9999

Initial states:

l = 293.4672

sigma: 14.0461

AIC AICc BIC

2776.439 2776.534 2787.074

> summary(stseas)

Forecast method: Simple exponential smoothing

Model Information:

Simple exponential smoothing

Call:

ses(y = st.ts, h = 24)

Smoothing parameters:

alpha = 0.9999

Initial states:

l = 293.4672

sigma: 14.0461

AIC AICc BIC

2776.439 2776.534 2787.074

Error measures:

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	1.155905	13.99115	9.881256	0.2229322	2.222652	0.3016857	0.1291811

Forecasts:

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
May 2021	589.3494	571.3486	607.3502	561.8195	616.8793
Jun 2021	589.3494	563.8936	614.8051	550.4182	628.2806
Jul 2021	589.3494	558.1731	620.5257	541.6694	637.0294
Aug 2021	589.3494	553.3504	625.3484	534.2937	644.4051
Sep 2021	589.3494	549.1015	629.5973	527.7956	650.9032
Oct 2021	589.3494	545.2602	633.4386	521.9208	656.7780
Nov 2021	589.3494	541.7278	636.9710	516.5184	662.1804
Dec 2021	589.3494	538.4398	640.2590	511.4899	667.2089
Jan 2022	589.3494	535.3517	643.3471	506.7671	671.9317
Feb 2022	589.3494	532.4309	646.2679	502.3001	676.3987
Mar 2022	589.3494	529.6528	649.0460	498.0514	680.6474
Apr 2022	589.3494	526.9984	651.7004	493.9918	684.7070
May 2022	589.3494	524.4525	654.2463	490.0981	688.6007
Jun 2022	589.3494	522.0027	656.6961	486.3515	692.3473
Jul 2022	589.3494	519.6390	659.0598	482.7365	695.9623

Aug 2022 589.3494 517.3528 661.3460 479.2401 699.4586

Sep 2022 589.3494 515.1371 663.5617 475.8514 702.8474

Oct 2022 589.3494 512.9856 665.7132 472.5610 706.1378

Nov 2022 589.3494 510.8930 667.8058 469.3607 709.3380

Dec 2022 589.3494 508.8549 669.8439 466.2437 712.4551

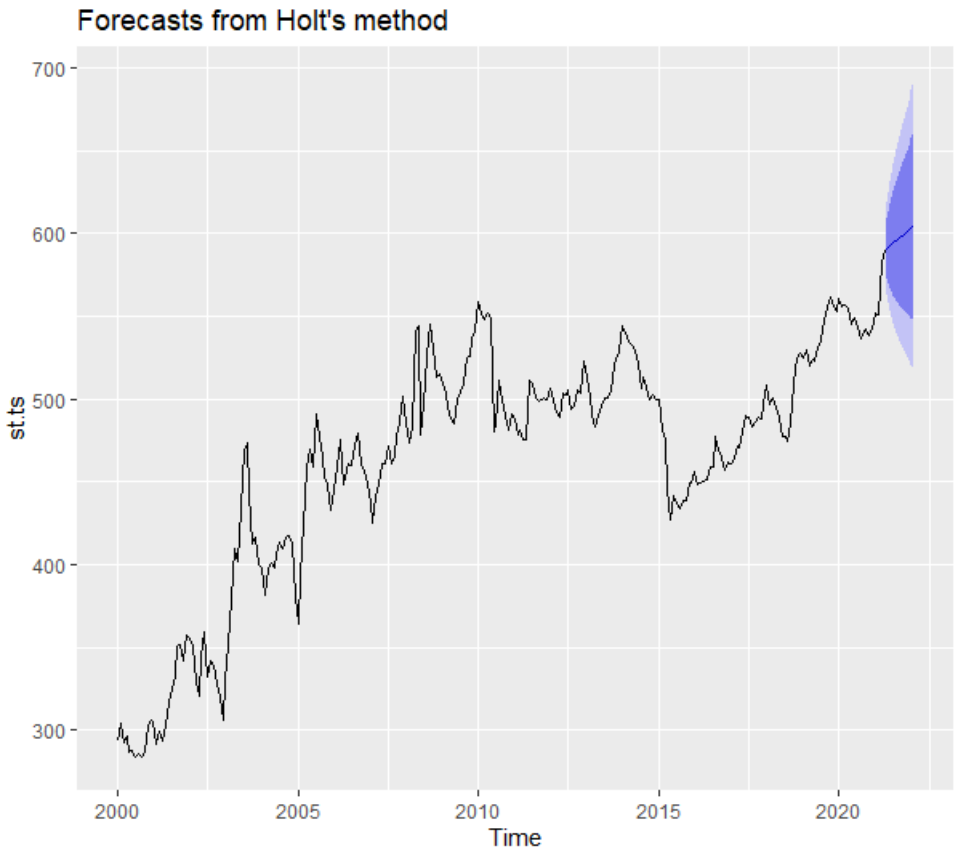
Jan 2023 589.3494 506.8671 671.8317 463.2036 715.4952

Feb 2023 589.3494 504.9261 673.7727 460.2351 718.4637

Mar 2023 589.3494 503.0287 675.6701 457.3333 721.3655

Apr 2023 589.3494 501.1722 677.5266 454.4939 724.2049

```
#with holt
stholt= holt(st.ts,t.h=24)
autoplot(stholt)
```



stholt$model

summary(stholt)

Holt's method

Call:

holt(y = st.ts, t.h = 24)

Smoothing parameters:

alpha = 0.9999

beta = 1e-04

Initial states:

l = 298.2966

b = 1.5574

sigma: 14.0653

AIC AICc BIC

2779.113 2779.353 2796.839

> summary(stholt)

Forecast method: Holt's method

Model Information:

Holt's method

Call:

holt(y = st.ts, t.h = 24)

Smoothing parameters:

alpha = 0.9999

beta = 1e-04

Initial states:

l = 298.2966

b = 1.5574

sigma: 14.0653

AIC AICc BIC

2779.113 2779.353 2796.839

Error measures:

ME RMSE MAE MPE MAPE MASE ACF1

Training set -0.4168627 13.95496 9.935464 -0.1307381 2.240328 0.3033407 0.128173

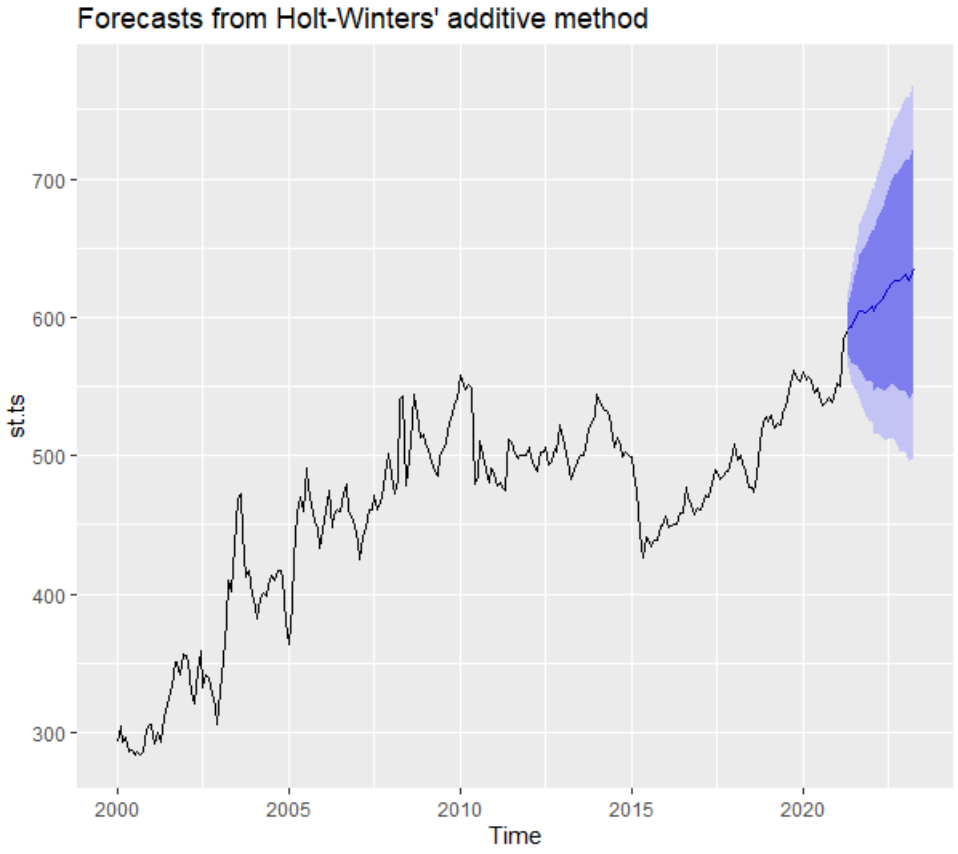
Forecasts:

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
May 2021	590.8963	572.8709	608.9216	563.3288	618.4637
Jun 2021	592.4430	566.9512	617.9347	553.4567	631.4292
Jul 2021	593.9897	562.7678	625.2116	546.2399	641.7395
Aug 2021	595.5364	559.4829	631.5899	540.3974	650.6754
Sep 2021	597.0831	556.7723	637.3939	535.4330	658.7332
Oct 2021	598.6298	554.4695	642.7902	531.0924	666.1672
Nov 2021	600.1765	552.4756	647.8774	527.2243	673.1288
Dec 2021	601.7232	550.7264	652.7201	523.7303	679.7162
Jan 2022	603.2700	549.1770	657.3629	520.5419	685.9980

#with holtwinter

stholtwinter= hw(st.ts,t.h=24,seasonal = "a")

autoplot(stholtwinter)



stholtwinter$model

summary(stholtwinter)

Holt-Winters' additive method

Call:

hw(y = st.ts, seasonal = "a", t.h = 24)

Smoothing parameters:

alpha = 0.998

beta = 1e-04

gamma = 1e-04

```
  Initial states:
    l = 275.6449
    b = 1.9152
    s = -0.1511 -0.3198 2.0063 4.1462 3.6223 1.4856
          -1.5113 -1.033 -1.3125 -2.1753 -5.2552 0.4978

  sigma:  14.3256

     AIC     AICc      BIC
2800.012 2802.584 2860.280
> summary(stholtwinter)

Forecast method: Holt-Winters' additive method

Model Information:
Holt-Winters' additive method

Call:
 hw(y = st.ts, seasonal = "a", t.h = 24)

  Smoothing parameters:
    alpha = 0.998
    beta  = 1e-04
```

gamma = 1e-04

Initial states:

l = 275.6449

b = 1.9152

s = -0.1511 -0.3198 2.0063 4.1462 3.6223 1.4856

-1.5113 -1.033 -1.3125 -2.1753 -5.2552 0.4978

sigma: 14.3256

AIC AICc BIC

2800.012 2802.584 2860.280

Error measures:

ME RMSE MAE MPE MAPE MASE ACF1

Training set -0.6786758 13.8707 9.821967 -0.1778904 2.224525 0.2998755 0.1397126

Forecasts:

Point Forecast Lo 80 Hi 80 Lo 95 Hi 95

May 2021 591.5176 573.1586 609.8766 563.4400 619.5953

Jun 2021 592.9321 566.9925 618.8717 553.2609 632.6033

Jul 2021 597.8218 566.0609 629.5828 549.2477 646.3960

Aug 2021 601.8537 565.1831 638.5243 545.7708 657.9366

Sep 2021 604.2710 563.2735 645.2685 541.5708 666.9713

Oct 2021 604.0242 559.1139 648.9345 535.3398 672.7086

Nov 2021 603.5948 555.0854 652.1042 529.4061 677.7835

Dec 2021 605.6531 553.7930 657.5132 526.3399 684.9663

Jan 2022 608.1998 553.1919 663.2076 524.0725 692.3270

Feb 2022 604.3421 546.3564 662.3278 515.6607 693.0235

Mar 2022 609.3120 548.4935 670.1306 516.2981 702.3260

Apr 2022 612.0689 548.5430 675.5948 514.9145 709.2234

May 2022 614.2428 548.1192 680.3664 513.1155 715.3701

Jun 2022 615.6572 547.0341 684.2804 510.7072 720.6073

Jul 2022 620.5470 549.5116 691.5824 511.9077 729.1862

Aug 2022 624.5788 551.2099 697.9478 512.3708 736.7869

Sep 2022 626.9962 551.3651 702.6272 511.3285 742.6639

Oct 2022 626.7493 548.9213 704.5773 507.7217 745.7770

Nov 2022 626.3199 546.3548 706.2851 504.0239 748.6160

Dec 2022 628.3783 546.3312 710.4253 502.8981 753.8584

Jan 2023 630.9249 546.8469 715.0029 502.3387 759.5112

Feb 2023 627.0673 541.0057 713.1288 495.4475 758.6870

Mar 2023 632.0372 544.0364 720.0380 497.4516 766.6228

Apr 2023 634.7941 544.8954 724.6928 497.3059 772.2823

3)Using Arima

```
> library(forecast)
> library(smooth)
```

```
> library(ggplot2)
> library(fpp2)
> library(tseries)
> library(imputeTS)
> st.arima <- read.csv("E://fffiiles//college pracs and projects//ai ccsp//pro//HDFC.csv")
> dim(st.arima)
[1] 5306   15
> names(st.arima)
 [1] "Date"             "Symbol"           "Series"           "Prev.Close"
"Open"             "High"             "Low"
 [8] "Last"             "Close"            "VWAP"             "Volume"
"Turnover"         "Trades"           "Deliverable.Volume"
[15] "X.Deliverble"
> attach(st.arima)
The following objects are masked from st.arima (pos = 4):

    Close, Date, Deliverable.Volume, High, Last, Low, Open, Prev.Close,
Series, Symbol, Trades, Turnover, Volume, VWAP, X.Deliverble

> #transforming raw data then plotting as well
> st.ts.arima=ts(st.arima[,9],start =
c(2000,1),end=c(2021,4),frequency=12)
> st.ts.arima
```

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2000 293.50 304.05 292.80 296.45 286.55 287.20 283.85 285.60 283.85 286.55 302.20 305.75

2001 305.25 291.35 299.55 293.05 303.15 316.60 324.40 333.50 350.55 351.40 341.90 357.20

2002 355.45 350.50 329.15 320.35 343.65 359.15 332.60 341.60 339.20 327.90 319.15 305.95

2003 330.45 351.70 379.85 409.70 401.70 433.85 468.60 473.05 443.50 412.20 416.70 399.60

2004 397.55 381.60 396.65 400.50 398.20 406.35 413.25 409.85 416.80 417.40 412.70 380.30

2005 363.85 393.00 424.45 458.45 469.80 459.25 490.95 477.70 464.30 453.25 448.70 433.10

2006 445.40 459.35 475.10 448.05 456.90 460.65 460.15 472.35 479.35 460.85 455.75 449.00

2007 437.55 424.95 441.75 448.65 461.05 460.40 471.75 461.35 465.45 477.65 486.15 501.90

2008 486.40 473.00 483.30 541.30 543.65 478.45 496.35 525.35 544.70 530.70 513.20 515.25

2009 509.35 503.60 495.35 488.20 484.85 499.85 504.10 509.20 525.10 525.35 536.25 541.15

2010 558.20 551.55 548.15 551.65 548.70 480.00 484.65 511.25 499.90 489.85 481.20 490.55

2011 487.65 478.55 480.95 475.55 475.30 511.65 509.25 501.00 498.40 499.75 500.30 500.05

2012 505.90 499.30 491.75 489.15 503.15 502.75 505.55 493.55 496.05 504.95 503.15 522.80

2013 513.00 501.10 490.40 482.90 489.60 495.35 500.50 500.70 505.00 520.15 524.05 528.25

2014 544.60 539.95 534.30 532.20 529.45 520.65 506.00 513.55 507.50 499.55 502.05 500.00

2015 499.70 481.00 474.95 445.15 426.55 441.05 437.85 433.90 439.00 439.00 449.45 449.25

2016 455.95 448.60 449.65 450.00 450.85 458.80 458.75 477.40 469.75 464.65 457.35 462.20

2017 461.30 464.10 471.45 470.25 480.00 489.85 488.50 482.90 485.60 489.00 488.20 496.85

2018 508.05 496.80 500.40 494.65 489.20 477.35 477.25 474.15 485.50 509.40 525.10 528.00

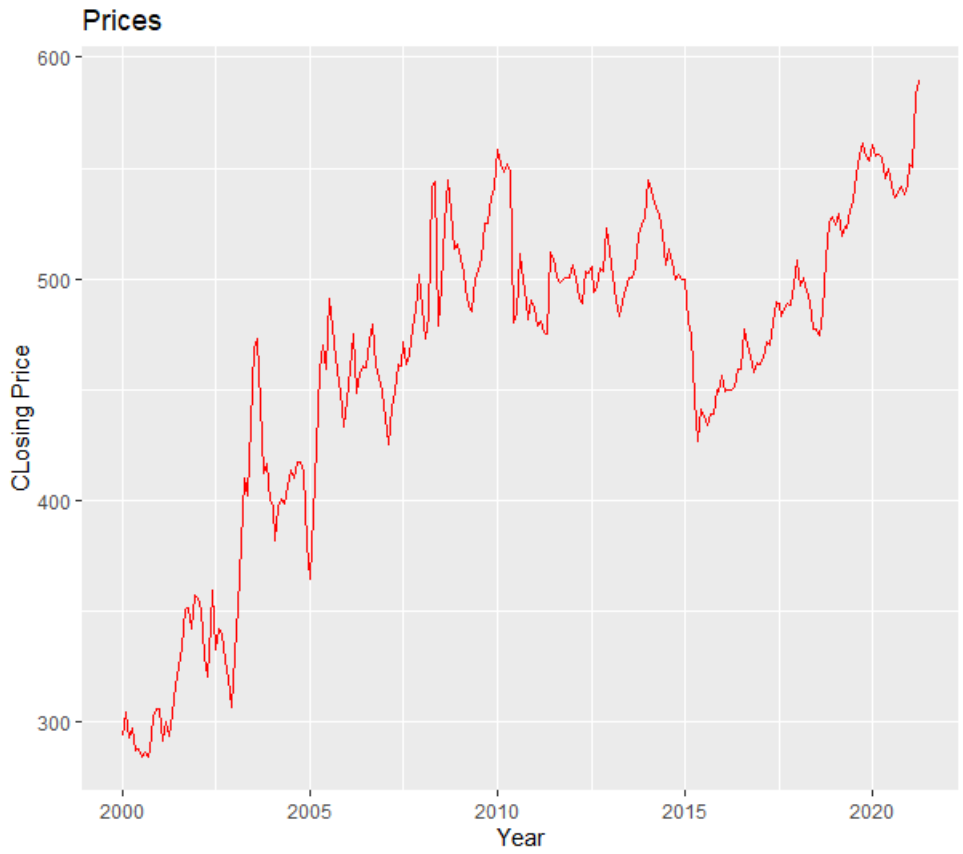
2019 524.65 529.20 519.50 523.40 522.55 530.75 535.30 546.70 555.60 561.55 555.35 553.30

2020 560.45 555.30 556.50 554.75 545.05 549.30 542.75 536.60 538.70 541.80 538.25 542.15

2021 552.15 550.60 583.30 589.35

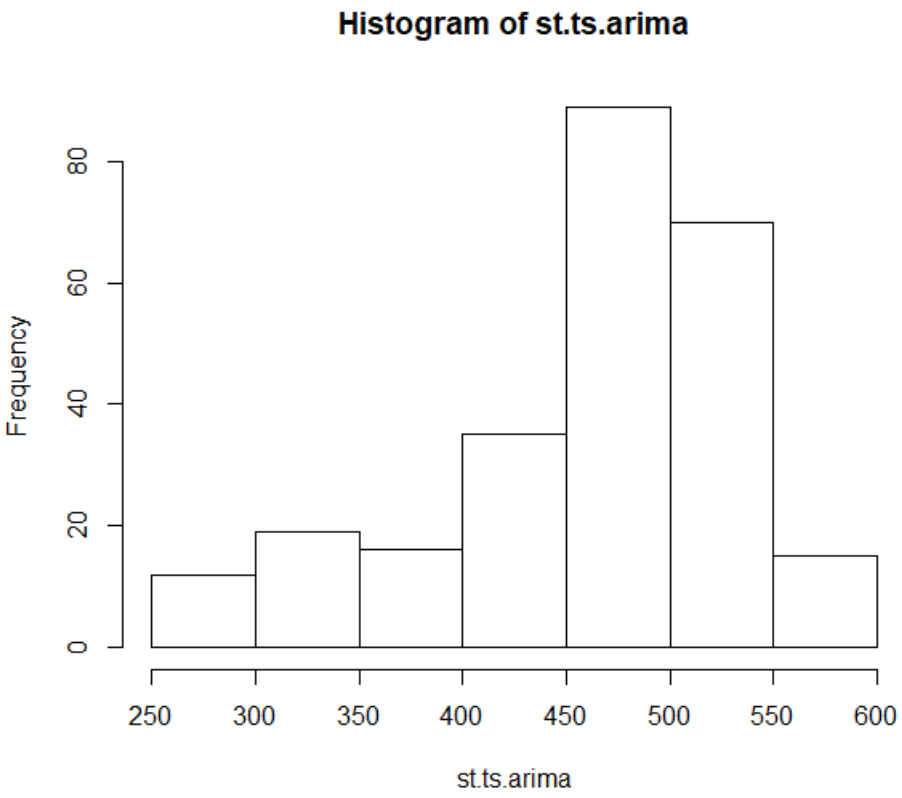
> #here is the plot for arima

> autoplot(st.ts.arima)+ ggtitle("Prices")+xlab("Year")+ylab("CLosing Price")+geom_line(color="red")

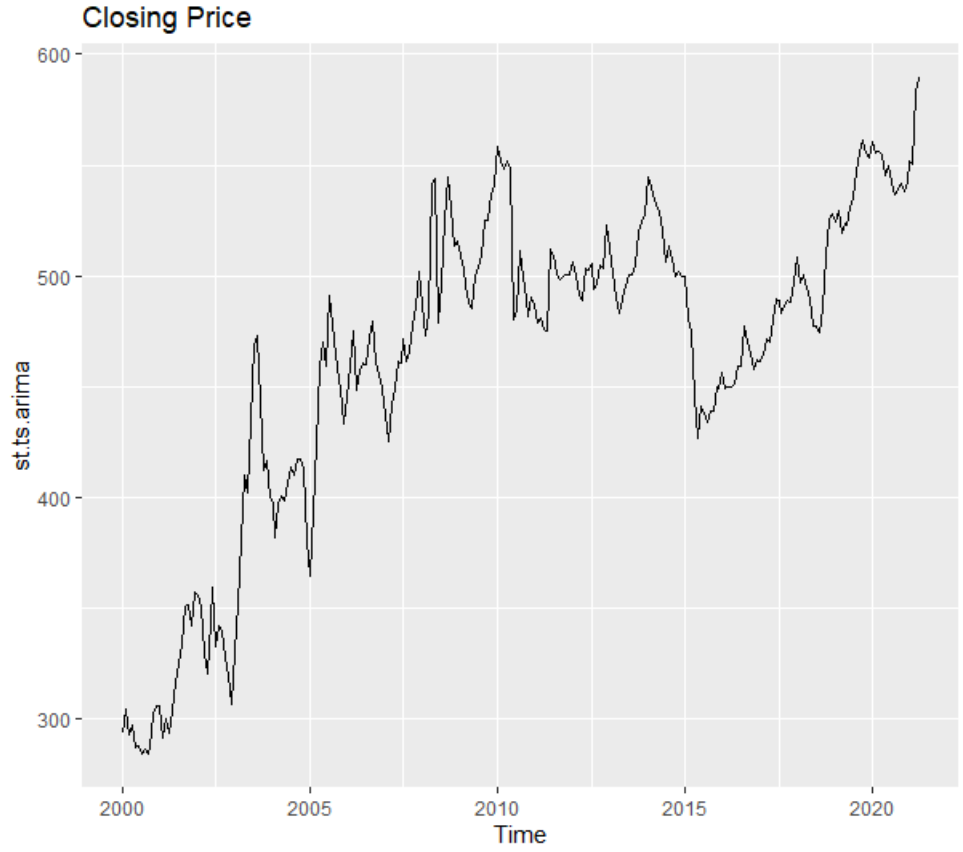


#histogram fot stationary data

hist(st.ts.arima)



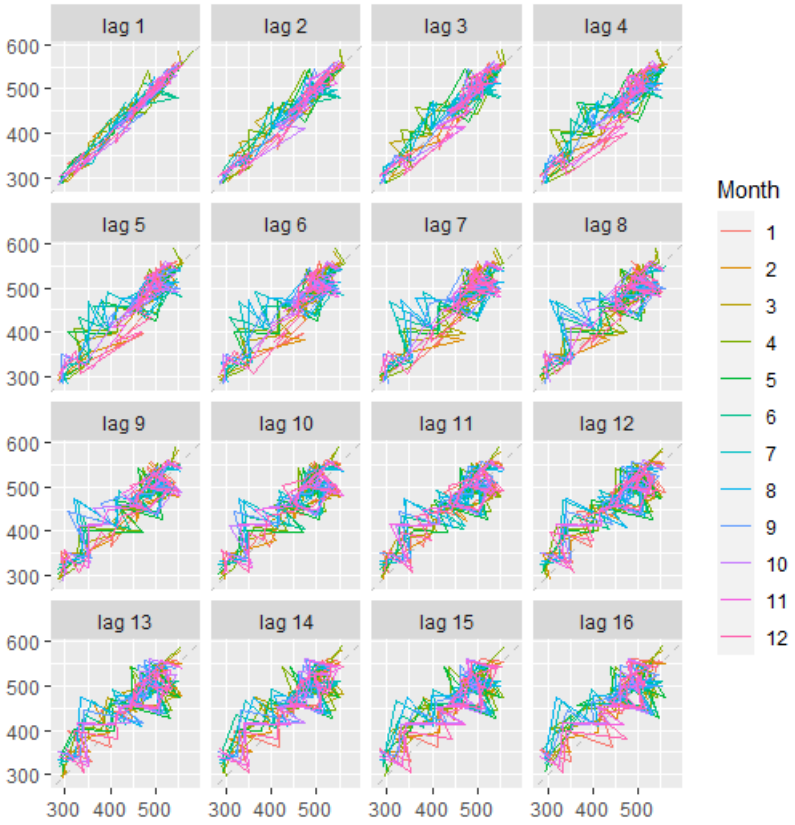
autoplot(st.ts.arima,main="Closing Price")



#to see lag

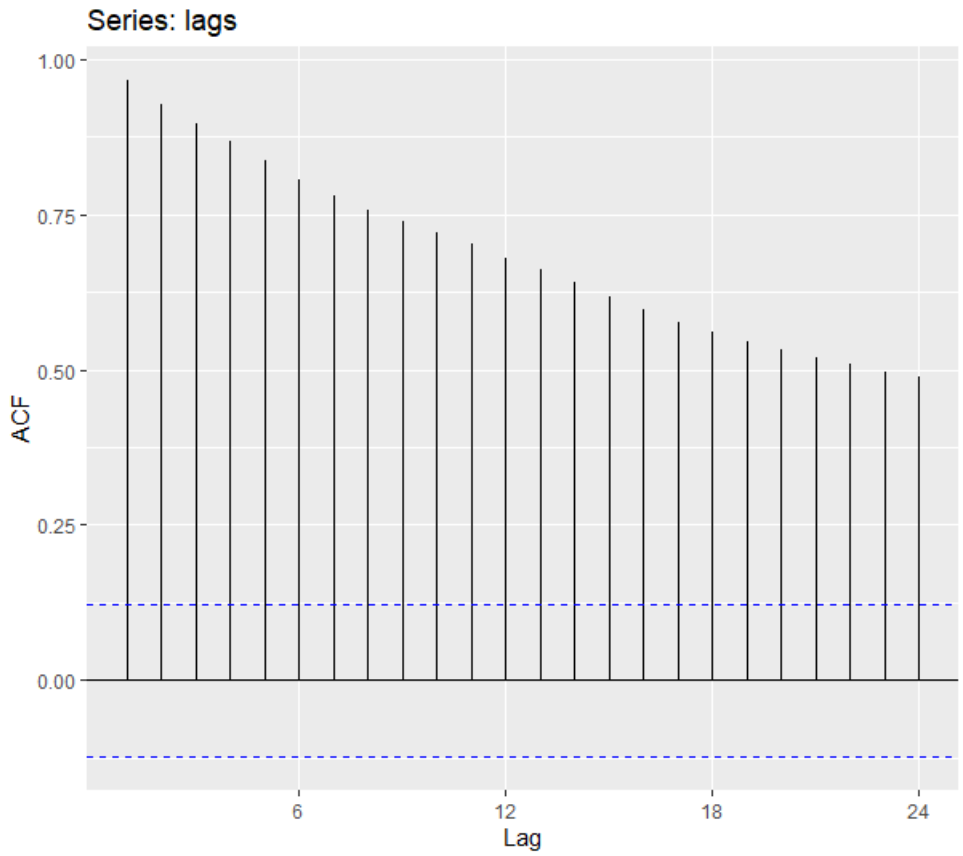
lags=window(st.ts.arima,start=c(2000,1),end=c(2021,4))

gglagplot(lags)



ggAcf(lags)

#stattistcial test



> adf.test(st.ts.arima)

Augmented Dickey-Fuller Test

data: st.ts.arima

Dickey-Fuller = -2.5918, Lag order = 6, p-value = 0.3266

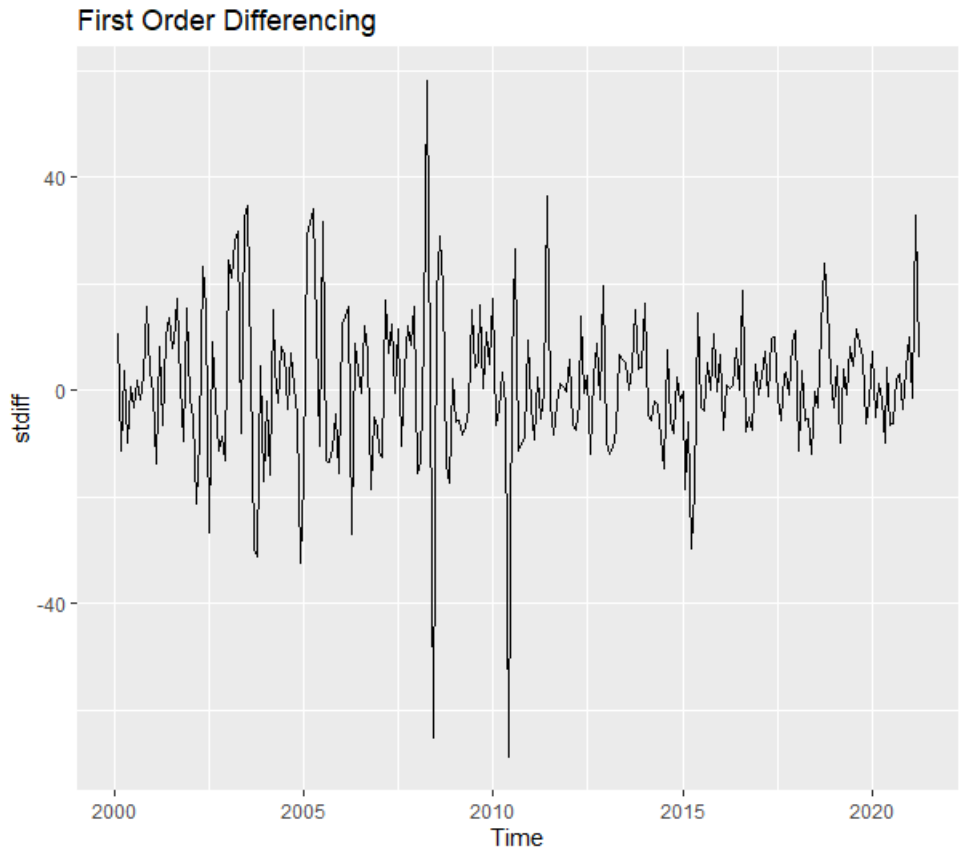
alternative hypothesis: stationary

>

> #making stationary data

> stdiff=diff(st.ts.arima)

> autoplot(stdiff,main="First Order Differencing")

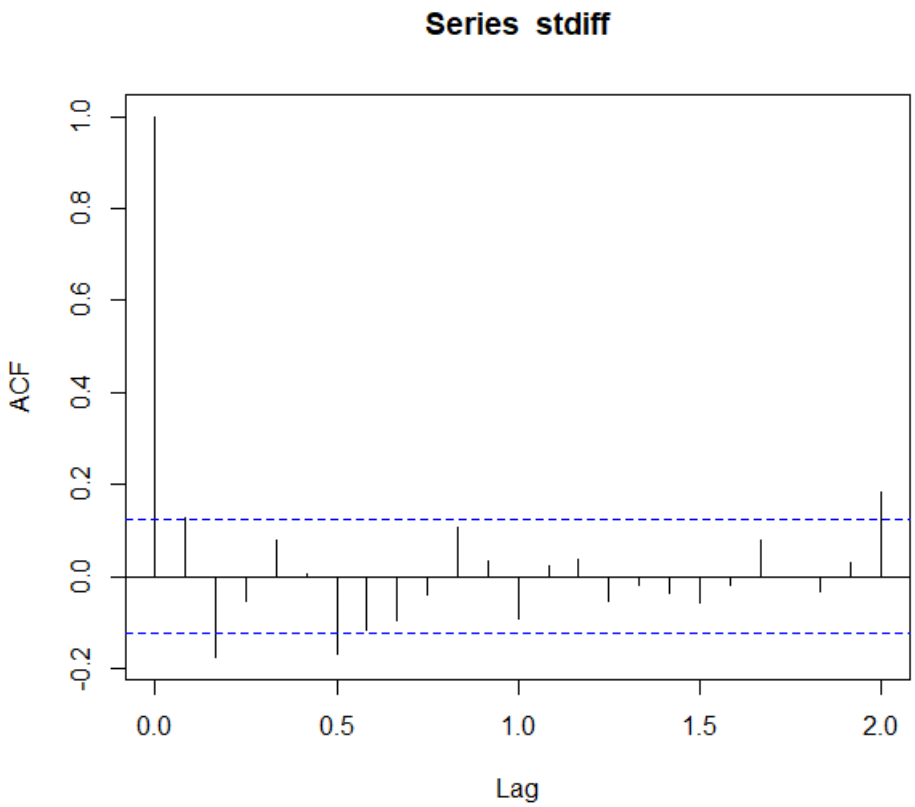



```
adf.test(stdiff,alternative = "stationary",k=0)

        Augmented Dickey-Fuller Test

data:  stdiff
Dickey-Fuller = -13.921, Lag order = 0, p-value = 0.01
alternative hypothesis: stationary

Warning message:
In adf.test(stdiff, alternative = "stationary", k = 0) :
  p-value smaller than printed p-value
>
```

> #to see corelation using acf and pacf

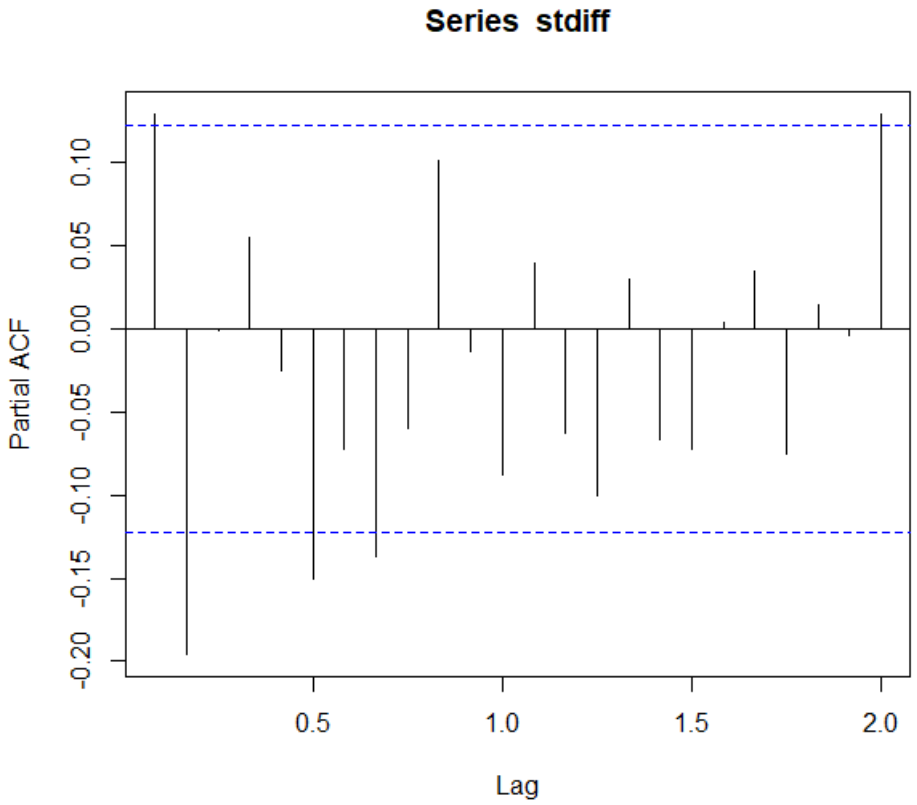
>

> acf(stdiff)



>

> pacf(stdiff)



>

> #split data

> sttrain = window(st.ts.arima,end=c(2019,1),frequency=12)

> sttest = window(st.ts.arima,start=c(2019,2),frequency=12)

>

> sttrain

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2000 293.50 304.05 292.80 296.45 286.55 287.20 283.85 285.60 283.85 286.55 302.20 305.75

2001 305.25 291.35 299.55 293.05 303.15 316.60 324.40 333.50 350.55 351.40 341.90 357.20

2002 355.45 350.50 329.15 320.35 343.65 359.15 332.60 341.60 339.20 327.90 319.15 305.95

2003 330.45 351.70 379.85 409.70 401.70 433.85 468.60 473.05 443.50 412.20 416.70 399.60

2004 397.55 381.60 396.65 400.50 398.20 406.35 413.25 409.85 416.80 417.40 412.70 380.30

2005 363.85 393.00 424.45 458.45 469.80 459.25 490.95 477.70 464.30 453.25 448.70 433.10

2006 445.40 459.35 475.10 448.05 456.90 460.65 460.15 472.35 479.35 460.85 455.75 449.00

2007 437.55 424.95 441.75 448.65 461.05 460.40 471.75 461.35 465.45 477.65 486.15 501.90

2008 486.40 473.00 483.30 541.30 543.65 478.45 496.35 525.35 544.70 530.70 513.20 515.25

2009 509.35 503.60 495.35 488.20 484.85 499.85 504.10 509.20 525.10 525.35 536.25 541.15

2010 558.20 551.55 548.15 551.65 548.70 480.00 484.65 511.25 499.90 489.85 481.20 490.55

2011 487.65 478.55 480.95 475.55 475.30 511.65 509.25 501.00 498.40 499.75 500.30 500.05

2012 505.90 499.30 491.75 489.15 503.15 502.75 505.55 493.55 496.05 504.95 503.15 522.80

2013 513.00 501.10 490.40 482.90 489.60 495.35 500.50 500.70 505.00 520.15 524.05 528.25

2014 544.60 539.95 534.30 532.20 529.45 520.65 506.00 513.55 507.50 499.55 502.05 500.00

2015 499.70 481.00 474.95 445.15 426.55 441.05 437.85 433.90 439.00 439.00 449.45 449.25

2016 455.95 448.60 449.65 450.00 450.85 458.80 458.75 477.40 469.75 464.65 457.35 462.20

2017 461.30 464.10 471.45 470.25 480.00 489.85 488.50 482.90 485.60 489.00 488.20 496.85

2018 508.05 496.80 500.40 494.65 489.20 477.35 477.25 474.15 485.50 509.40 525.10 528.00

2019 524.65

> sttest

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2019 529.20 519.50 523.40 522.55 530.75 535.30 546.70 555.60 561.55 555.35 553.30

2020 560.45 555.30 556.50 554.75 545.05 549.30 542.75 536.60 538.70 541.80 538.25 542.15

2021 552.15 550.60 583.30 589.35

#auto arima model

>

> autoarima.train=auto.arima(sttrain,seasonal = TRUE, ic="bic")

> autoarima.train

Series: sttrain

ARIMA(0,1,0)

sigma^2 estimated as 210.9: log likelihood=-933.56

AIC=1869.13 AICc=1869.15 BIC=1872.56

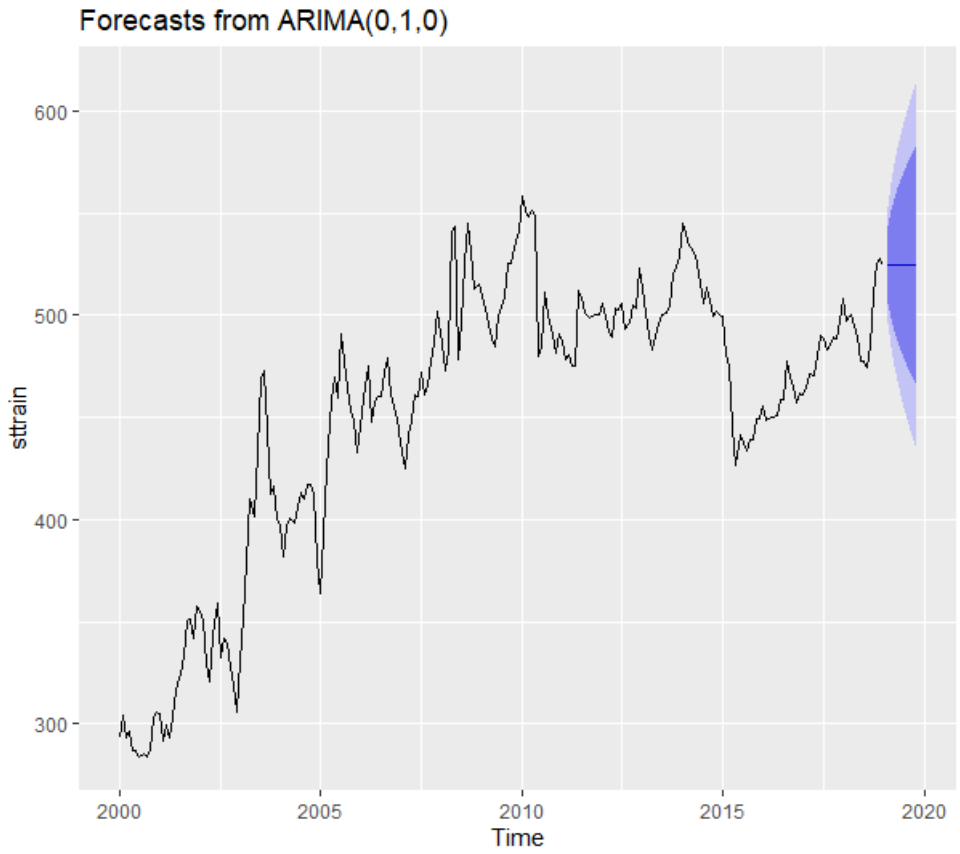
>

>

> #camparing values to see accuracy levels

> autoarima.train.forecast=forecast(autoarima.train,h=10)

> autoplot(autoarima.train.forecast)



>

#accuracy

> rmse=sqrt(mean(sttest-autoarima.train.forecast$mean)^2)

> rmse

[1] 13.34

>

> accuracy(autoarima.train.forecast,sttest)

ME RMSE MAE MPE MAPE MASE ACF1 Theil's U

Training set 1.01067 14.48991 10.30019 0.2002216 2.349842 0.3109416 0.1326448 NA

Test set 13.34000 19.87973 15.04000 2.4069596 2.733367 0.4540267 0.8021589 2.785558

>

> #residuals

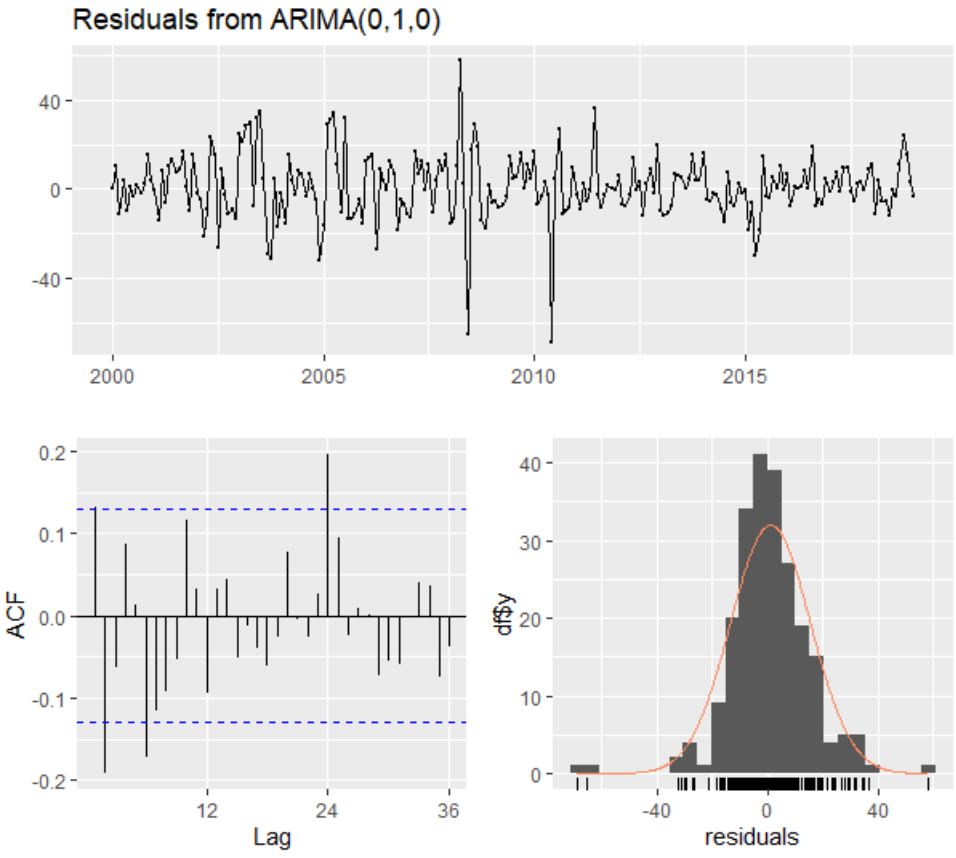
> checkresiduals(autoarima.train.forecast)

Ljung-Box test

data: Residuals from ARIMA(0,1,0)

Q* = 48.477, df = 24, p-value = 0.002202

Model df: 0. Total lags used: 24



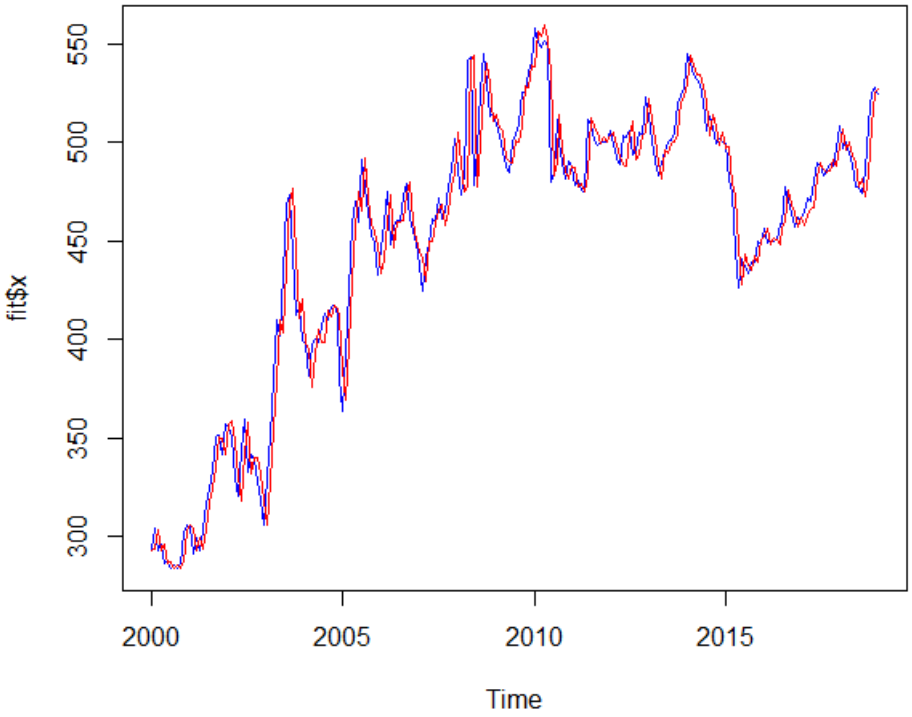
#fitarimamodel

>

> fit=Arima(sttrain, c(0,1,0),seasonal = list(order=c(2,0,0),period=12))

> plot(fit$x,col="blue")

> lines(fit$fitted,col="red",main="Actucal VS forecast")



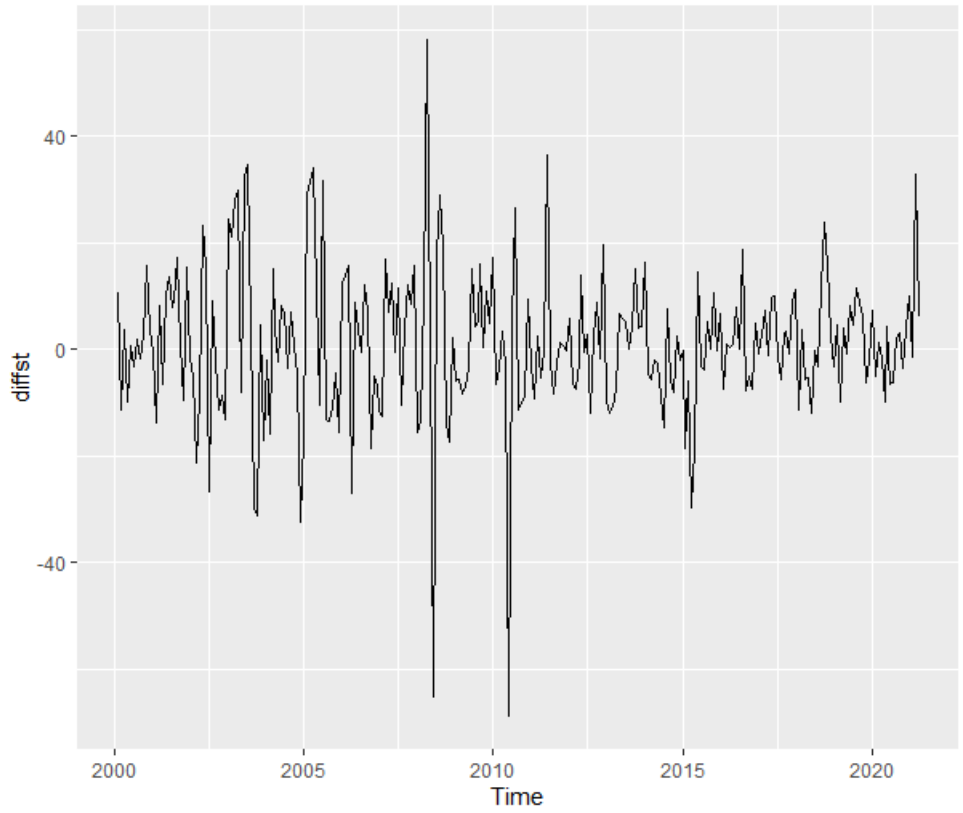
>

> #TO see variance and remove

>

> diffst= diff(st.ts.arima)

> autoplot(diffst)

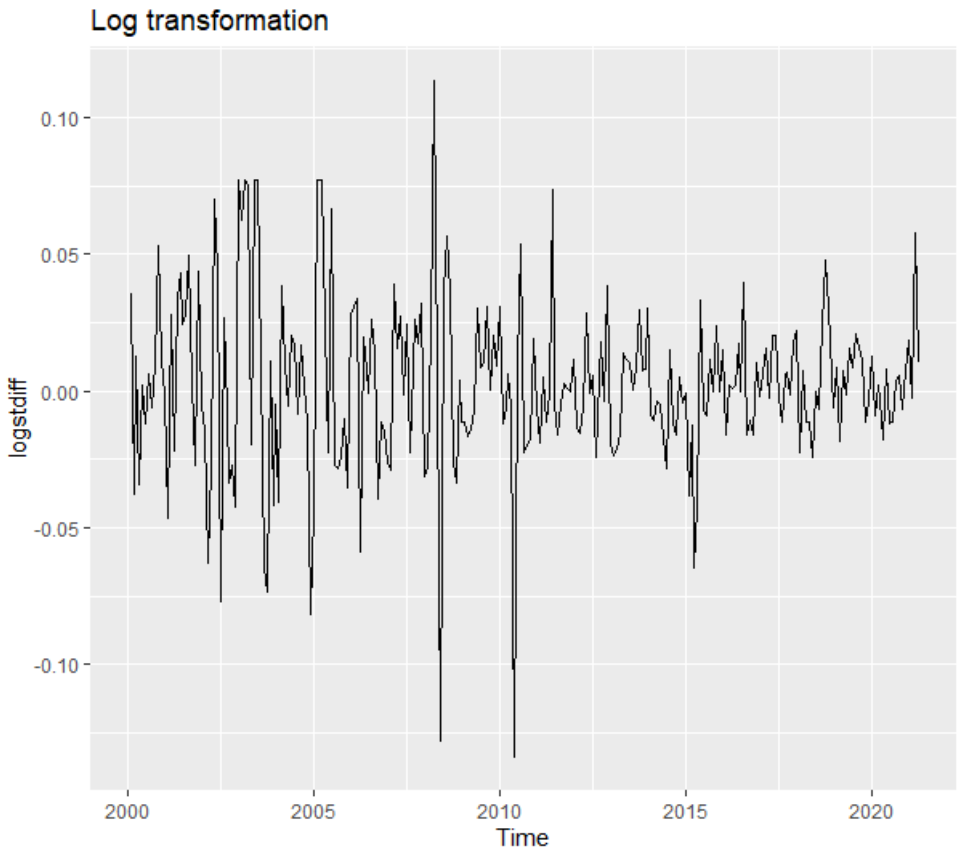


#log

>

> logstdiff=diff(log(st.ts.arima))

> autoplot(logstdiff,main="Log transformation")



>

>

> adf.test(diffst)

Augmented Dickey-Fuller Test

data: diffst

Dickey-Fuller = -7.2811, Lag order = 6, p-value = 0.01

alternative hypothesis: stationary

Warning message:

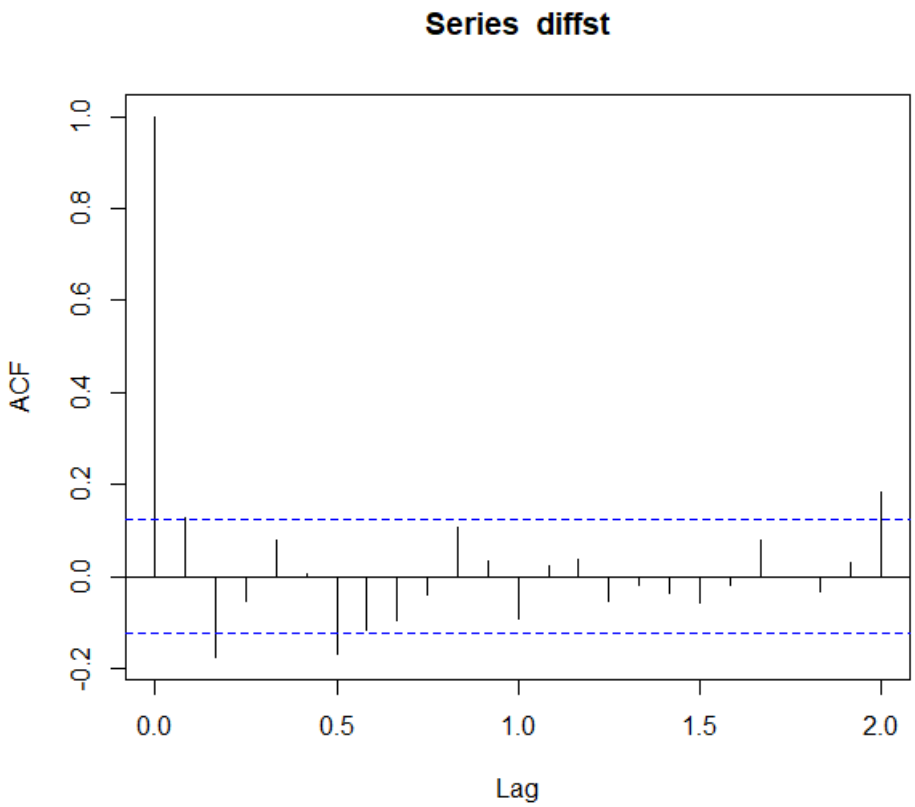
In adf.test(diffst) : p-value smaller than printed p-value

>

>

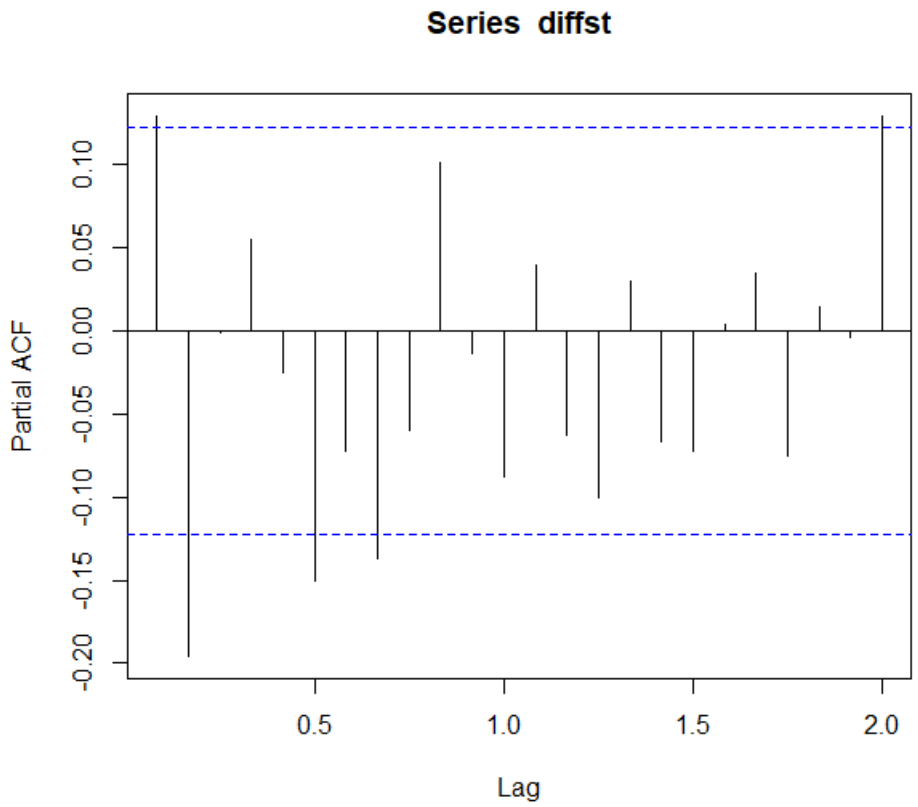
>

> acf(diffst)

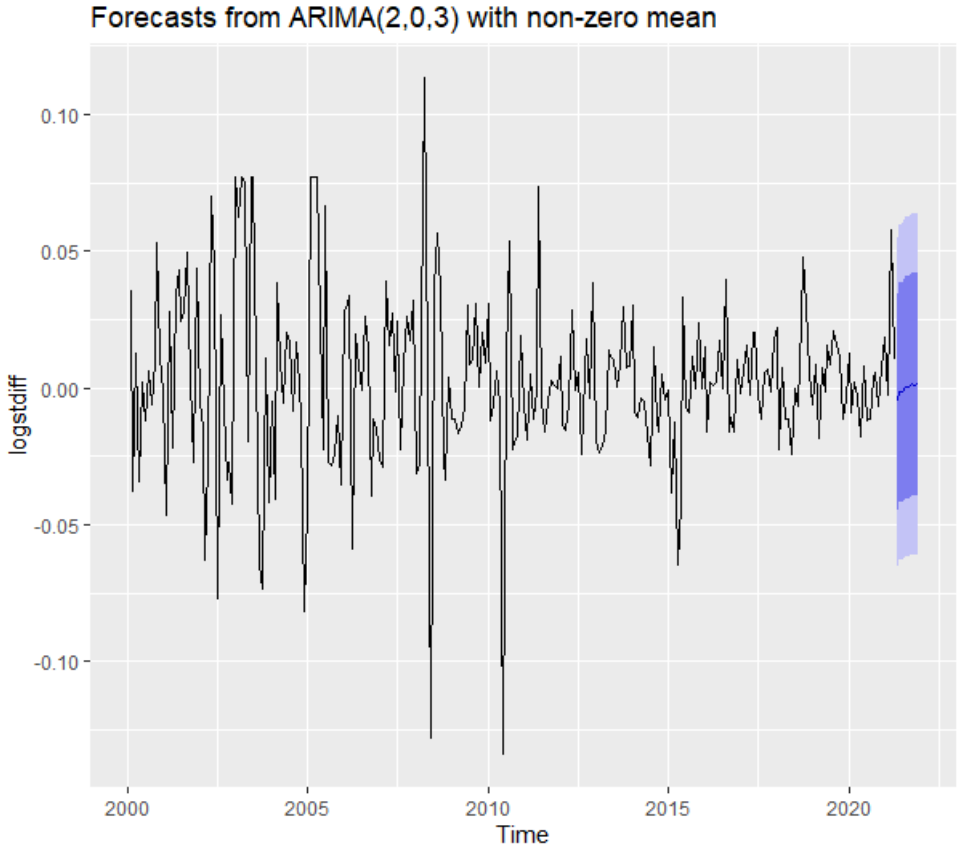


>

> pacf(diffst)



autoplot(forecast(auto.arima(logstdiff),h=8))



>

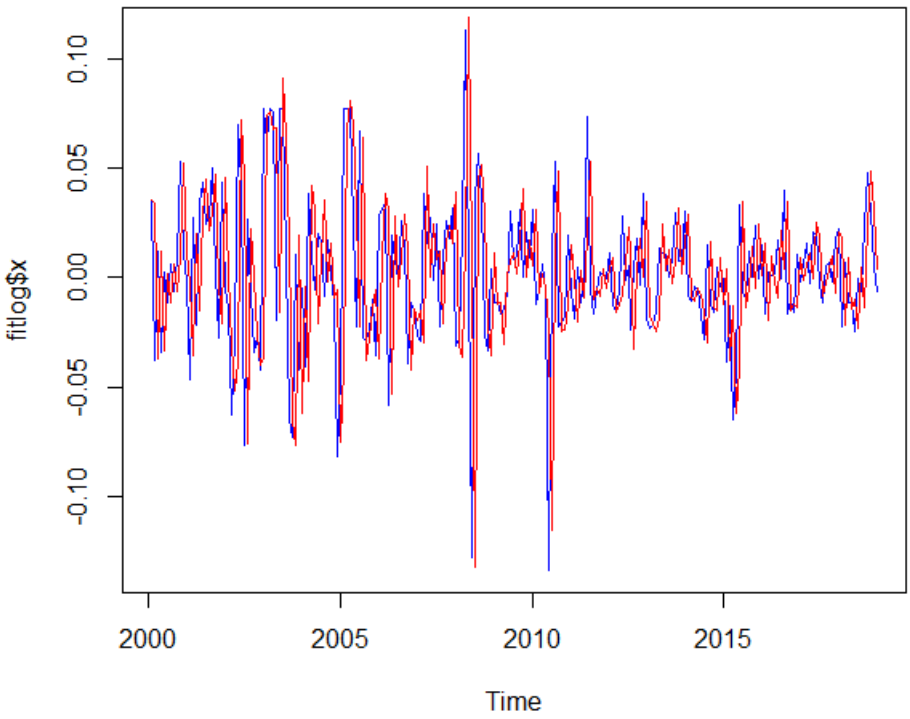
> logtrain=window(logstdiff,end=c(2019,1),frequency=12)

> logtest=window(logstdiff,start=c(2019,2),frequency=12)

>

> fitlog=Arima(logtrain, c(0,1,0),seasonal = list(order=c(2,0,0),period=12))

> plot(fitlog$x,col="blue")

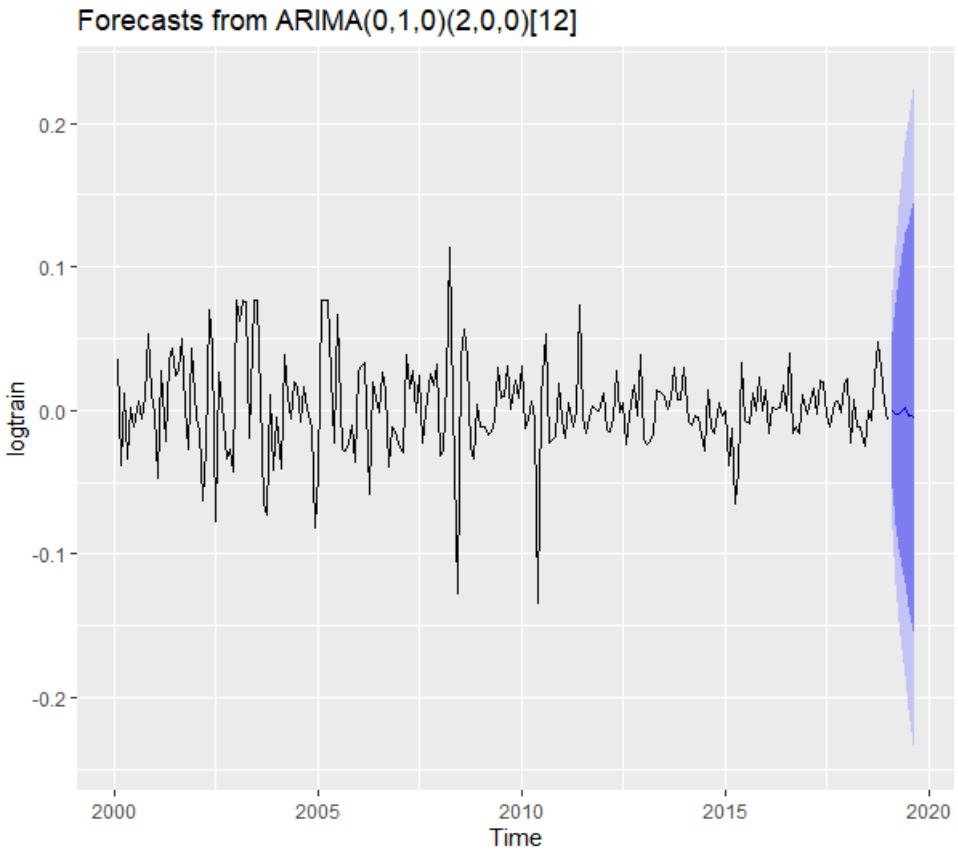


> lines(fitlog$fitted,col="red",main="Actucal VS forecast with log trandormation")

>

> logforecast= forecast(fitlog,h=8)

> autoplot(logforecast)



>

> accuracy(fitlog)

	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	-0.0001748147	0.04218236	0.02991583	-Inf	Inf	0.843532	-0.3276072

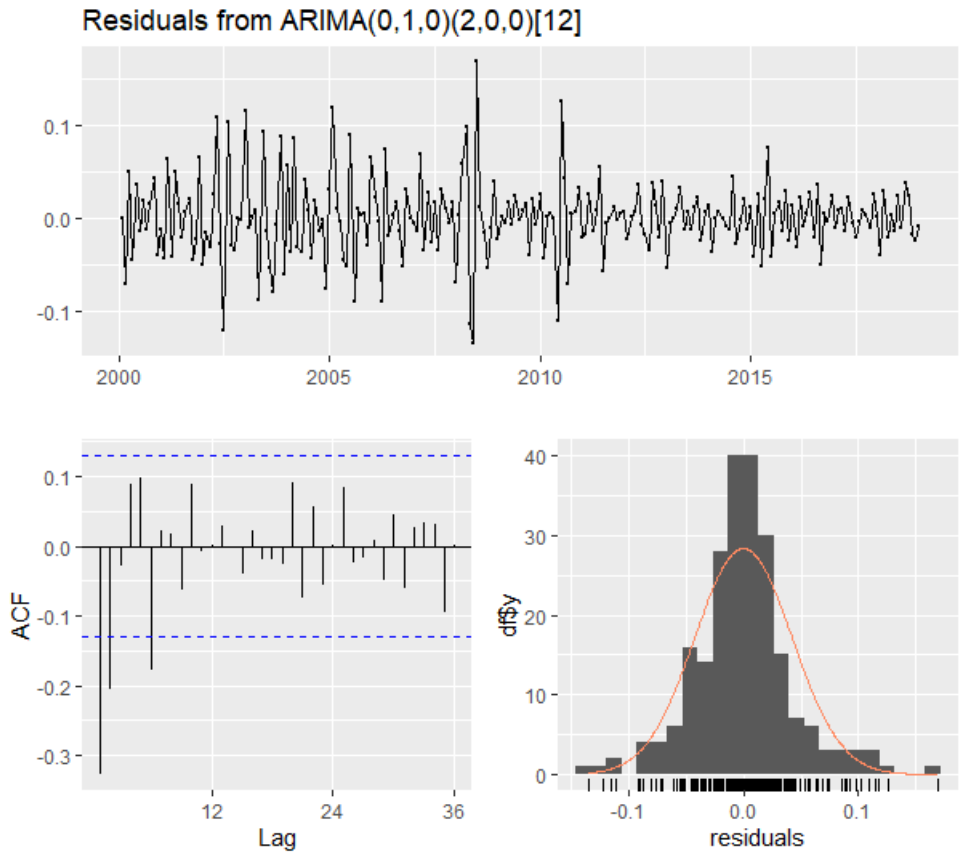
> checkresiduals(fitlog)

Ljung-Box test

data: Residuals from ARIMA(0,1,0)(2,0,0)[12]

Q* = 55.638, df = 22, p-value = 9.635e-05

Model df: 2. Total lags used: 24


Residuals from ARIMA(0,1,0)(2,0,0)[12]
0.1
0.0
-0.1
2000
2005
2010
2015
ACF
0.1
0.0
-0.1
-0.2
-0.3
12
24
36
Lag
df$y
40
30
20
10
0
-0.1
0.0
0.1
residuals