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**kernel70a6d58848**R notebook using data from [DJIA 30 Stock Time Series](#) · 1 views · 20d ago · [Edit tags](#)

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...

Welcome, saketgarodia1!



In [1]:

```

## Importing packages

# This R environment comes with all of CRAN and many other helpful packages preinstalled.
# You can see which packages are installed by checking out the kaggle/rstats docker image:
# https://github.com/kaggle/docker-rstats

library(tidyverse) # metapackage with lots of helpful functions

## Running code

# In a notebook, you can run a single code cell by clicking in the cell and then hitting
# the blue arrow to the left, or by clicking in the cell and pressing Shift+Enter. In a script,
# you can run code by highlighting the code you want to run and then
# clicking the blue arrow
# at the bottom of this window.

## Reading in files

# You can access files from datasets you've added to this kernel in the "../input/" directory.
# You can see the files added to this kernel by running the code below.

list.files(path = "../input")

## Saving data

# If you save any files or images, these will be put in the "output"
# directory. You
# can see the output directory by committing and running your kernel
# (using the
# Commit & Run button) and then checking out the compiled version of
# your kernel.

```

— Attaching packages ————— tidyverse 1.2.1 —

✓ ggplot2 3.2.1.9000	✓ purrr 0.3.3
✓ tibble 2.1.3	✓ dplyr 0.8.3
✓ tidyverse 1.0.0	✓ stringr 1.4.0
✓ readr 1.3.1	✓forcats 0.4.0

— Conflicts ————— tidyverse\_conflicts() —

✗ dplyr::filter()	masks stats::filter()
✗ dplyr::lag()	masks stats::lag()

'stock-time-series-20050101-to-20171231'

```
, 'gridExtra', 'forecast', 'tseries', 'TSA', 'tibble', 'TTR', 'xts'  
, 'dygraphs', 'assertthat')  
  
my.install <- function(pkg, ...){  
  if (!(pkg %in% installed.packages()[,1])) {  
    install.packages(pkg)  
  }  
  return (library(pkg, ...))  
}  
  
purrr::walk(packages, my.install, character.only = TRUE, warn.conflicts = FALSE)
```

corrplot 0.84 loaded

Registered S3 method overwritten by 'xts':  
method from  
as.zoo.xts zoo

Registered S3 method overwritten by 'quantmod':  
method from  
as.zoo.data.frame zoo

Registered S3 methods overwritten by 'forecast':  
method from  
fitted.fracdiff fracdiff  
residuals.fracdiff fracdiff

Registered S3 methods overwritten by 'TSA':  
method from  
fitted.Arima forecast  
plot.Arima forecast

Loading required package: zoo

Attaching package: 'zoo'

The following objects are masked from 'package:base':

as.Date, as.Date.numeric

In [3]:  
sample\_num = 5

In [4]:  
list.files(path = "../input/stock-time-series-20050101-to-20171231")

'AABA\_2006-01-01\_to\_2018-01-01.csv' 'AAPL\_2006-01-01\_to\_2018-01-01.csv'  
'all\_stocks\_2006-01-01\_to\_2018-01-01.csv'  
'all\_stocks\_2017-01-01\_to\_2018-01-01.csv' 'AMZN\_2006-01-01\_to\_2018-01-01.csv'



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```
CVX_2006-01-01_to_2018-01-01.csv' 'DIS_2006-01-01_to_2018-01-01.csv'
'GE_2006-01-01_to_2018-01-01.csv' 'GOOGL_2006-01-01_to_2018-01-01.csv'
'GS_2006-01-01_to_2018-01-01.csv' 'HD_2006-01-01_to_2018-01-01.csv'
'IBM_2006-01-01_to_2018-01-01.csv' 'INTC_2006-01-01_to_2018-01-01.csv'
'JNJ_2006-01-01_to_2018-01-01.csv' 'JPM_2006-01-01_to_2018-01-01.csv'
'KO_2006-01-01_to_2018-01-01.csv' 'MCD_2006-01-01_to_2018-01-01.csv'
'MMM_2006-01-01_to_2018-01-01.csv' 'MRK_2006-01-01_to_2018-01-01.csv'
'MSFT_2006-01-01_to_2018-01-01.csv' 'NKE_2006-01-01_to_2018-01-01.csv'
'PFE_2006-01-01_to_2018-01-01.csv' 'PG_2006-01-01_to_2018-01-01.csv'
'TRV_2006-01-01_to_2018-01-01.csv' 'UNH_2006-01-01_to_2018-01-01.csv'
'UTX_2006-01-01_to_2018-01-01.csv' 'VZ_2006-01-01_to_2018-01-01.csv'
'WMT_2006-01-01_to_2018-01-01.csv' 'XOM_2006-01-01_to_2018-01-01.csv'
```

In [5]:

```
google_data <- read.csv(file = "../input/stock-time-series-20050101-
-to-20171231/GOOGL_2006-01-01_to_2018-01-01.csv")
```

In [6]:

```
ibm_data <- read.csv(file = "../input/stock-time-series-20050101-to-
-20171231/IBM_2006-01-01_to_2018-01-01.csv")
```

In [7]:

```
apple_data <- read.csv(file = "../input/stock-time-series-20050101-
-to-20171231/AAPL_2006-01-01_to_2018-01-01.csv")
```

In [8]:

```
gs_data <- read.csv(file = "../input/stock-time-series-20050101-to-
-20171231/GS_2006-01-01_to_2018-01-01.csv")
```

In [9]:

```
ba_data <- read.csv(file = "../input/stock-time-series-20050101-to-
-20171231/BA_2006-01-01_to_2018-01-01.csv")
```

In [10]:

```
head(ba_data)
print(dim(ba_data))
```

A data.frame: 6 × 7

	Date	Open	High	Low	Close	Volume	Name
	<fct>	<dbl>	<dbl>	<dbl>	<dbl>	<int>	<fct>
1	2006-01-03	70.40	70.60	69.33	70.44	4943100	BA
2	2006-01-04	70.08	71.27	69.86	71.17	3165000	BA
3	2006-01-05	70.55	70.55	69.58	70.33	4598300	BA
4	2006-01-06	70.34	70.50	69.05	69.35	4820200	BA
5	2006-01-09	69.28	69.40	68.66	68.77	4567700	BA
6	2006-01-10	68.80	69.24	68.57	69.10	3869000	BA

[1] 3020 7

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A data.frame: 6 × 7

	Date	Open	High	Low	Close	Volume	Name
	<fct>	<dbl>	<dbl>	<dbl>	<dbl>	<int>	<fct>
1	2006-01-03	126.70	129.44	124.23	128.87	6188700	GS
2	2006-01-04	127.35	128.91	126.38	127.09	4862000	GS
3	2006-01-05	126.00	127.32	125.61	127.04	3717600	GS
4	2006-01-06	127.29	129.25	127.29	128.84	4319600	GS
5	2006-01-09	128.50	130.62	128.00	130.39	4723500	GS
6	2006-01-10	130.05	132.95	130.02	132.03	5539800	GS

[1] 3020 7

In [12]:

```
head(apple_data)
print(dim(apple_data))
```

A data.frame: 6 × 7

	Date	Open	High	Low	Close	Volume	Name
	<fct>	<dbl>	<dbl>	<dbl>	<dbl>	<int>	<fct>
1	2006-01-03	10.34	10.68	10.32	10.68	201853036	AAPL
2	2006-01-04	10.73	10.85	10.64	10.71	155225609	AAPL
3	2006-01-05	10.69	10.70	10.54	10.63	112396081	AAPL
4	2006-01-06	10.75	10.96	10.65	10.90	176139334	AAPL
5	2006-01-09	10.96	11.03	10.82	10.86	168861224	AAPL
6	2006-01-10	10.89	11.70	10.83	11.55	570088246	AAPL

[1] 3019 7

In [13]:

```
head(ibm_data)
print(dim(ibm_data))
```

A data.frame: 6 × 7

	Date	Open	High	Low	Close	Volume	Name
	<fct>	<dbl>	<dbl>	<dbl>	<dbl>	<int>	<fct>
1	2006-01-03	82.45	82.55	80.81	82.06	11715200	IBM
2	2006-01-04	82.20	82.50	81.33	81.95	9840600	IBM
3	2006-01-05	81.40	82.90	81.00	82.50	7213500	IBM
4	2006-01-06	83.95	85.03	83.41	84.95	8197400	IBM
5	2006-01-09	84.10	84.25	83.38	83.73	6858200	IBM
6	2006-01-10	83.15	84.12	83.12	84.07	5701000	IBM

[1] 3020 7

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```
head(google_data)
print(dim(google_data))
```

A data.frame: 6 × 7

	Date	Open	High	Low	Close	Volume	Name
	<fct>	<dbl>	<dbl>	<dbl>	<dbl>	<int>	<fct>
1	2006-01-03	211.47	218.05	209.32	217.83	13137450	GOOGL
2	2006-01-04	222.17	224.70	220.09	222.84	15292353	GOOGL
3	2006-01-05	223.22	226.00	220.97	225.85	10815661	GOOGL
4	2006-01-06	228.66	235.49	226.85	233.06	17759521	GOOGL
5	2006-01-09	233.44	236.94	230.70	233.68	12795837	GOOGL
6	2006-01-10	232.44	235.36	231.25	235.11	9104719	GOOGL

[1] 3019 7

In [15]:

```
summary(gs_data)
```

	Date	Open	High	Low
2006-01-03:	1	Min. : 54.0	Min. : 54.54	Min. : 47.
41				
2006-01-04:	1	1st Qu.:144.9	1st Qu.:146.50	1st Qu.:143.
27				
2006-01-05:	1	Median :164.2	Median :165.99	Median :162.
67				
2006-01-06:	1	Mean :165.6	Mean :167.55	Mean :163.
60				
2006-01-09:	1	3rd Qu.:189.5	3rd Qu.:191.11	3rd Qu.:187.
44				
2006-01-10:	1	Max. :261.7	Max. :262.14	Max. :259.
16				
(Other) :	3014	NA's : 1		NA's : 1
	Close	Volume	Name	
Min. : 52.0	Min. : 149411	GS:3020		
1st Qu.:145.0	1st Qu.: 3042140			
Median :164.1	Median : 4681432			
Mean :165.6	Mean : 7175135			
3rd Qu.:189.7	3rd Qu.: 8278272			
Max. :261.0	Max. :114590630			

◀ ▶

In [16]:

```
head(gs_data)
```

A data.frame: 6 × 7

	Date	Open	High	Low	Close	Volume	Name
	<fct>	<dbl>	<dbl>	<dbl>	<dbl>	<int>	<fct>
1	2006-01-03	126.70	129.44	124.23	128.87	6188700	GS
2	2006-01-04	127.35	128.91	126.38	127.09	4862000	GS

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5	2006-01-09	128.50	130.62	128.00	130.39	4723500	GS		
6	2006-01-10	130.05	132.95	130.02	132.03	5539800	GS		

In [17]:

```
str(gs_data)
```

```
'data.frame': 3020 obs. of 7 variables:
 $ Date   : Factor w/ 3020 levels "2006-01-03", "2006-01-04", ...: 1
2 3 4 5 6 7 8 9 10 ...
 $ Open   : num 127 127 126 127 128 ...
 $ High   : num 129 129 127 129 131 ...
 $ Low    : num 124 126 126 127 128 ...
 $ Close  : num 129 127 127 129 130 ...
 $ Volume: int 6188700 4862000 3717600 4319600 4723500 5539800
4671400 3725500 2894900 3624600 ...
 $ Name   : Factor w/ 1 level "GS": 1 1 1 1 1 1 1 1 1 1 ...
```

In [18]:

```
#data cleaning sanity check

gs_data[is.na(gs_data)] <- 0
gs_data$Date <- as.Date(gs_data$Date, format = "%Y-%m-%d")
summary(gs_data)

google_data[is.na(google_data)] <- 0
google_data$Date <- as.Date(google_data$Date, format = "%Y-%m-%d")
summary(google_data)

ibm_data[is.na(ibm_data)] <- 0
ibm_data$Date <- as.Date(ibm_data$Date, format = "%Y-%m-%d")
summary(ibm_data)

apple_data[is.na(apple_data)] <- 0
apple_data$Date <- as.Date(apple_data$Date, format = "%Y-%m-%d")
summary(apple_data)

ba_data[is.na(ba_data)] <- 0
ba_data$Date <- as.Date(ba_data$Date, format = "%Y-%m-%d")
summary(ba_data)
```

Date	Open	High	Low
Min. :2006-01-03	Min. : 0.0	Min. : 54.54	Min. :
0.0			
1st Qu.:2009-01-01	1st Qu.:144.9	1st Qu.:146.50	1st Qu.:1
43.3			
Median :2011-12-29	Median :164.2	Median :165.99	Median :1
62.6			
Mean :2012-01-01	Mean :165.5	Mean :167.55	Mean :1
63.5			
3rd Qu.:2014-12-31	3rd Qu.:189.5	3rd Qu.:191.11	3rd Qu.:1
87.4			
Max. :2017-12-29	Max. :261.7	Max. :262.14	Max. :2
59.2			

Close      Volume      Name

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```
Median :164.1  Median : 4681432
Mean   :165.6  Mean   : 7175135
3rd Qu.:189.7 3rd Qu.: 8278272
Max.   :261.0  Max.   :114590630
```

	Date	Open	High	Low
Min.	:2006-01-03	Min. : 131.4	Min. : 134.8	Min. :
1st Qu.	:2009-01-01	1st Qu.: 247.8	1st Qu.: 250.2	1st Qu.:
Median	:2011-12-30	Median : 310.5	Median : 312.8	Median :
Mean	:2012-01-01	Mean   : 428.2	Mean   : 431.8	Mean   :
3rd Qu.	:2015-01-01	3rd Qu.: 572.1	3rd Qu.: 576.0	3rd Qu.:
Max.	:2017-12-29	Max.  :1083.0	Max.  :1086.5	Max.  :

	Close	Volume	Name
Min.	: 128.8	Min. : 521141	GOOGL:3019
1st Qu.	: 247.6	1st Qu.: 1760854	
Median	: 310.1	Median : 2517630	
Mean	: 428.0	Mean   : 3551504	
3rd Qu.	: 570.8	3rd Qu.: 4242182	
Max.	:1085.1	Max.  :41182889	

	Date	Open	High	Low
Min.	:2006-01-03	Min. : 0.0	Min. : 73.94	Min. :
0.0				
1st Qu.	:2009-01-01	1st Qu.:116.4	1st Qu.:117.77	1st Qu.:1
15.4				
Median	:2011-12-29	Median :149.6	Median :150.33	Median :1
48.4				
Mean	:2012-01-01	Mean   :145.5	Mean   :146.68	Mean   :1
44.4				
3rd Qu.	:2014-12-31	3rd Qu.:178.4	3rd Qu.:179.76	3rd Qu.:1
77.3				
Max.	:2017-12-29	Max.  :215.4	Max.  :215.90	Max.  :2
14.3				

	Close	Volume	Name
Min.	: 71.74	Min. : 254256	IBM:3020
1st Qu.	:116.53	1st Qu.: 3622681	
Median	:149.31	Median : 4928852	
Mean	:145.62	Mean   : 5773301	
3rd Qu.	:178.69	3rd Qu.: 6965014	
Max.	:215.80	Max.  :30774276	

	Date	Open	High	Low
Min.	:2006-01-03	Min. : 7.39	Min. : 7.56	Min. :
7.17				
1st Qu.	:2009-01-01	1st Qu.: 23.43	1st Qu.: 23.80	1st Qu.:
23.02				
Median	:2011-12-30	Median : 57.86	Median : 58.46	Median :
57.32				

```
3rd Qu.:2015-01-01    3rd Qu.: 99.17    3rd Qu.:100.28    3rd Qu.:
98.39
Max.     :2017-12-29    Max.     :175.11    Max.     :177.20    Max.     :
174.86
      Close          Volume         Name
Min.    : 7.24    Min.    :11475922    AAPL:3019
1st Qu.: 23.42   1st Qu.: 52928887
Median  : 57.92   Median  :106627080
Mean    : 64.66   Mean    :131145688
3rd Qu.: 99.48   3rd Qu.:179897652
Max.    :176.42   Max.    :843264044
```

	Date	Open	High	Low
Min.	:2006-01-03	Min. : 0.00	Min. : 0.00	Min. :
1st Qu.	:2009-01-01	1st Qu.: 70.66	1st Qu.: 71.40	1st Qu.:
Median	:2011-12-29	Median : 85.56	Median : 86.19	Median :
Mean	:2012-01-01	Mean   :101.45	Mean   :102.33	Mean   :
3rd Qu.	:2014-12-31	3rd Qu.:130.59	3rd Qu.:131.60	3rd Qu.:
Max.	:2017-12-29	Max.  :298.70	Max.  :299.33	Max.  :

	Close	Volume	Name
Min.	: 29.36	Min. : 361602	BA:3020
1st Qu.	: 70.60	1st Qu.: 3313697	
Median	: 85.49	Median : 4406546	
Mean	:101.52	Mean   : 5067786	
3rd Qu.	:130.62	3rd Qu.: 5959070	
Max.	:297.90	Max.  :44397607	

In [ ]:

In [19]:

```
library(gridExtra)
library(grid)
library(ggplot2)
library(lattice)
options(repr.plot.width=12, repr.plot.height=12)

p1 = ggplot(gs_data, aes(Open)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_densit
y()# + xlim(c(0, 1000))

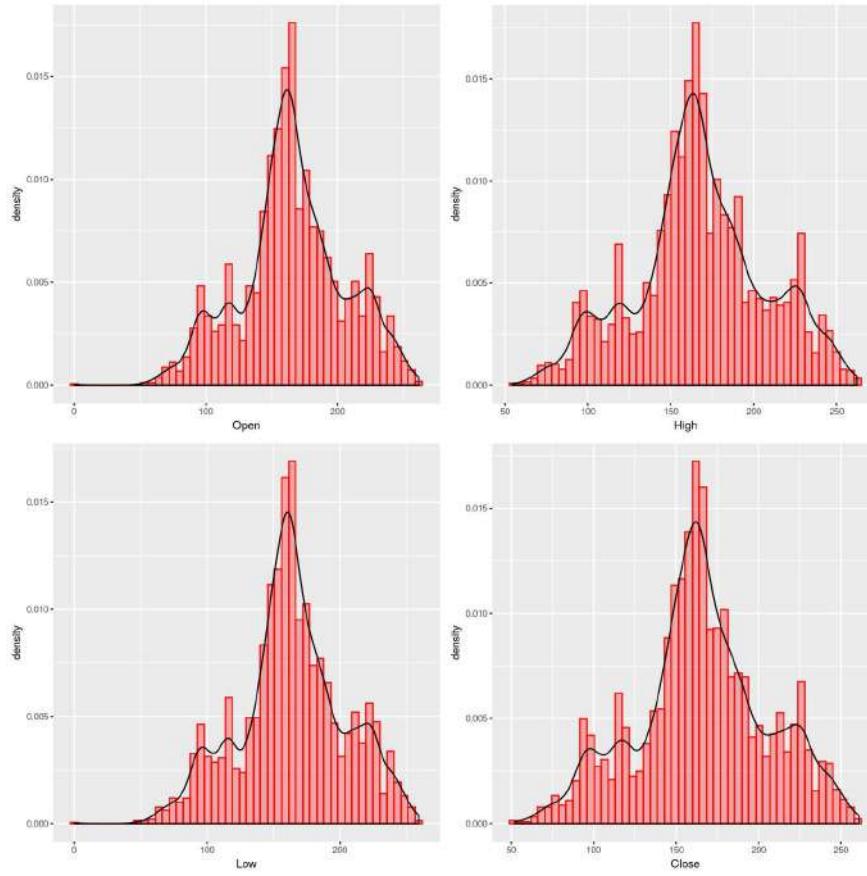
p2 = ggplot(gs_data, aes(High)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_densit
y()# + xlim(c(0, 1000))

p3 = ggplot(gs_data, aes(Low)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_densit
y()# + xlim(c(0, 1000))
```

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```
ity()# + xlim(c(0, 1000))

grid.arrange(p1,p2,p3,p4, nrow=2,ncol=2)
```



In [20]:

```
options(repr.plot.width=12, repr.plot.height=12)

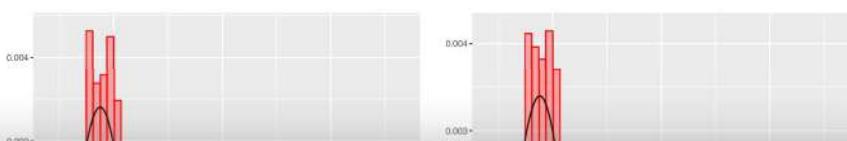
p1 = ggplot(google_data, aes(Open)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_d
ensity()# + xlim(c(0, 1000))

p2 = ggplot(google_data, aes(High)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_d
ensity()# + xlim(c(0, 1000))

p3 = ggplot(google_data, aes(Low)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_de
nsity()# + xlim(c(0, 1000))

p4 = ggplot(google_data, aes(Close)) + geom_histogram(bins = 50, ae
s(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_
density()# + xlim(c(0, 1000))

grid.arrange(p1,p2,p3,p4, nrow=2,ncol=2)
```

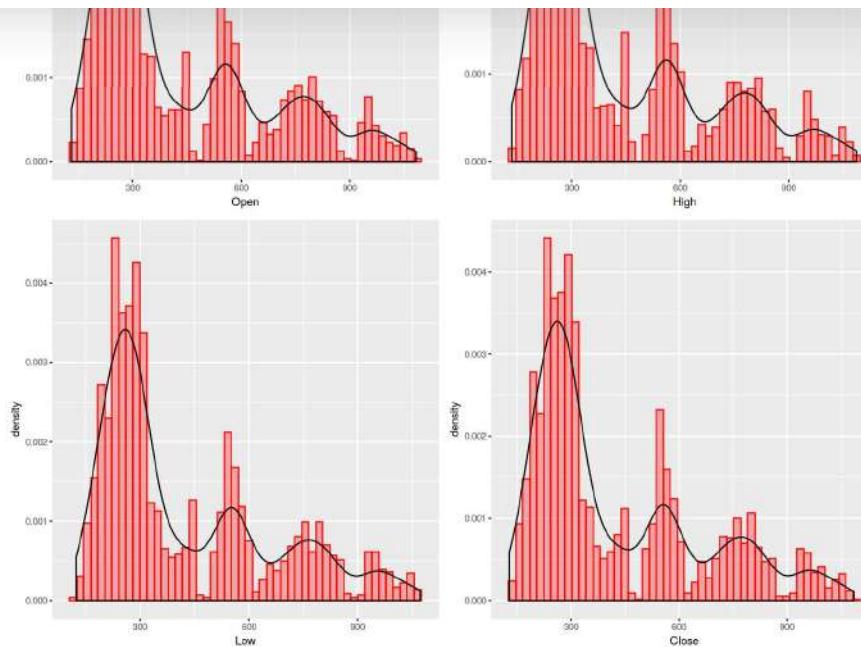


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In [21]:

```
options(repr.plot.width=12, repr.plot.height=12).

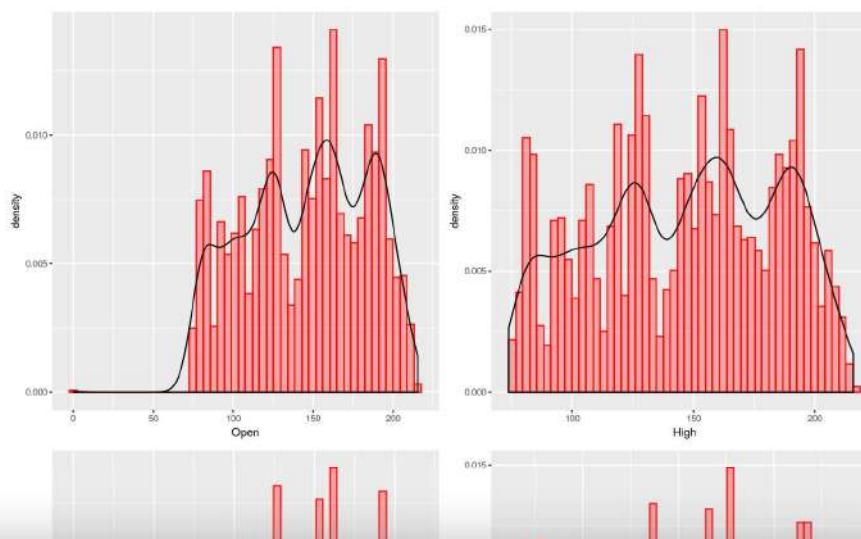
p1 = ggplot(ibm_data, aes(Open)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

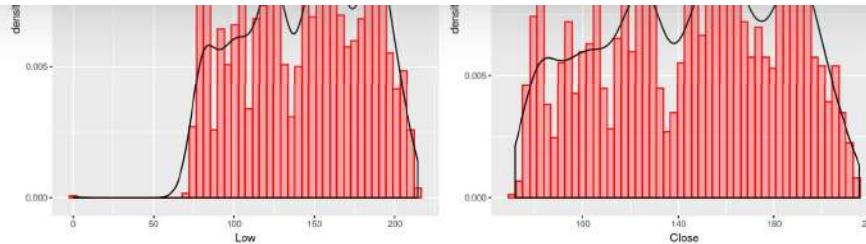
p2 = ggplot(ibm_data, aes(High)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

p3 = ggplot(ibm_data, aes(Low)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

p4 = ggplot(ibm_data, aes(Close)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

grid.arrange(p1,p2,p3,p4, nrow=2,ncol=2)
```





In [22]:

```
options(repr.plot.width=12, repr.plot.height=12)

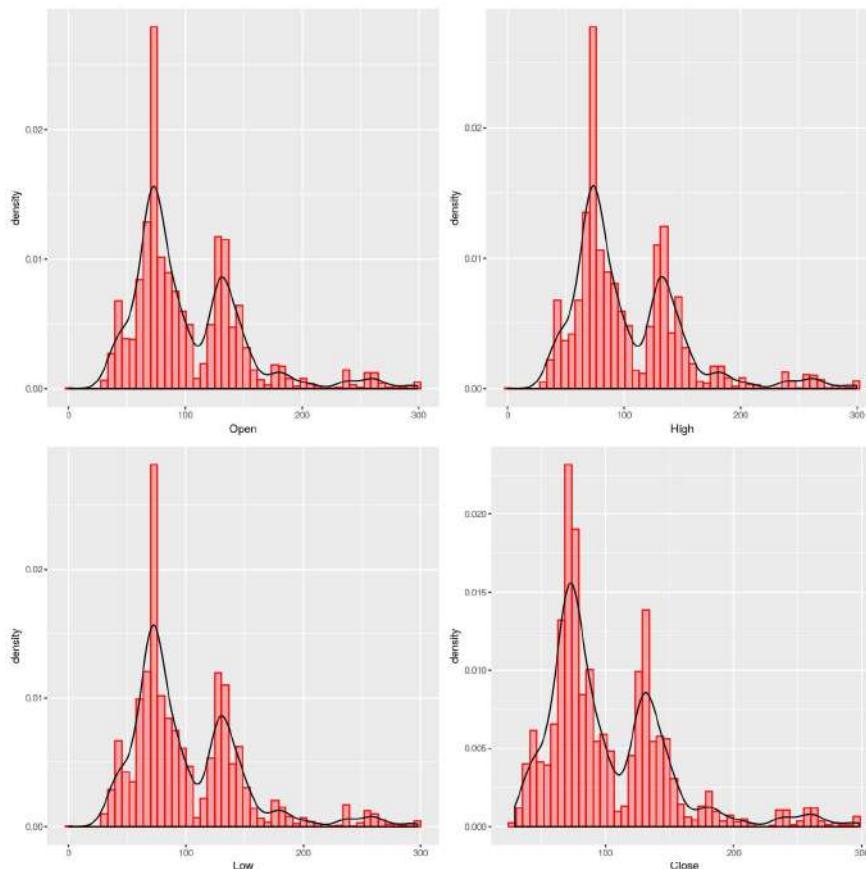
p1 = ggplot(ba_data, aes(Open)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

p2 = ggplot(ba_data, aes(High)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

p3 = ggplot(ba_data, aes(Low)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

p4 = ggplot(ba_data, aes(Close)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

grid.arrange(p1,p2,p3,p4, nrow=2,ncol=2)
```



```

p1 = ggplot(apple_data, aes(Open)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

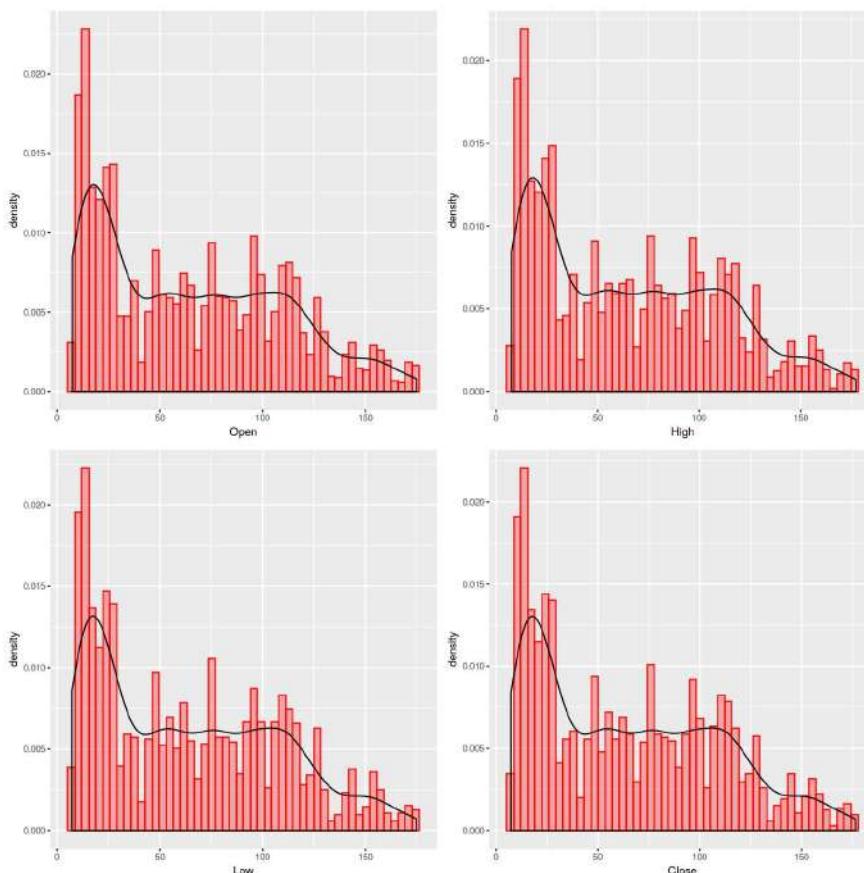
p2 = ggplot(apple_data, aes(High)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

p3 = ggplot(apple_data, aes(Low)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

p4 = ggplot(apple_data, aes(Close)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# + xlim(c(0, 1000))

grid.arrange(p1,p2,p3,p4, nrow=2,ncol=2)

```



In [24]:

```
s_data <- rbind(google_data,ibm_data, gs_data,apple_data,ba_data)
```

In [25]:

```
dim(s_data)
```

```
15098 7
```

In [26]:

  
Notebook

  
Data

  
Output

  
Comments

```

p1 = ggplot(s_data, aes(open)) + geom_histogram(bins = 50, aes(y =
..density..), col = "red", fill = "red", alpha = 0.3) + geom_densit
y()# + xlim(c(0, 1000))

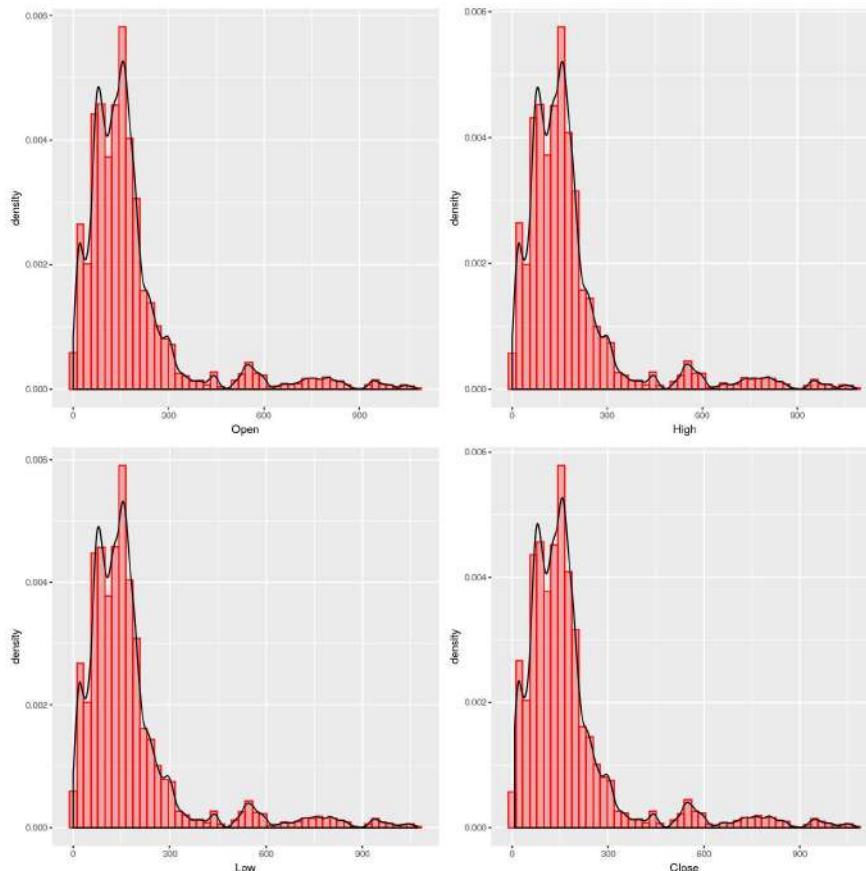
p2 = ggplot(s_data, aes(High)) + geom_histogram(bins = 50, aes(y =
..density..), col = "red", fill = "red", alpha = 0.3) + geom_densit
y()# + xlim(c(0, 1000))

p3 = ggplot(s_data, aes(Low)) + geom_histogram(bins = 50, aes(y =
..density..), col = "red", fill = "red", alpha = 0.3) + geom_densit
y()# + xlim(c(0, 1000))

p4 = ggplot(s_data, aes(Close)) + geom_histogram(bins = 50, aes(y =
..density..), col = "red", fill = "red", alpha = 0.3) + geom_densit
y()# + xlim(c(0, 1000))

grid.arrange(p1,p2,p3,p4, nrow=2,ncol=2)

```



In [27]:

```

tmp <- filter(s_data, High > 100)
length(unique(tmp$Name))

```

5

In [28]:

```
tmp
```

A data.frame: 10385 x 7

[Notebook](#)
[Data](#)
[Output](#)
[Comments](#)

2006-01-03	211.47	218.05	209.32	217.83	13137450	GOOGL
2006-01-04	222.17	224.70	220.09	222.84	15292353	GOOGL
2006-01-05	223.22	226.00	220.97	225.85	10815661	GOOGL
2006-01-06	228.66	235.49	226.85	233.06	17759521	GOOGL
2006-01-09	233.44	236.94	230.70	233.68	12795837	GOOGL
2006-01-10	232.44	235.36	231.25	235.11	9104719	GOOGL
2006-01-11	235.87	237.79	234.82	236.05	9008664	GOOGL
2006-01-12	237.10	237.73	230.98	232.05	10125212	GOOGL
2006-01-13	232.39	233.68	231.04	233.36	7660220	GOOGL
2006-01-17	231.76	235.18	231.50	233.79	8335300	GOOGL
2006-01-18	223.87	228.91	221.85	222.68	20511176	GOOGL
2006-01-19	225.81	226.97	216.72	218.44	14539830	GOOGL
2006-01-20	219.57	220.24	197.57	199.93	41182889	GOOGL
2006-01-23	203.89	214.41	203.07	213.96	22768073	GOOGL
2006-01-24	218.23	222.70	217.46	221.74	15468453	GOOGL
2006-01-25	225.86	227.34	214.82	216.72	18746567	GOOGL
2006-01-26	219.99	220.22	211.99	217.35	12931382	GOOGL
2006-01-27	217.72	219.33	214.70	216.96	8459747	GOOGL
2006-01-30	214.83	216.86	212.71	213.62	8596167	GOOGL
2006-01-31	215.50	220.02	212.20	216.55	22449604	GOOGL
2006-02-01	194.71	201.20	193.95	201.09	27132792	GOOGL
2006-02-02	202.11	203.45	198.19	198.22	11810931	GOOGL
2006-02-03	197.01	197.15	186.47	190.97	18286547	GOOGL
2006-02-06	192.85	195.14	189.97	192.74	8948485	GOOGL
2006-02-07	191.69	192.04	181.85	184.14	16640139	GOOGL
2006-02-08	184.42	185.53	177.51	184.72	20818364	GOOGL
2006-02-09	185.79	187.39	178.23	179.56	11913420	GOOGL
2006-02-10	181.16	182.43	176.75	181.49	15223458	GOOGL
2006-02-13	173.49	175.48	171.12	173.02	19724806	GOOGL
2006-02-14	172.84	176.02	171.37	171.83	14658822	GOOGL
:	:	:	:	:	:	:
2017-11-16	263.76	265.04	263.34	263.70	2710174	BA
2017-11-17	262.82	263.74	262.03	262.26	1724790	BA
2017-11-20	263.00	265.62	262.76	264.63	2447398	BA
2017-11-21	266.24	267.00	264.71	266.99	2267052	BA
2017-11-22	267.00	267.48	264.53	265.15	1471390	BA
2017-11-24	265.26	266.57	264.53	265.88	788957	BA
2017-11-27	265.38	266.84	264.72	265.58	1772196	BA
2017-11-28	267.00	268.01	265.23	267.99	2262052	BA
2017-11-29	269.48	269.68	266.15	269.30	3029095	BA
2017-11-30	269.91	277.04	269.43	276.80	4820313	BA
2017-12-01	277.51	278.73	270.60	271.38	4592483	BA
2017-12-04	276.16	281.83	276.00	277.97	5523013	BA
2017-12-05	279.01	279.44	274.86	275.54	2806075	BA
2017-12-06	276.58	279.14	274.00	278.27	2538083	BA
2017-12-07	282.81	284.79	277.80	281.97	4264354	BA
2017-12-08	285.01	287.32	283.56	285.90	4440528	BA
2017-12-11	286.21	286.49	279.90	283.16	4065242	BA
2017-12-12	289.94	292.80	287.72	289.94	5517550	BA
2017-12-13	290.50	295.85	289.70	291.84	5003328	BA
2017-12-14	293.35	296.82	292.60	293.88	3913444	BA
2017-12-15	295.87	297.37	293.02	293.94	6933490	BA
2017-12-18	296.00	297.14	294.52	296.14	2901644	BA
2017-12-19	296.50	297.58	294.18	297.25	2728367	BA
2017-12-20	299.70	300.33	297.11	297.90	2622699	BA

 Notebook Data Output Comments

2017-12-26	295.54	297.44	294.65	295.36	1394737	BA
2017-12-27	296.41	296.80	294.80	295.62	1447837	BA
2017-12-28	295.81	296.99	294.74	296.35	1436751	BA
2017-12-29	296.94	297.30	294.83	294.91	1824591	BA

In [29]:

```

sample_ticker <- as.character(sample(tmp$Name, sample_num))
sample_ticker <- c(sample_ticker, 'GOOGL')
candidate_ticker <- unique(sample_ticker)
candidate_ticker <- c("IBM", "BA", "AAPL", "GS", "GOOGL")
candidate_num <- length(candidate_ticker)
stock_list <- vector(mode="list", length=candidate_num)
names(stock_list) <- candidate_ticker
i = 1
for (ticker in candidate_ticker){
  stock_list[[i]] <- filter(s_data, Name == ticker)
  # print(stock_list[[i]])
  i <- i+1
  # print(ticker)
}
str(stock_list)

```

```

List of 5
$ IBM  :'data.frame': 3020 obs. of 7 variables:
..$ Date  : Date[1:3020], format: "2006-01-03" "2006-01-04"
...
..$ Open  : num [1:3020] 82.5 82.2 81.4 84 84.1 ...
..$ High  : num [1:3020] 82.5 82.5 82.9 85 84.2 ...
..$ Low   : num [1:3020] 80.8 81.3 81 83.4 83.4 ...
..$ Close  : num [1:3020] 82.1 82 82.5 85 83.7 ...
..$ Volume: int [1:3020] 11715200 9840600 7213500 8197400 6858
200 5701000 5776500 4926500 6921700 8761700 ...
..$ Name   : Factor w/ 5 levels "GOOGL","IBM",...: 2 2 2 2 2 2 2
2 2 2 ...
$ BA    :'data.frame': 3020 obs. of 7 variables:
..$ Date  : Date[1:3020], format: "2006-01-03" "2006-01-04"
...
..$ Open  : num [1:3020] 70.4 70.1 70.5 70.3 69.3 ...
..$ High  : num [1:3020] 70.6 71.3 70.5 70.5 69.4 ...
..$ Low   : num [1:3020] 69.3 69.9 69.6 69 68.7 ...
..$ Close  : num [1:3020] 70.4 71.2 70.3 69.3 68.8 ...
..$ Volume: int [1:3020] 4943100 3165000 4598300 4820200 45677
00 3869000 5011900 2347000 2963700 2712900 ...
..$ Name   : Factor w/ 5 levels "GOOGL","IBM",...: 5 5 5 5 5 5 5
5 5 5 ...
$ AAPL  :'data.frame': 3019 obs. of 7 variables:
..$ Date  : Date[1:3019], format: "2006-01-03" "2006-01-04"
...
..$ Open  : num [1:3019] 10.3 10.7 10.7 10.8 11 ...
..$ High  : num [1:3019] 10.7 10.8 10.7 11 11 ...
..$ Low   : num [1:3019] 10.3 10.6 10.5 10.7 10.8 ...
..$ Close  : num [1:3019] 10.7 10.7 10.6 10.9 10.9 ...
..$ Volume: int [1:3019] 201853036 155225609 112396081 1761393
34 168861224 570088246 373548882 320201966 194153393 209215265

```

```
$ GS    :'data.frame': 3020 obs. of 7 variables:
..$ Date  : Date[1:3020], format: "2006-01-03" "2006-01-04"
...
..$ Open   : num [1:3020] 127 127 126 127 128 ...
..$ High   : num [1:3020] 129 129 127 129 131 ...
..$ Low    : num [1:3020] 124 126 126 127 128 ...
..$ Close   : num [1:3020] 129 127 127 129 130 ...
..$ Volume: int [1:3020] 6188700 4862000 3717600 4319600 47235
00 5539800 4671400 3725500 2894900 3624600 ...
..$ Name   : Factor w/ 5 levels "GOOGL","IBM",...: 3 3 3 3 3 3
3 3 3 ...
$ GOOGL:'data.frame': 3019 obs. of 7 variables:
..$ Date  : Date[1:3019], format: "2006-01-03" "2006-01-04"
...
..$ Open   : num [1:3019] 211 222 223 229 233 ...
..$ High   : num [1:3019] 218 225 226 235 237 ...
..$ Low    : num [1:3019] 209 220 221 227 231 ...
..$ Close   : num [1:3019] 218 223 226 233 234 ...
..$ Volume: int [1:3019] 13137450 15292353 10815661 17759521 1
2795837 9104719 9008664 10125212 7660220 8335300 ...
..$ Name   : Factor w/ 5 levels "GOOGL","IBM",...: 1 1 1 1 1 1
1 1 1 ...
```

In [30]:

```
library(xts)
library(dygraphs)

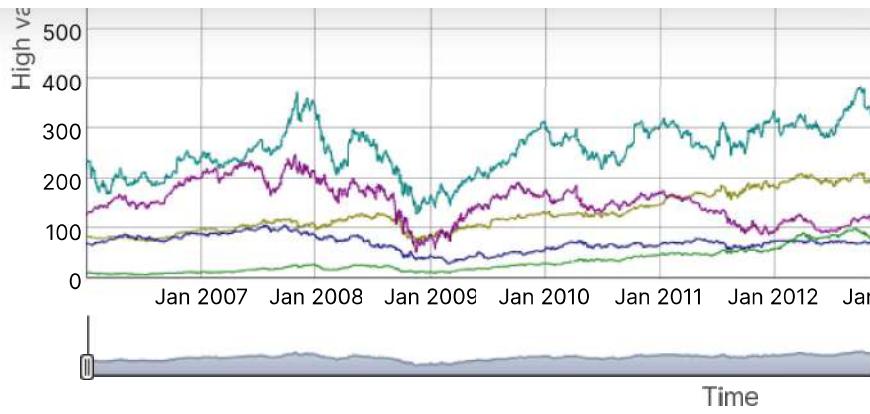
xts_list <- vector(mode="list", length=candidate_num)
ts_list <- vector(mode="list", length=candidate_num)

names(xts_list) = candidate_ticker
names(ts_list) = candidate_ticker

for (ticker in candidate_ticker){
  stock = stock_list[[ticker]]
  xts = xts(stock$Close, order.by=stock$Date)
  attr(xts, 'frequency') <- length(xts)/12
  ts = as.ts(xts, start = c(2006))
  xts_list[[ticker]] <- xts
  ts_list[[ticker]] <- ts
}
xts_table= do.call(cbind, xts_list)
dygraph(xts_table, xlab = "Time", ylab = "High value", main = "Time
Series") %>%
  # dySeries(labels.default()) %>%
  # dyOptions(colors = c("red")) %>%
  dyRangeSelector()
```

Time Series





In [31]:

```
install.packages('tseries')  
library(tseries)
```

Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:

"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"

Warning message:

"package 'tseries' is not available (for R version 3.6.0)"

In [32]:

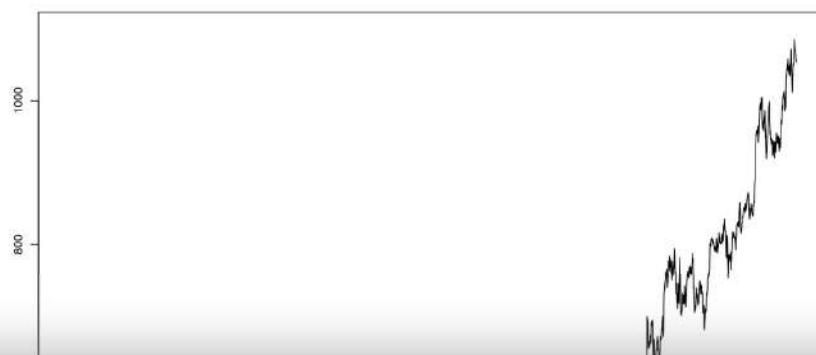
```
xts = xts_list[['GOOGL']]  
ts = ts_list[['GOOGL']]  
adf.test(xts, alternative = "stationary", k = 0)
```

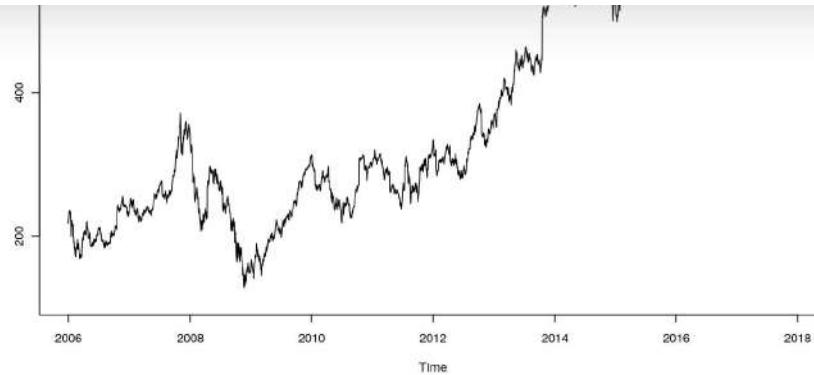
Augmented Dickey-Fuller Test

```
data: xts  
Dickey-Fuller = -1.3188, Lag order = 0, p-value = 0.8667  
alternative hypothesis: stationary
```

In [33]:

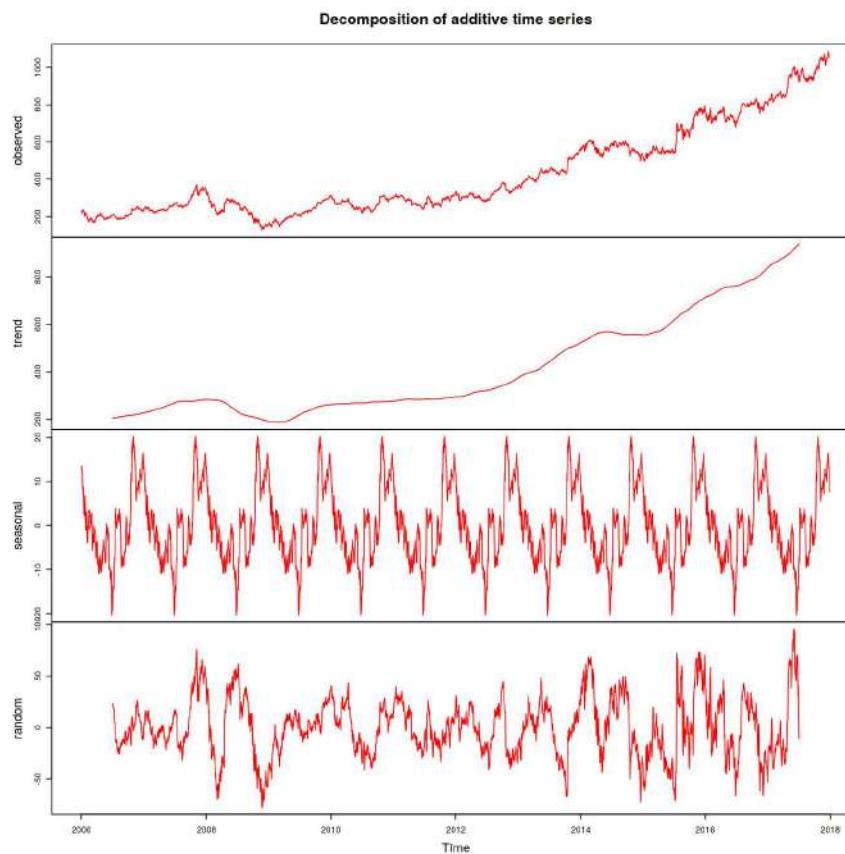
```
plot(ts)
```





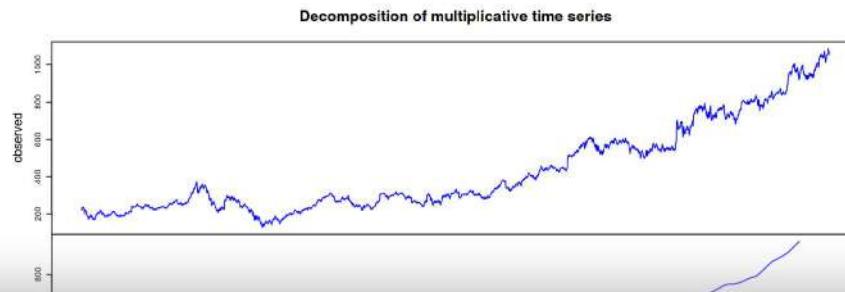
In [34]:

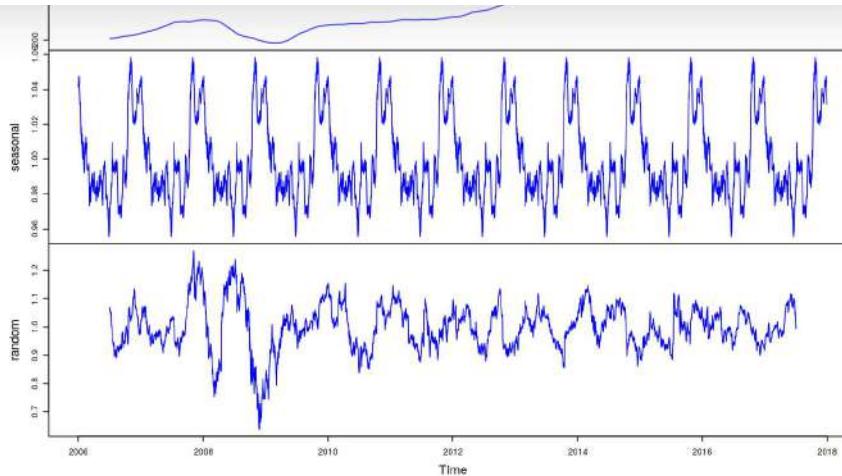
```
tscomponents_add <- decompose(ts, type = "additive")
tscomponents_mul <- decompose(ts, type = "multiplicative")
plot(tscomponents_add, col = "red")
```



In [35]:

```
plot(tscomponents_mul, col = "blue")
```





In [36]:

xts

```
[ ,1]
2006-01-03 217.83
2006-01-04 222.84
2006-01-05 225.85
2006-01-06 233.06
2006-01-09 233.68
2006-01-10 235.11
2006-01-11 236.05
2006-01-12 232.05
2006-01-13 233.36
2006-01-17 233.79
2006-01-18 222.68
2006-01-19 218.44
2006-01-20 199.93
2006-01-23 213.96
2006-01-24 221.74
2006-01-25 216.72
2006-01-26 217.35
2006-01-27 216.96
2006-01-30 213.62
2006-01-31 216.55
2006-02-01 201.09
2006-02-02 198.22
2006-02-03 190.97
2006-02-06 192.74
2006-02-07 184.14
2006-02-08 184.72
2006-02-09 179.56
2006-02-10 181.49
2006-02-13 173.02
2006-02-14 171.83
2006-02-15 171.36
2006-02-16 183.41
2006-02-17 184.56
2006-02-21 183.48
2006-02-22 182.93
2006-02-23 189.22
2006-02-24 188.89
```

2006-03-01	182.58
2006-03-02	188.41
2006-03-03	189.28
2006-03-06	184.23
2006-03-07	182.41
2006-03-08	177.12
2006-03-09	171.67
2006-03-10	168.92
2006-03-13	168.70
2006-03-14	175.76
2006-03-15	172.42
2006-03-16	169.55
2006-03-17	170.06
2006-03-20	174.27
2006-03-21	170.13
2006-03-22	170.28
2006-03-23	171.12
2006-03-24	183.08
2006-03-27	185.03
2006-03-28	188.79
2006-03-29	197.69
2006-03-30	194.41
2006-03-31	195.19
2006-04-03	195.04
2006-04-04	202.37
2006-04-05	204.20
2006-04-06	205.80
2006-04-07	203.28
2006-04-10	208.40
2006-04-11	205.03
2006-04-12	204.68
2006-04-13	201.28
2006-04-17	203.61
2006-04-18	202.32
2006-04-19	205.46
2006-04-20	207.71
2006-04-21	218.77
2006-04-24	220.47
2006-04-25	213.79
2006-04-26	213.20
2006-04-27	210.23
2006-04-28	209.18
2006-05-01	199.65
2006-05-02	197.60
2006-05-03	197.28
2006-05-04	197.57
2006-05-05	197.35
2006-05-08	197.59
2006-05-09	204.60
2006-05-10	201.69
2006-05-11	193.69
2006-05-12	187.25
2006-05-15	188.29
2006-05-16	185.84
2006-05-17	187.44
2006-05-18	185.68
2006-05-19	185.20
2006-05-22	185.66

 Notebook Data Output Comments

2006-05-25	191.69
2006-05-26	190.87
2006-05-30	186.16
2006-05-31	186.10
2006-06-01	191.50
2006-06-02	189.91
2006-06-05	187.41
2006-06-06	195.19
2006-06-07	193.45
2006-06-08	196.85
2006-06-09	193.48
2006-06-12	190.96
2006-06-13	193.46
2006-06-14	192.39
2006-06-15	195.70
2006-06-16	195.55
2006-06-19	194.26
2006-06-20	193.78
2006-06-21	201.27
2006-06-22	200.17
2006-06-23	202.63
2006-06-26	202.31
2006-06-27	201.36
2006-06-28	203.26
2006-06-29	209.11
2006-06-30	209.87
2006-07-03	211.81
2006-07-05	210.94
2006-07-06	211.81
2006-07-07	210.44
2006-07-10	209.31
2006-07-11	212.49
2006-07-12	208.83
2006-07-13	204.62
2006-07-14	201.95
2006-07-17	204.15
2006-07-18	201.73
2006-07-19	199.70
2006-07-20	193.75
2006-07-21	195.25
2006-07-24	195.65
2006-07-25	194.87
2006-07-26	192.94
2006-07-27	191.39
2006-07-28	194.25
2006-07-31	193.49
2006-08-01	187.94
2006-08-02	183.80
2006-08-03	187.88
2006-08-04	187.11
2006-08-07	189.16
2006-08-08	190.69
2006-08-09	188.66
2006-08-10	187.29
2006-08-11	184.43
2006-08-14	184.90
2006-08-15	190.68

2006-08-21	188.84
2006-08-22	189.33
2006-08-23	186.90
2006-08-24	187.05
2006-08-25	186.82
2006-08-28	190.67
2006-08-29	189.66
2006-08-30	190.57
2006-08-31	189.45
2006-09-01	189.49
2006-09-05	192.37
2006-09-06	190.26
2006-09-07	189.43
2006-09-08	189.11
2006-09-11	192.24
2006-09-12	196.15
2006-09-13	203.49
2006-09-14	202.19
2006-09-15	205.14
2006-09-18	207.55
2006-09-19	202.11
2006-09-20	198.70
2006-09-21	203.63
2006-09-22	202.09
2006-09-25	202.19
2006-09-26	203.64
2006-09-27	201.66
2006-09-28	201.99
2006-09-29	201.15
2006-10-02	200.92
2006-10-03	202.22
2006-10-04	208.06
2006-10-05	206.11
2006-10-06	210.46
2006-10-09	214.71
2006-10-10	213.54
2006-10-11	213.46
2006-10-12	213.93
2006-10-13	213.86
2006-10-16	211.09
2006-10-17	210.53
2006-10-18	209.86
2006-10-19	213.24
2006-10-20	230.06
2006-10-23	240.63
2006-10-24	236.89
2006-10-25	243.54
2006-10-26	242.79
2006-10-27	237.84
2006-10-30	238.52
2006-10-31	238.43
2006-11-01	233.98
2006-11-02	235.19
2006-11-03	236.13
2006-11-06	238.71
2006-11-07	236.52
2006-11-08	237.74

2006-11-13	240.70
2006-11-14	244.89
2006-11-15	246.21
2006-11-16	248.20
2006-11-17	249.64
2006-11-20	247.77
2006-11-21	255.08
2006-11-22	254.26
2006-11-24	252.80
2006-11-27	242.62
2006-11-28	244.99
2006-11-29	242.57
2006-11-30	242.65
2006-12-01	240.64
2006-12-04	242.67
2006-12-05	243.74
2006-12-06	244.60
2006-12-07	241.56
2006-12-08	242.30
2006-12-11	242.21
2006-12-12	241.13
2006-12-13	239.73
2006-12-14	241.30
2006-12-15	240.39
2006-12-18	231.63
2006-12-19	234.55
2006-12-20	231.68
2006-12-21	228.33
2006-12-22	228.02
2006-12-26	228.99
2006-12-27	234.25
2006-12-28	231.51
2006-12-29	230.47
2007-01-03	234.03
2007-01-04	241.87
2007-01-05	243.84
2007-01-08	242.03
2007-01-09	242.99
2007-01-10	244.97
2007-01-11	250.11
2007-01-12	252.75
2007-01-16	252.39
2007-01-17	248.89
2007-01-18	244.16
2007-01-19	245.12
2007-01-22	240.66
2007-01-23	239.76
2007-01-24	249.78
2007-01-25	244.29
2007-01-26	248.17
2007-01-29	246.48
2007-01-30	247.41
2007-01-31	251.00
2007-02-01	241.12
2007-02-02	240.99
2007-02-05	233.81
2007-02-06	235.98
2007-02-07	235.24

 Notebook Data Output Comments

2007-02-12	229.37
2007-02-13	229.78
2007-02-14	233.20
2007-02-15	230.97
2007-02-16	235.20
2007-02-20	236.29
2007-02-21	238.17
2007-02-22	238.16
2007-02-23	235.55
2007-02-26	232.70
2007-02-27	224.61
2007-02-28	224.95
2007-03-01	224.34
2007-03-02	219.56
2007-03-05	220.69
2007-03-06	229.00
2007-03-07	228.05
2007-03-08	227.59
2007-03-09	226.71
2007-03-12	227.60
2007-03-13	221.74
2007-03-14	224.22
2007-03-15	223.32
2007-03-16	220.65
2007-03-19	223.84
2007-03-20	222.86
2007-03-21	228.50
2007-03-22	231.25
2007-03-23	231.15
2007-03-26	232.73
2007-03-27	232.04
2007-03-28	231.17
2007-03-29	230.69
2007-03-30	229.31
2007-04-02	229.49
2007-04-03	236.54
2007-04-04	235.75
2007-04-05	235.99
2007-04-09	234.34
2007-04-10	233.48
2007-04-11	232.50
2007-04-12	233.93
2007-04-13	233.38
2007-04-16	237.37
2007-04-17	236.64
2007-04-18	238.24
2007-04-19	236.06
2007-04-20	241.48
2007-04-23	239.78
2007-04-24	239.00
2007-04-25	239.23
2007-04-26	240.83
2007-04-27	239.74
2007-04-30	235.93
2007-05-01	234.73
2007-05-02	233.12
2007-05-03	236.85

2007-05-09	234.86
2007-05-10	230.97
2007-05-11	233.60
2007-05-14	231.12
2007-05-15	229.23
2007-05-16	236.54
2007-05-17	235.72
2007-05-18	235.40
2007-05-21	235.54
2007-05-22	238.17
2007-05-23	237.22
2007-05-24	237.40
2007-05-25	242.00
2007-05-29	243.80
2007-05-30	249.55
2007-05-31	249.20
2007-06-01	250.45
2007-06-04	253.79
2007-06-05	259.68
2007-06-06	259.38
2007-06-07	257.79
2007-06-08	258.00
2007-06-11	255.93
2007-06-12	252.64
2007-06-13	252.87
2007-06-14	251.67
2007-06-15	253.20
2007-06-18	257.86
2007-06-19	257.41
2007-06-20	255.24
2007-06-21	257.31
2007-06-22	262.75
2007-06-25	263.97
2007-06-26	265.40
2007-06-27	263.41
2007-06-28	262.77
2007-06-29	261.61
2007-07-02	265.46
2007-07-03	267.44
2007-07-05	271.09
2007-07-06	269.97
2007-07-09	271.55
2007-07-10	271.94
2007-07-11	272.51
2007-07-12	272.94
2007-07-13	276.36
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2007-07-17	277.78
2007-07-18	275.02
2007-07-19	274.57
2007-07-20	260.32
2007-07-23	256.51
2007-07-24	257.26
2007-07-25	255.13
2007-07-26	254.25
2007-07-27	256.20
2007-07-30	258.31

2007-08-02	255.70
2007-08-03	251.75
2007-08-06	255.25
2007-08-07	258.27
2007-08-08	263.15
2007-08-09	257.62
2007-08-10	258.13
2007-08-13	258.01
2007-08-14	254.55
2007-08-15	249.02
2007-08-16	246.01
2007-08-17	250.27
2007-08-20	249.21
2007-08-21	253.56
2007-08-22	256.63
2007-08-23	256.35
2007-08-24	257.76
2007-08-27	256.89
2007-08-28	253.45
2007-08-29	256.70
2007-08-30	255.96
2007-08-31	257.88
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2007-09-05	264.16
2007-09-06	262.02
2007-09-07	259.93
2007-09-10	257.50
2007-09-11	260.93
2007-09-12	261.59
2007-09-13	262.65
2007-09-14	264.64
2007-09-17	262.91
2007-09-18	267.90
2007-09-19	273.70
2007-09-20	276.69
2007-09-21	280.33
2007-09-24	284.29
2007-09-25	284.78
2007-09-26	284.36
2007-09-27	284.03
2007-09-28	283.92
2007-10-01	291.57
2007-10-02	292.49
2007-10-03	292.30
2007-10-04	289.80
2007-10-05	297.32
2007-10-08	305.11
2007-10-09	307.90
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2007-10-12	319.01
2007-10-15	310.37
2007-10-16	308.31
2007-10-17	317.06
2007-10-18	320.13
2007-10-19	322.68
2007-10-22	325.70
2007-10-23	338.22

 Notebook Data Output Comments

2007-10-26	337.64
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2007-10-30	347.73
2007-10-31	353.85
2007-11-01	351.96
2007-11-02	355.98
2007-11-05	363.19
2007-11-06	371.27
2007-11-07	366.84
2007-11-08	347.27
2007-11-09	332.32
2007-11-12	316.35
2007-11-13	330.61
2007-11-14	321.16
2007-11-15	315.14
2007-11-16	317.13
2007-11-19	313.24
2007-11-20	324.59
2007-11-21	330.59
2007-11-23	338.69
2007-11-26	333.30
2007-11-27	337.12
2007-11-28	346.48
2007-11-29	348.85
2007-11-30	346.85
2007-12-03	341.11
2007-12-04	342.42
2007-12-05	349.60
2007-12-06	357.99
2007-12-07	357.79
2007-12-10	359.57
2007-12-11	349.95
2007-12-12	350.02
2007-12-13	347.37
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2007-12-17	334.95
2007-12-18	337.01
2007-12-19	339.02
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2007-12-21	348.69
2007-12-24	350.72
2007-12-26	355.78
2007-12-27	350.72
2007-12-28	351.62
2007-12-31	346.09
2008-01-02	342.94
2008-01-03	343.01
2008-01-04	328.83
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2008-01-10	323.69
2008-01-11	319.44
2008-01-14	327.24
2008-01-15	319.14
2008-01-16	308.28
2008-01-17	300.70
2008-01-18	300.42

 Notebook Data Output Comments

2008-01-24	287.53
2008-01-25	283.48
2008-01-28	278.27
2008-01-29	275.54
2008-01-30	274.41
2008-01-31	282.43
2008-02-01	258.21
2008-02-04	247.96
2008-02-05	253.65
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2008-02-14	266.39
2008-02-15	265.08
2008-02-19	254.73
2008-02-20	254.75
2008-02-21	251.68
2008-02-22	254.15
2008-02-25	243.46
2008-02-26	232.33
2008-02-27	236.67
2008-02-28	237.93
2008-02-29	235.83
2008-03-03	228.74
2008-03-04	222.52
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2008-03-07	216.89
2008-03-10	207.02
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2008-03-12	220.31
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2008-03-14	219.18
2008-03-17	210.14
2008-03-18	219.80
2008-03-19	216.22
2008-03-20	216.99
2008-03-24	230.51
2008-03-25	225.62
2008-03-26	229.32
2008-03-27	222.26
2008-03-28	219.26
2008-03-31	220.46
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2008-04-02	233.08
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2008-04-08	234.14
2008-04-09	232.33
2008-04-10	234.78
2008-04-11	228.95
2008-04-14	226.06
2008-04-15	223.64

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2008-04-22	277.78
2008-04-23	273.52
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2008-04-28	276.34
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2008-04-30	287.43
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2008-05-02	290.94
2008-05-05	297.75
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2008-05-08	291.80
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2008-05-12	292.76
2008-05-13	291.79
2008-05-14	288.44
2008-05-15	290.79
2008-05-16	290.33
2008-05-19	289.05
2008-05-20	289.59
2008-05-21	275.27
2008-05-22	275.00
2008-05-23	272.58
2008-05-27	280.73
2008-05-28	284.40
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2008-05-30	293.19
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2008-06-04	286.40
2008-06-05	293.44
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2008-06-17	285.01
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2008-06-30	263.47
2008-07-01	267.63
2008-07-02	263.78
2008-07-03	268.77
2008-07-07	272.23
2008-07-08	277.54
2008-07-09	271.05
2008-07-10	270.56

 Notebook Data Output Comments

2008-07-15	258.30
2008-07-16	268.07
2008-07-17	266.99
2008-07-18	240.90
2008-07-21	234.63
2008-07-22	238.79
2008-07-23	244.85
2008-07-24	238.05
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2008-08-07	239.80
2008-08-08	247.75
2008-08-11	250.67
2008-08-12	251.56
2008-08-13	250.27
2008-08-14	253.00
2008-08-15	255.33
2008-08-18	249.40
2008-08-19	245.50
2008-08-20	242.74
2008-08-21	243.51
2008-08-22	245.54
2008-08-25	241.75
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2008-09-02	232.86
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2008-09-04	225.36
2008-09-05	222.35
2008-09-08	210.18
2008-09-09	209.54
2008-09-10	207.29
2008-09-11	217.09
2008-09-12	219.05
2008-09-15	217.15
2008-09-16	221.69
2008-09-17	207.45
2008-09-18	219.76
2008-09-19	224.80
2008-09-22	215.29
2008-09-23	214.85
2008-09-24	217.77
2008-09-25	220.02
2008-09-26	215.74
2008-09-29	190.69
2008-09-30	200.46
2008-10-01	206.07
2008-10-02	195.44
2008-10-03	193.65

 Notebook Data Output Comments

2008-10-08	169.22
2008-10-09	164.65
2008-10-10	166.17
2008-10-13	190.70
2008-10-14	181.54
2008-10-15	169.75
2008-10-16	176.69
2008-10-17	186.46
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2008-10-23	176.34
2008-10-24	169.81
2008-10-27	164.91
2008-10-28	184.56
2008-10-29	179.18
2008-10-30	180.02
2008-10-31	179.86
2008-11-03	173.42
2008-11-04	183.65
2008-11-05	171.29
2008-11-06	165.78
2008-11-07	165.74
2008-11-10	159.55
2008-11-11	155.89
2008-11-12	145.65
2008-11-13	156.20
2008-11-14	155.17
2008-11-17	150.21
2008-11-18	148.86
2008-11-19	140.23
2008-11-20	129.91
2008-11-21	131.35
2008-11-24	128.85
2008-11-25	141.17
2008-11-26	146.19
2008-11-28	146.63
2008-12-01	133.13
2008-12-02	137.69
2008-12-03	139.85
2008-12-04	137.31
2008-12-05	142.14
2008-12-08	151.21
2008-12-09	153.14
2008-12-10	154.56
2008-12-11	150.26
2008-12-12	158.04
2008-12-15	155.49
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2008-12-19	155.24
2008-12-22	148.70
2008-12-23	149.16
2008-12-24	151.63
2008-12-26	150.33
2008-12-29	148.86

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2009-01-06	167.20
2009-01-07	161.17
2009-01-08	162.76
2009-01-09	157.69
2009-01-12	156.50
2009-01-13	157.32
2009-01-14	150.64
2009-01-15	149.64
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2009-02-04	171.67
2009-02-05	177.04
2009-02-06	185.83
2009-02-09	189.57
2009-02-10	179.43
2009-02-11	179.20
2009-02-12	181.71
2009-02-13	179.02
2009-02-17	171.50
2009-02-18	176.73
2009-02-19	171.49
2009-02-20	173.40
2009-02-23	165.20
2009-02-24	172.90
2009-02-25	170.99
2009-02-26	168.76
2009-02-27	169.16
2009-03-02	163.74
2009-03-03	162.90
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2009-03-13	162.37
2009-03-16	160.00
2009-03-17	167.84
2009-03-18	166.72
2009-03-19	165.13
2009-03-20	165.25
2009-03-23	174.48
2009-03-24	173.76
2009-03-25	172.21
2009-03-26	176.82

2009-03-31	174.20
2009-04-01	177.22
2009-04-02	181.43
2009-04-03	185.07
2009-04-06	184.30
2009-04-07	179.50
2009-04-08	181.18
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2009-04-13	189.24
2009-04-14	184.64
2009-04-15	189.94
2009-04-16	194.56
2009-04-17	196.32
2009-04-20	189.84
2009-04-21	190.93
2009-04-22	192.12
2009-04-23	192.54
2009-04-24	194.94
2009-04-27	193.17
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2009-05-08	203.87
2009-05-11	204.19
2009-05-12	199.70
2009-05-13	194.96
2009-05-14	193.94
2009-05-15	195.20
2009-05-18	198.62
2009-05-19	199.64
2009-05-20	198.79
2009-05-21	198.45
2009-05-22	196.95
2009-05-26	202.38
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2009-06-12	212.63
2009-06-15	208.59
2009-06-16	208.21
2009-06-17	207.79
2009-06-18	207.24
2009-06-19	210.26
2009-06-22	203.88

 Notebook Data Output Comments

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2009-06-26	212.87
2009-06-29	212.28
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2009-07-01	209.70
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2009-07-14	212.56
2009-07-15	219.30
2009-07-16	221.52
2009-07-17	215.34
2009-07-20	215.30
2009-07-21	214.16
2009-07-22	214.06
2009-07-23	218.89
2009-07-24	223.58
2009-07-27	222.62
2009-07-28	220.14
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2009-08-04	227.09
2009-08-05	225.80
2009-08-06	225.41
2009-08-07	228.78
2009-08-10	228.53
2009-08-11	227.20
2009-08-12	229.52
2009-08-13	231.37
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2009-08-18	222.86
2009-08-19	222.21
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2009-08-24	234.60
2009-08-25	235.92
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2009-08-28	232.61
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2009-09-02	226.73
2009-09-03	228.99
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2009-09-10	235.71
2009-09-11	236.31
2009-09-14	237.80
2009-09-15	239.01

2009-09-21	248.75
2009-09-22	249.78
2009-09-23	249.48
2009-09-24	248.63
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2009-10-13	263.32
2009-10-14	267.93
2009-10-15	265.22
2009-10-16	275.20
2009-10-19	276.32
2009-10-20	276.14
2009-10-21	275.83
2009-10-22	277.32
2009-10-23	277.12
2009-10-26	277.38
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2009-11-25	293.16
2009-11-27	290.17
2009-11-30	291.79
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2009-12-03	293.16
2009-12-04	292.80
2009-12-07	293.42
2009-12-08	293.82
2009-12-09	294.80

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2009-12-15	296.87
2009-12-16	299.18
2009-12-17	297.27
2009-12-18	298.51
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2009-12-22	300.86
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2010-01-11	300.86
2010-01-12	295.54
2010-01-13	293.84
2010-01-14	295.22
2010-01-15	290.29
2010-01-19	294.10
2010-01-20	290.50
2010-01-21	291.78
2010-01-22	275.28
2010-01-25	270.27
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2010-02-18	271.88
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2010-02-22	271.67
2010-02-23	267.80
2010-02-24	266.00
2010-02-25	263.48
2010-02-26	263.66
2010-03-01	266.61
2010-03-02	270.80
2010-03-03	272.93
2010-03-04	277.57
2010-03-05	282.39
2010-03-08	281.52
2010-03-09	280.38

 Notebook Data Output Comments

2010-03-12	290.06
2010-03-15	281.87
2010-03-16	282.88
2010-03-17	283.06
2010-03-18	283.48
2010-03-19	280.28
2010-03-22	279.03
2010-03-23	274.77
2010-03-24	278.94
2010-03-25	281.72
2010-03-26	281.63
2010-03-29	281.51
2010-03-30	283.64
2010-03-31	283.84
2010-04-05	285.79
2010-04-06	284.39
2010-04-07	282.05
2010-04-08	284.03
2010-04-09	283.39
2010-04-12	286.65
2010-04-13	293.68
2010-04-14	294.79
2010-04-15	297.95
2010-04-16	275.35
2010-04-19	275.33
2010-04-20	277.80
2010-04-21	277.43
2010-04-22	273.80
2010-04-23	272.77
2010-04-26	266.09
2010-04-27	264.80
2010-04-28	264.86
2010-04-29	266.27
2010-04-30	263.11
2010-05-03	265.57
2010-05-04	253.44
2010-05-05	255.13
2010-05-06	249.58
2010-05-07	246.82
2010-05-10	261.09
2010-05-11	254.78
2010-05-12	252.95
2010-05-13	255.70
2010-05-14	254.02
2010-05-17	254.24
2010-05-18	249.43
2010-05-19	247.46
2010-05-20	237.74
2010-05-21	236.26
2010-05-24	238.82
2010-05-25	238.77
2010-05-26	237.97
2010-05-27	245.48
2010-05-28	243.06
2010-06-01	241.43
2010-06-02	246.93
2010-06-03	253.05
2010-06-04	242.61

 Notebook Data Output Comments

2010-06-09	237.25
2010-06-10	243.75
2010-06-11	244.49
2010-06-14	241.84
2010-06-15	249.24
2010-06-16	250.89
2010-06-17	250.29
2010-06-18	250.27
2010-06-21	244.52
2010-06-22	243.37
2010-06-23	241.27
2010-06-24	237.79
2010-06-25	236.58
2010-06-28	236.28
2010-06-29	227.36
2010-06-30	222.70
2010-07-01	219.96
2010-07-02	218.49
2010-07-06	218.25
2010-07-07	225.33
2010-07-08	228.51
2010-07-09	233.98
2010-07-12	238.15
2010-07-13	244.84
2010-07-14	245.91
2010-07-15	247.26
2010-07-16	230.03
2010-07-19	233.32
2010-07-20	241.04
2010-07-21	238.99
2010-07-22	242.65
2010-07-23	245.28
2010-07-26	244.73
2010-07-27	246.56
2010-07-28	242.42
2010-07-29	242.74
2010-07-30	242.67
2010-08-02	245.45
2010-08-03	245.16
2010-08-04	253.41
2010-08-05	254.30
2010-08-06	250.36
2010-08-09	252.93
2010-08-10	252.11
2010-08-11	246.12
2010-08-12	246.25
2010-08-13	243.42
2010-08-16	243.04
2010-08-17	245.51
2010-08-18	241.32
2010-08-19	234.22
2010-08-20	231.24
2010-08-23	232.27
2010-08-24	225.92
2010-08-25	227.54
2010-08-26	225.72
2010-08-27	229.64

2010-09-01	200.40
2010-09-02	231.82
2010-09-03	235.39
2010-09-07	232.43
2010-09-08	235.53
2010-09-09	238.33
2010-09-10	238.31
2010-09-13	241.38
2010-09-14	240.46
2010-09-15	240.56
2010-09-16	240.77
2010-09-17	245.32
2010-09-20	254.39
2010-09-21	256.99
2010-09-22	258.26
2010-09-23	257.00
2010-09-24	263.91
2010-09-27	265.47
2010-09-28	263.85
2010-09-29	264.11
2010-09-30	263.16
2010-10-01	263.07
2010-10-04	261.44
2010-10-05	269.38
2010-10-06	267.44
2010-10-07	265.27
2010-10-08	268.44
2010-10-11	269.69
2010-10-12	270.97
2010-10-13	271.92
2010-10-14	270.74
2010-10-15	301.03
2010-10-18	309.16
2010-10-19	304.22
2010-10-20	304.29
2010-10-21	306.30
2010-10-22	306.57
2010-10-25	308.56
2010-10-26	309.61
2010-10-27	308.54
2010-10-28	309.60
2010-10-29	307.16
2010-11-01	307.81
2010-11-02	308.11
2010-11-03	310.40
2010-11-04	312.45
2010-11-05	312.85
2010-11-08	313.70
2010-11-09	312.72
2010-11-10	311.75
2010-11-11	308.90
2010-11-12	301.95
2010-11-15	298.03
2010-11-16	292.15
2010-11-17	292.07
2010-11-18	298.58
2010-11-19	295.71
2010-11-22	295.91

2010-11-26	295.29
2010-11-29	291.35
2010-11-30	278.13
2010-12-01	282.46
2010-12-02	286.20
2010-12-03	286.79
2010-12-06	289.47
2010-12-07	293.86
2010-12-08	295.57
2010-12-09	296.05
2010-12-10	296.40
2010-12-13	297.61
2010-12-14	297.75
2010-12-15	295.45
2010-12-16	296.15
2010-12-17	295.70
2010-12-20	297.83
2010-12-21	301.84
2010-12-22	303.05
2010-12-23	302.42
2010-12-27	301.49
2010-12-28	299.76
2010-12-29	300.80
2010-12-30	299.73
2010-12-31	297.28
2011-01-03	302.48
2011-01-04	301.36
2011-01-05	304.84
2011-01-06	307.06
2011-01-07	308.53
2011-01-10	307.41
2011-01-11	308.31
2011-01-12	308.74
2011-01-13	308.65
2011-01-14	312.40
2011-01-18	320.13
2011-01-19	316.19
2011-01-20	313.70
2011-01-21	306.22
2011-01-24	305.85
2011-01-25	310.26
2011-01-26	308.56
2011-01-27	308.70
2011-01-28	300.80
2011-01-31	300.48
2011-02-01	305.83
2011-02-02	306.31
2011-02-03	305.38
2011-02-04	305.80
2011-02-07	307.46
2011-02-08	309.50
2011-02-09	308.56
2011-02-10	308.53
2011-02-11	312.56
2011-02-14	314.39
2011-02-15	312.39
2011-02-16	312.42
2011-02-17	312.04

 Notebook Data Output Comments

2011-02-23	305.97
2011-02-24	304.71
2011-02-25	305.33
2011-02-28	307.01
2011-03-01	300.68
2011-03-02	300.70
2011-03-03	305.08
2011-03-04	300.61
2011-03-07	296.13
2011-03-08	296.45
2011-03-09	296.18
2011-03-10	290.44
2011-03-11	288.64
2011-03-14	285.28
2011-03-15	285.06
2011-03-16	278.83
2011-03-17	280.96
2011-03-18	280.81
2011-03-21	288.54
2011-03-22	288.95
2011-03-23	291.37
2011-03-24	293.74
2011-03-25	290.16
2011-03-28	287.97
2011-03-29	291.16
2011-03-30	291.21
2011-03-31	293.67
2011-04-01	296.20
2011-04-04	294.13
2011-04-05	284.83
2011-04-06	287.38
2011-04-07	290.29
2011-04-08	289.37
2011-04-11	288.97
2011-04-12	285.59
2011-04-13	288.43
2011-04-14	289.54
2011-04-15	265.62
2011-04-18	263.68
2011-04-19	261.03
2011-04-20	263.13
2011-04-21	262.81
2011-04-25	262.79
2011-04-26	266.68
2011-04-27	269.15
2011-04-28	269.25
2011-04-29	272.32
2011-05-02	269.55
2011-05-03	267.21
2011-05-04	268.16
2011-05-05	267.40
2011-05-06	267.92
2011-05-09	269.11
2011-05-10	271.60
2011-05-11	267.99
2011-05-12	267.79
2011-05-13	265.04

2011-05-19	265.89
2011-05-20	262.28
2011-05-23	259.45
2011-05-24	259.39
2011-05-25	260.09
2011-05-26	259.32
2011-05-27	260.71
2011-05-31	264.77
2011-06-01	263.06
2011-06-02	264.29
2011-06-03	261.80
2011-06-06	260.79
2011-06-07	259.77
2011-06-08	259.84
2011-06-09	258.62
2011-06-10	255.01
2011-06-13	252.62
2011-06-14	254.44
2011-06-15	251.73
2011-06-16	250.44
2011-06-17	242.75
2011-06-20	242.53
2011-06-21	246.75
2011-06-22	243.75
2011-06-23	240.35
2011-06-24	237.68
2011-06-27	241.60
2011-06-28	247.07
2011-06-29	249.03
2011-06-30	253.44
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2011-07-06	267.95
2011-07-07	273.57
2011-07-08	266.26
2011-07-11	263.90
2011-07-12	267.27
2011-07-13	269.40
2011-07-14	264.73
2011-07-15	299.11
2011-07-18	297.77
2011-07-19	301.58
2011-07-20	297.97
2011-07-21	303.80
2011-07-22	309.42
2011-07-25	309.80
2011-07-26	311.57
2011-07-27	303.91
2011-07-28	305.78
2011-07-29	302.15
2011-08-01	303.69
2011-08-02	297.37
2011-08-03	300.89
2011-08-04	289.05
2011-08-05	289.81
2011-08-08	273.28
2011-08-09	286.99

 Notebook Data Output Comments

2011-08-12	282.17
2011-08-15	278.89
2011-08-16	269.77
2011-08-17	266.84
2011-08-18	252.69
2011-08-19	245.71
2011-08-22	249.33
2011-08-23	259.67
2011-08-24	261.91
2011-08-25	260.28
2011-08-26	263.69
2011-08-29	269.81
2011-08-30	270.62
2011-08-31	270.75
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2011-09-02	262.68
2011-09-06	261.35
2011-09-07	267.28
2011-09-08	267.75
2011-09-09	262.69
2011-09-12	265.33
2011-09-13	265.02
2011-09-14	266.30
2011-09-15	271.55
2011-09-16	273.61
2011-09-19	273.61
2011-09-20	273.59
2011-09-21	269.87
2011-09-22	260.59
2011-09-23	263.02
2011-09-26	266.21
2011-09-27	269.94
2011-09-28	264.68
2011-09-29	264.01
2011-09-30	257.78
2011-10-03	248.01
2011-10-04	251.20
2011-10-05	252.60
2011-10-06	257.61
2011-10-07	257.82
2011-10-10	268.85
2011-10-11	271.86
2011-10-12	274.52
2011-10-13	279.77
2011-10-14	296.14
2011-10-17	291.50
2011-10-18	295.55
2011-10-19	290.64
2011-10-20	292.13
2011-10-21	295.54
2011-10-24	298.51
2011-10-25	291.87
2011-10-26	293.45
2011-10-27	299.63
2011-10-28	300.37
2011-10-31	296.62
2011-11-01	289.61
2011-11-02	292.70

 Notebook Data Output Comments

2011-11-07	304.47
2011-11-08	306.48
2011-11-09	300.78
2011-11-10	297.84
2011-11-11	304.48
2011-11-14	306.81
2011-11-15	308.59
2011-11-16	306.04
2011-11-17	300.74
2011-11-18	297.74
2011-11-21	290.76
2011-11-22	290.29
2011-11-23	285.34
2011-11-25	281.78
2011-11-28	294.39
2011-11-29	291.76
2011-11-30	299.99
2011-12-01	307.19
2011-12-02	310.49
2011-12-05	313.14
2011-12-06	312.20
2011-12-07	312.01
2011-12-08	308.33
2011-12-09	314.02
2011-12-12	313.01
2011-12-13	313.13
2011-12-14	309.34
2011-12-15	310.08
2011-12-16	313.29
2011-12-19	311.23
2011-12-20	315.50
2011-12-21	313.22
2011-12-22	315.16
2011-12-23	316.89
2011-12-27	320.45
2011-12-28	320.17
2011-12-29	321.52
2011-12-30	323.27
2012-01-03	333.04
2012-01-04	334.47
2012-01-05	329.83
2012-01-06	325.34
2012-01-09	311.54
2012-01-10	311.88
2012-01-11	313.29
2012-01-12	315.13
2012-01-13	312.81
2012-01-17	314.60
2012-01-18	316.77
2012-01-19	320.10
2012-01-20	293.29
2012-01-23	293.05
2012-01-24	290.76
2012-01-25	285.03
2012-01-26	284.33
2012-01-27	290.28
2012-01-30	289.13

2012-02-03	298.46
2012-02-06	304.85
2012-02-07	303.69
2012-02-08	305.23
2012-02-09	306.04
2012-02-10	303.26
2012-02-13	306.41
2012-02-14	305.18
2012-02-15	303.08
2012-02-16	303.56
2012-02-17	302.62
2012-02-21	307.31
2012-02-22	304.27
2012-02-23	303.36
2012-02-24	305.25
2012-02-27	304.96
2012-02-28	309.50
2012-02-29	309.43
2012-03-01	311.51
2012-03-02	310.94
2012-03-05	307.43
2012-03-06	302.78
2012-03-07	303.70
2012-03-08	303.87
2012-03-09	300.43
2012-03-12	302.88
2012-03-13	309.20
2012-03-14	308.30
2012-03-15	310.88
2012-03-16	312.83
2012-03-19	317.31
2012-03-20	317.06
2012-03-21	320.31
2012-03-22	323.35
2012-03-23	321.62
2012-03-26	324.99
2012-03-27	323.83
2012-03-28	328.21
2012-03-29	324.53
2012-03-30	320.94
2012-04-02	323.78
2012-04-03	321.63
2012-04-04	317.89
2012-04-05	316.48
2012-04-09	315.74
2012-04-10	313.74
2012-04-11	318.30
2012-04-12	325.83
2012-04-13	312.61
2012-04-16	303.34
2012-04-17	305.09
2012-04-18	304.03
2012-04-19	299.95
2012-04-20	298.33
2012-04-23	299.10
2012-04-24	300.94
2012-04-25	305.16

2012-04-30	302.73
2012-05-01	302.52
2012-05-02	303.93
2012-05-03	305.82
2012-05-04	298.78
2012-05-07	304.08
2012-05-08	306.70
2012-05-09	304.88
2012-05-10	307.14
2012-05-11	302.92
2012-05-14	302.30
2012-05-15	305.86
2012-05-16	314.78
2012-05-17	311.84
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2012-06-05	285.49
2012-06-06	290.58
2012-06-07	289.40
2012-06-08	290.52
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2012-06-12	282.83
2012-06-13	280.83
2012-06-14	279.80
2012-06-15	282.54
2012-06-18	285.71
2012-06-19	291.06
2012-06-20	289.04
2012-06-21	282.89
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2012-06-25	280.63
2012-06-26	282.62
2012-06-27	284.94
2012-06-28	282.44
2012-06-29	290.33
2012-07-02	290.53
2012-07-03	294.21
2012-07-05	298.26
2012-07-06	293.28
2012-07-09	293.30
2012-07-10	291.14
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2012-07-12	285.53
2012-07-13	288.55
2012-07-16	287.75
2012-07-17	288.65
2012-07-18	290.67
2012-07-19	296.83
2012-07-20	305.72

 Notebook Data Output Comments

2012-07-25	304.30
2012-07-26	306.99
2012-07-27	317.80
2012-07-30	316.47
2012-07-31	316.80
2012-08-01	316.66
2012-08-02	314.69
2012-08-03	320.99
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2012-08-07	320.59
2012-08-08	321.44
2012-08-09	321.50
2012-08-10	321.32
2012-08-13	330.34
2012-08-14	334.66
2012-08-15	334.10
2012-08-16	336.77
2012-08-17	338.91
2012-08-20	338.11
2012-08-21	335.09
2012-08-22	338.93
2012-08-23	338.74
2012-08-24	339.65
2012-08-27	334.94
2012-08-28	338.96
2012-08-29	344.35
2012-08-30	341.18
2012-08-31	342.89
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2012-09-07	353.43
2012-09-10	350.74
2012-09-11	346.44
2012-09-12	345.78
2012-09-13	353.37
2012-09-14	355.19
2012-09-17	355.34
2012-09-18	359.50
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2012-09-20	364.42
2012-09-21	367.36
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2012-09-25	374.95
2012-09-26	377.11
2012-09-27	378.63
2012-09-28	377.63
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2012-10-02	378.87
2012-10-03	381.63
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2012-10-08	379.30
2012-10-09	372.42
2012-10-10	372.65
2012-10-11	376.12
2012-10-12	372.75
2012-10-15	372.81

2012-10-18	347.85
2012-10-19	341.24
2012-10-22	339.67
2012-10-23	340.52
2012-10-24	338.99
2012-10-25	339.22
2012-10-26	337.91
2012-10-31	340.49
2012-11-01	344.14
2012-11-02	344.30
2012-11-05	341.82
2012-11-06	341.20
2012-11-07	333.89
2012-11-08	326.47
2012-11-09	331.85
2012-11-12	333.28
2012-11-13	329.86
2012-11-14	326.60
2012-11-15	323.95
2012-11-16	323.91
2012-11-19	334.44
2012-11-20	335.32
2012-11-21	333.27
2012-11-23	334.32
2012-11-26	330.91
2012-11-27	335.69
2012-11-28	342.18
2012-11-29	346.29
2012-11-30	349.53
2012-12-03	347.97
2012-12-04	345.86
2012-12-05	344.25
2012-12-06	345.91
2012-12-07	342.45
2012-12-10	343.05
2012-12-11	348.79
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2012-12-13	351.70
2012-12-14	351.33
2012-12-17	360.75
2012-12-18	360.90
2012-12-19	360.42
2012-12-20	361.54
2012-12-21	358.17
2012-12-24	355.10
2012-12-26	354.79
2012-12-27	353.50
2012-12-28	350.36
2012-12-31	354.04
2013-01-02	361.99
2013-01-03	362.20
2013-01-04	369.35
2013-01-07	367.74
2013-01-08	367.02
2013-01-09	369.43
2013-01-10	371.11
2013-01-11	370.36

2013-01-10	357.99
2013-01-17	356.02
2013-01-18	352.61
2013-01-22	351.79
2013-01-23	371.12
2013-01-24	377.29
2013-01-25	377.21
2013-01-28	375.74
2013-01-29	377.22
2013-01-30	377.29
2013-01-31	378.22
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2013-02-04	379.89
2013-02-05	383.25
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2013-02-07	387.36
2013-02-08	393.08
2013-02-11	391.60
2013-02-12	390.74
2013-02-13	391.82
2013-02-14	394.30
2013-02-15	396.84
2013-02-19	403.83
2013-02-20	396.63
2013-02-21	398.16
2013-02-22	400.25
2013-02-25	395.78
2013-02-26	395.46
2013-02-27	400.29
2013-02-28	401.00
2013-03-01	403.50
2013-03-04	411.16
2013-03-05	419.72
2013-03-06	416.11
2013-03-07	416.71
2013-03-08	416.18
2013-03-11	417.83
2013-03-12	414.22
2013-03-13	413.07
2013-03-14	411.18
2013-03-15	407.56
2013-03-18	404.30
2013-03-19	406.07
2013-03-20	407.76
2013-03-21	406.04
2013-03-22	405.56
2013-03-25	405.22
2013-03-26	406.62
2013-03-27	401.73
2013-03-28	397.49
2013-04-01	401.00
2013-04-02	406.93
2013-04-03	403.50
2013-04-04	397.93
2013-04-05	391.92
2013-04-08	387.81
2013-04-09	389.21
2013-04-10	395.49

 Notebook Data Output Comments

2013-04-15	391.36
2013-04-16	397.08
2013-04-17	391.67
2013-04-18	383.34
2013-04-19	400.33
2013-04-22	400.46
2013-04-23	404.35
2013-04-24	407.13
2013-04-25	404.95
2013-04-26	401.11
2013-04-29	409.94
2013-04-30	412.70
2013-05-01	410.63
2013-05-02	415.22
2013-05-03	423.28
2013-05-06	431.21
2013-05-07	429.04
2013-05-08	437.25
2013-05-09	436.18
2013-05-10	440.56
2013-05-13	439.20
2013-05-14	443.99
2013-05-15	458.40
2013-05-16	452.39
2013-05-17	455.04
2013-05-20	454.72
2013-05-21	453.94
2013-05-22	445.15
2013-05-23	441.84
2013-05-24	437.10
2013-05-28	441.08
2013-05-29	434.59
2013-05-30	435.82
2013-05-31	436.04
2013-06-03	434.25
2013-06-04	429.98
2013-06-05	430.28
2013-06-06	432.75
2013-06-07	440.30
2013-06-10	445.56
2013-06-11	440.34
2013-06-12	436.43
2013-06-13	438.94
2013-06-14	437.96
2013-06-17	443.57
2013-06-18	450.76
2013-06-19	450.79
2013-06-20	442.81
2013-06-21	440.91
2013-06-24	435.33
2013-06-25	433.53
2013-06-26	437.26
2013-06-27	438.97
2013-06-28	440.62
2013-07-01	444.38
2013-07-02	441.60
2013-07-03	443.66
2013-07-05	447.10

 Notebook Data Output Comments

2013-07-10	453.45
2013-07-11	460.58
2013-07-12	461.96
2013-07-15	462.81
2013-07-16	460.26
2013-07-17	459.73
2013-07-18	455.80
2013-07-19	448.75
2013-07-22	455.81
2013-07-23	452.35
2013-07-24	451.90
2013-07-25	444.29
2013-07-26	443.12
2013-07-29	441.58
2013-07-30	445.91
2013-07-31	444.32
2013-08-01	452.56
2013-08-02	453.74
2013-08-05	452.95
2013-08-06	448.73
2013-08-07	445.77
2013-08-08	446.78
2013-08-09	445.65
2013-08-12	443.20
2013-08-13	441.07
2013-08-14	435.34
2013-08-15	430.26
2013-08-16	428.88
2013-08-19	433.26
2013-08-20	433.14
2013-08-21	435.10
2013-08-22	437.29
2013-08-23	435.54
2013-08-26	433.63
2013-08-27	425.50
2013-08-28	424.70
2013-08-29	428.14
2013-08-30	423.87
2013-09-03	430.62
2013-09-04	436.25
2013-09-05	440.22
2013-09-06	440.23
2013-09-09	444.47
2013-09-10	444.78
2013-09-11	448.54
2013-09-12	446.98
2013-09-13	444.98
2013-09-16	444.32
2013-09-17	443.50
2013-09-18	452.11
2013-09-19	449.64
2013-09-20	452.01
2013-09-23	443.69
2013-09-24	443.86
2013-09-25	439.05
2013-09-26	439.52
2013-09-27	438.63

2013-10-03	438.48
2013-10-04	436.61
2013-10-07	433.30
2013-10-08	427.26
2013-10-09	428.36
2013-10-10	434.55
2013-10-11	436.43
2013-10-14	438.49
2013-10-15	441.45
2013-10-16	449.46
2013-10-17	444.84
2013-10-18	506.21
2013-10-21	502.15
2013-10-22	504.00
2013-10-23	516.22
2013-10-24	513.29
2013-10-25	508.11
2013-10-28	508.01
2013-10-29	518.64
2013-10-30	515.73
2013-10-31	515.81
2013-11-01	514.03
2013-11-04	513.57
2013-11-05	511.27
2013-11-06	511.89
2013-11-07	504.48
2013-11-08	508.52
2013-11-11	505.80
2013-11-12	506.40
2013-11-13	516.75
2013-11-14	518.13
2013-11-15	517.30
2013-11-18	516.29
2013-11-19	513.12
2013-11-20	511.67
2013-11-21	517.55
2013-11-22	516.46
2013-11-25	523.49
2013-11-26	529.73
2013-11-27	532.09
2013-11-29	530.32
2013-12-02	527.77
2013-12-03	527.16
2013-12-04	529.62
2013-12-05	529.20
2013-12-06	535.47
2013-12-09	539.61
2013-12-10	542.87
2013-12-11	539.18
2013-12-12	535.51
2013-12-13	530.92
2013-12-16	537.03
2013-12-17	535.46
2013-12-18	542.92
2013-12-19	543.65
2013-12-20	550.86
2013-12-23	558.11

 Notebook Data Output Comments

2013-12-27	559.76
2013-12-30	555.28
2013-12-31	560.92
2014-01-02	557.12
2014-01-03	553.05
2014-01-06	559.22
2014-01-07	570.00
2014-01-08	571.19
2014-01-09	565.69
2014-01-10	565.66
2014-01-13	562.05
2014-01-14	575.27
2014-01-15	574.88
2014-01-16	578.69
2014-01-17	575.84
2014-01-21	582.43
2014-01-22	583.09
2014-01-23	580.63
2014-01-24	562.48
2014-01-27	551.17
2014-01-28	562.07
2014-01-29	554.01
2014-01-30	568.26
2014-01-31	591.08
2014-02-03	567.28
2014-02-04	569.65
2014-02-05	572.17
2014-02-06	580.56
2014-02-07	589.31
2014-02-10	587.05
2014-02-11	595.69
2014-02-12	593.94
2014-02-13	600.55
2014-02-14	602.00
2014-02-18	606.05
2014-02-19	601.77
2014-02-20	602.66
2014-02-21	602.50
2014-02-24	606.86
2014-02-25	610.61
2014-02-26	610.70
2014-02-27	610.22
2014-02-28	608.43
2014-03-03	601.95
2014-03-04	608.06
2014-03-05	609.74
2014-03-06	610.42
2014-03-07	608.00
2014-03-10	606.39
2014-03-11	600.60
2014-03-12	604.25
2014-03-13	595.12
2014-03-14	586.99
2014-03-17	596.65
2014-03-18	606.24
2014-03-19	600.22
2014-03-20	599.18
2014-03-21	592.11

2014-03-26	566.55
2014-03-27	557.70
2014-03-28	560.64
2014-03-31	557.81
2014-04-01	568.01
2014-04-02	568.12
2014-04-03	571.50
2014-04-04	545.25
2014-04-07	540.63
2014-04-08	557.51
2014-04-09	567.04
2014-04-10	546.69
2014-04-11	537.76
2014-04-14	545.20
2014-04-15	548.70
2014-04-16	563.90
2014-04-17	543.34
2014-04-21	539.37
2014-04-22	545.50
2014-04-23	537.51
2014-04-24	534.44
2014-04-25	523.10
2014-04-28	522.98
2014-04-29	536.33
2014-04-30	534.88
2014-05-01	538.53
2014-05-02	533.87
2014-05-05	535.33
2014-05-06	522.57
2014-05-07	518.00
2014-05-08	520.17
2014-05-09	526.62
2014-05-12	538.43
2014-05-13	541.54
2014-05-14	534.41
2014-05-15	529.12
2014-05-16	528.30
2014-05-19	538.83
2014-05-20	540.39
2014-05-21	549.70
2014-05-22	555.45
2014-05-23	563.80
2014-05-27	574.87
2014-05-28	570.45
2014-05-29	570.56
2014-05-30	571.65
2014-06-02	564.34
2014-06-03	554.51
2014-06-04	553.76
2014-06-05	564.93
2014-06-06	566.03
2014-06-09	570.73
2014-06-10	568.30
2014-06-11	567.50
2014-06-12	559.50
2014-06-13	560.35
2014-06-16	552.30

2014-06-20	566.52
2014-06-23	574.29
2014-06-24	572.54
2014-06-25	585.93
2014-06-26	584.77
2014-06-27	585.69
2014-06-30	584.67
2014-07-01	591.49
2014-07-02	590.78
2014-07-03	593.08
2014-07-07	590.76
2014-07-08	578.40
2014-07-09	583.36
2014-07-10	580.04
2014-07-11	586.65
2014-07-14	594.26
2014-07-15	593.06
2014-07-16	590.62
2014-07-17	580.82
2014-07-18	605.11
2014-07-21	598.44
2014-07-22	603.57
2014-07-23	605.19
2014-07-24	603.01
2014-07-25	598.08
2014-07-28	599.02
2014-07-29	593.95
2014-07-30	595.44
2014-07-31	579.55
2014-08-01	573.60
2014-08-04	582.27
2014-08-05	573.14
2014-08-06	574.49
2014-08-07	571.81
2014-08-08	577.94
2014-08-11	577.25
2014-08-12	572.12
2014-08-13	584.56
2014-08-14	584.65
2014-08-15	583.71
2014-08-18	592.70
2014-08-19	597.11
2014-08-20	595.41
2014-08-21	592.42
2014-08-22	592.54
2014-08-25	590.57
2014-08-26	588.12
2014-08-27	583.00
2014-08-28	580.32
2014-08-29	582.36
2014-09-02	588.63
2014-09-03	589.52
2014-09-04	593.14
2014-09-05	597.78
2014-09-08	601.63
2014-09-09	591.97
2014-09-10	593.42

2014-09-15	581.64
2014-09-16	588.78
2014-09-17	593.29
2014-09-18	597.27
2014-09-19	605.40
2014-09-22	597.27
2014-09-23	591.18
2014-09-24	598.42
2014-09-25	585.25
2014-09-26	587.90
2014-09-29	587.81
2014-09-30	588.41
2014-10-01	579.63
2014-10-02	580.88
2014-10-03	586.25
2014-10-06	587.78
2014-10-07	574.10
2014-10-08	583.74
2014-10-09	570.81
2014-10-10	555.19
2014-10-13	544.75
2014-10-14	548.69
2014-10-15	540.73
2014-10-16	536.92
2014-10-17	522.97
2014-10-20	532.38
2014-10-21	538.03
2014-10-22	542.69
2014-10-23	553.65
2014-10-24	548.90
2014-10-27	549.88
2014-10-28	558.94
2014-10-29	558.45
2014-10-30	560.27
2014-10-31	567.87
2014-11-03	563.77
2014-11-04	564.19
2014-11-05	555.95
2014-11-06	551.69
2014-11-07	551.82
2014-11-10	558.23
2014-11-11	561.29
2014-11-12	558.25
2014-11-13	556.44
2014-11-14	555.19
2014-11-17	546.64
2014-11-18	544.51
2014-11-19	547.20
2014-11-20	543.76
2014-11-21	545.89
2014-11-24	547.48
2014-11-25	549.23
2014-11-26	547.73
2014-11-28	549.08
2014-12-01	539.65
2014-12-02	538.59
2014-12-03	536.97
2014-12-04	542.58

 Notebook Data Output Comments

2014-12-09	536.11
2014-12-10	528.04
2014-12-11	532.11
2014-12-12	521.51
2014-12-15	515.84
2014-12-16	498.16
2014-12-17	506.45
2014-12-18	514.62
2014-12-19	520.04
2014-12-22	532.30
2014-12-23	538.77
2014-12-24	536.93
2014-12-26	541.52
2014-12-29	537.31
2014-12-30	535.28
2014-12-31	530.66
2015-01-02	529.55
2015-01-05	519.46
2015-01-06	506.64
2015-01-07	505.15
2015-01-08	506.91
2015-01-09	500.72
2015-01-12	497.06
2015-01-13	501.80
2015-01-14	505.93
2015-01-15	504.01
2015-01-16	510.46
2015-01-20	509.94
2015-01-21	520.39
2015-01-22	537.30
2015-01-23	541.95
2015-01-26	536.72
2015-01-27	521.19
2015-01-28	512.43
2015-01-29	513.23
2015-01-30	537.55
2015-02-02	532.20
2015-02-03	533.30
2015-02-04	526.10
2015-02-05	529.83
2015-02-06	533.88
2015-02-09	529.28
2015-02-10	540.16
2015-02-11	538.00
2015-02-12	546.01
2015-02-13	551.16
2015-02-17	545.01
2015-02-18	542.65
2015-02-19	546.45
2015-02-20	541.80
2015-02-23	535.00
2015-02-24	538.65
2015-02-25	547.33
2015-02-26	559.29
2015-02-27	562.63
2015-03-02	575.02
2015-03-03	578.80

2015-03-09	574.10
2015-03-10	559.85
2015-03-11	555.69
2015-03-12	561.17
2015-03-13	553.00
2015-03-16	561.64
2015-03-17	557.61
2015-03-18	566.16
2015-03-19	563.67
2015-03-20	564.95
2015-03-23	565.37
2015-03-24	577.54
2015-03-25	567.00
2015-03-26	563.64
2015-03-27	557.55
2015-03-30	561.14
2015-03-31	554.70
2015-04-01	549.49
2015-04-02	541.31
2015-04-06	543.95
2015-04-07	544.86
2015-04-08	548.84
2015-04-09	548.02
2015-04-10	548.54
2015-04-13	548.64
2015-04-14	539.78
2015-04-15	541.04
2015-04-16	543.52
2015-04-17	532.74
2015-04-20	544.53
2015-04-21	542.92
2015-04-22	549.18
2015-04-23	557.46
2015-04-24	573.66
2015-04-27	566.12
2015-04-28	564.37
2015-04-29	561.39
2015-04-30	548.77
2015-05-01	551.16
2015-05-04	552.84
2015-05-05	543.04
2015-05-06	535.08
2015-05-07	542.04
2015-05-08	548.95
2015-05-11	545.78
2015-05-12	538.73
2015-05-13	539.49
2015-05-14	549.20
2015-05-15	546.49
2015-05-18	546.67
2015-05-19	549.28
2015-05-20	552.51
2015-05-21	556.81
2015-05-22	554.52
2015-05-26	547.19
2015-05-27	554.25
2015-05-28	554.18

2015-06-02	553.93
2015-06-03	555.29
2015-06-04	551.69
2015-06-05	549.53
2015-06-08	543.48
2015-06-09	542.16
2015-06-10	552.60
2015-06-11	550.04
2015-06-12	547.47
2015-06-15	543.00
2015-06-16	544.87
2015-06-17	546.60
2015-06-18	556.18
2015-06-19	557.52
2015-06-22	559.68
2015-06-23	563.39
2015-06-24	558.57
2015-06-25	557.95
2015-06-26	553.06
2015-06-29	541.25
2015-06-30	540.04
2015-07-01	543.30
2015-07-02	547.34
2015-07-06	545.62
2015-07-07	550.03
2015-07-08	541.70
2015-07-09	544.65
2015-07-10	556.11
2015-07-13	571.73
2015-07-14	584.18
2015-07-15	583.96
2015-07-16	601.78
2015-07-17	699.62
2015-07-20	692.84
2015-07-21	695.35
2015-07-22	695.10
2015-07-23	674.73
2015-07-24	654.77
2015-07-27	658.27
2015-07-28	659.66
2015-07-29	661.43
2015-07-30	664.56
2015-07-31	657.50
2015-08-03	664.72
2015-08-04	661.28
2015-08-05	673.29
2015-08-06	670.15
2015-08-07	664.39
2015-08-10	663.14
2015-08-11	690.30
2015-08-12	691.47
2015-08-13	686.51
2015-08-14	689.37
2015-08-17	694.11
2015-08-18	688.73
2015-08-19	694.04
2015-08-20	679.48
2015-08-21	644.03

 Notebook Data Output Comments

2015-08-26	659.74
2015-08-27	667.96
2015-08-28	659.69
2015-08-31	647.82
2015-09-01	629.56
2015-09-02	644.91
2015-09-03	637.05
2015-09-04	628.96
2015-09-08	643.88
2015-09-09	643.41
2015-09-10	651.08
2015-09-11	655.30
2015-09-14	652.47
2015-09-15	665.07
2015-09-16	665.52
2015-09-17	671.67
2015-09-18	660.92
2015-09-21	666.98
2015-09-22	653.20
2015-09-23	653.29
2015-09-24	654.91
2015-09-25	640.15
2015-09-28	624.25
2015-09-29	622.61
2015-09-30	638.37
2015-10-01	642.00
2015-10-02	656.99
2015-10-05	671.68
2015-10-06	671.64
2015-10-07	670.00
2015-10-08	667.00
2015-10-09	671.24
2015-10-12	676.43
2015-10-13	683.17
2015-10-14	680.41
2015-10-15	693.02
2015-10-16	695.32
2015-10-19	699.95
2015-10-20	680.00
2015-10-21	671.80
2015-10-22	681.14
2015-10-23	719.33
2015-10-26	731.12
2015-10-27	732.82
2015-10-28	736.92
2015-10-29	744.85
2015-10-30	737.39
2015-11-02	747.74
2015-11-03	748.82
2015-11-04	755.31
2015-11-05	760.67
2015-11-06	761.60
2015-11-09	754.77
2015-11-10	758.26
2015-11-11	765.25
2015-11-12	756.53
2015-11-13	740.07
2015-11-16	750.10

 Notebook Data Output Comments

2015-11-19	759.94
2015-11-20	777.00
2015-11-23	776.70
2015-11-24	769.63
2015-11-25	769.26
2015-11-27	771.97
2015-11-30	762.85
2015-12-01	783.79
2015-12-02	777.85
2015-12-03	768.20
2015-12-04	779.21
2015-12-07	772.99
2015-12-08	775.14
2015-12-09	762.55
2015-12-10	760.04
2015-12-11	750.42
2015-12-14	762.54
2015-12-15	760.09
2015-12-16	776.59
2015-12-17	769.83
2015-12-18	756.85
2015-12-21	760.80
2015-12-22	767.13
2015-12-23	768.51
2015-12-24	765.84
2015-12-28	782.24
2015-12-29	793.96
2015-12-30	790.30
2015-12-31	778.01
2016-01-04	759.44
2016-01-05	761.53
2016-01-06	759.33
2016-01-07	741.00
2016-01-08	730.91
2016-01-11	733.07
2016-01-12	745.34
2016-01-13	719.57
2016-01-14	731.39
2016-01-15	710.49
2016-01-19	719.08
2016-01-20	718.56
2016-01-21	726.67
2016-01-22	745.46
2016-01-25	733.62
2016-01-26	733.79
2016-01-27	717.58
2016-01-28	748.30
2016-01-29	761.35
2016-02-01	770.77
2016-02-02	780.91
2016-02-03	749.38
2016-02-04	730.03
2016-02-05	703.76
2016-02-08	704.16
2016-02-09	701.02
2016-02-10	706.85
2016-02-11	706.36

2016-02-17	701.27
2016-02-18	717.51
2016-02-19	722.11
2016-02-22	729.05
2016-02-23	717.29
2016-02-24	720.90
2016-02-25	729.12
2016-02-26	724.86
2016-02-29	717.22
2016-03-01	742.17
2016-03-02	739.48
2016-03-03	731.59
2016-03-04	730.22
2016-03-07	712.80
2016-03-08	713.53
2016-03-09	725.41
2016-03-10	732.17
2016-03-11	744.87
2016-03-14	750.24
2016-03-15	750.57
2016-03-16	757.36
2016-03-17	758.48
2016-03-18	755.41
2016-03-21	762.16
2016-03-22	760.05
2016-03-23	757.56
2016-03-24	754.84
2016-03-28	753.28
2016-03-29	765.89
2016-03-30	768.34
2016-03-31	762.90
2016-04-01	769.67
2016-04-04	765.12
2016-04-05	758.57
2016-04-06	768.07
2016-04-07	760.12
2016-04-08	759.47
2016-04-11	757.54
2016-04-12	764.32
2016-04-13	771.91
2016-04-14	775.39
2016-04-15	780.00
2016-04-18	787.68
2016-04-19	776.25
2016-04-20	774.92
2016-04-21	780.00
2016-04-22	737.77
2016-04-25	742.21
2016-04-26	725.37
2016-04-27	721.46
2016-04-28	705.06
2016-04-29	707.88
2016-05-02	714.41
2016-05-03	708.44
2016-05-04	711.37
2016-05-05	714.71
2016-05-06	725.18
2016-05-09	729.13

 Notebook Data Output Comments

2016-05-12	728.07
2016-05-13	724.83
2016-05-16	730.30
2016-05-17	720.19
2016-05-18	721.78
2016-05-19	715.31
2016-05-20	721.71
2016-05-23	717.25
2016-05-24	733.03
2016-05-25	738.10
2016-05-26	736.93
2016-05-27	747.60
2016-05-31	748.85
2016-06-01	748.46
2016-06-02	744.27
2016-06-03	735.86
2016-06-06	730.06
2016-06-07	731.09
2016-06-08	742.93
2016-06-09	742.52
2016-06-10	733.19
2016-06-13	731.88
2016-06-14	733.25
2016-06-15	732.19
2016-06-16	724.25
2016-06-17	704.25
2016-06-20	706.13
2016-06-21	708.88
2016-06-22	710.47
2016-06-23	714.87
2016-06-24	685.20
2016-06-27	681.14
2016-06-28	691.26
2016-06-29	695.19
2016-06-30	703.53
2016-07-01	710.25
2016-07-05	704.89
2016-07-06	708.97
2016-07-07	707.26
2016-07-08	717.78
2016-07-11	727.20
2016-07-12	732.51
2016-07-13	729.48
2016-07-14	735.80
2016-07-15	735.63
2016-07-18	753.20
2016-07-19	753.41
2016-07-20	757.08
2016-07-21	754.41
2016-07-22	759.28
2016-07-25	757.52
2016-07-26	757.65
2016-07-27	761.97
2016-07-28	765.84
2016-07-29	791.34
2016-08-01	800.94
2016-08-02	800.12
2016-08-03	799.02

 Notebook Data Output Comments

2016-08-08	805.23
2016-08-09	807.48
2016-08-10	808.49
2016-08-11	808.20
2016-08-12	807.05
2016-08-15	805.96
2016-08-16	801.19
2016-08-17	805.42
2016-08-18	802.75
2016-08-19	799.65
2016-08-22	796.95
2016-08-23	796.59
2016-08-24	793.60
2016-08-25	791.30
2016-08-26	793.22
2016-08-29	795.82
2016-08-30	791.92
2016-08-31	789.85
2016-09-01	791.40
2016-09-02	796.87
2016-09-06	808.02
2016-09-07	807.99
2016-09-08	802.84
2016-09-09	788.48
2016-09-12	798.82
2016-09-13	788.72
2016-09-14	790.46
2016-09-15	801.23
2016-09-16	797.97
2016-09-19	795.39
2016-09-20	799.78
2016-09-21	805.03
2016-09-22	815.95
2016-09-23	814.96
2016-09-26	802.65
2016-09-27	810.73
2016-09-28	810.06
2016-09-29	802.64
2016-09-30	804.06
2016-10-03	800.38
2016-10-04	802.79
2016-10-05	801.23
2016-10-06	803.08
2016-10-07	800.71
2016-10-10	814.17
2016-10-11	809.57
2016-10-12	811.77
2016-10-13	804.08
2016-10-14	804.60
2016-10-17	806.84
2016-10-18	821.49
2016-10-19	827.09
2016-10-20	821.63
2016-10-21	824.06
2016-10-24	835.74
2016-10-25	828.55
2016-10-26	822.10

2016-11-01	805.48
2016-11-02	788.42
2016-11-03	782.19
2016-11-04	781.10
2016-11-07	802.03
2016-11-08	811.98
2016-11-09	805.59
2016-11-10	780.29
2016-11-11	771.75
2016-11-14	753.22
2016-11-15	775.16
2016-11-16	779.98
2016-11-17	786.16
2016-11-18	775.97
2016-11-21	784.80
2016-11-22	785.00
2016-11-23	779.00
2016-11-25	780.23
2016-11-28	785.79
2016-11-29	789.44
2016-11-30	775.88
2016-12-01	764.33
2016-12-02	764.46
2016-12-05	778.22
2016-12-06	776.18
2016-12-07	791.47
2016-12-08	795.17
2016-12-09	809.45
2016-12-12	807.90
2016-12-13	815.34
2016-12-14	817.89
2016-12-15	815.65
2016-12-16	809.84
2016-12-19	812.50
2016-12-20	815.20
2016-12-21	812.20
2016-12-22	809.68
2016-12-23	807.80
2016-12-27	809.93
2016-12-28	804.57
2016-12-29	802.88
2016-12-30	792.45
2017-01-03	808.01
2017-01-04	807.77
2017-01-05	813.02
2017-01-06	825.21
2017-01-09	827.18
2017-01-10	826.01
2017-01-11	829.86
2017-01-12	829.53
2017-01-13	830.94
2017-01-17	827.46
2017-01-18	829.02
2017-01-19	824.37
2017-01-20	828.17
2017-01-23	844.43
2017-01-24	849.53

2017-01-27	845.03
2017-01-30	823.83
2017-01-31	820.19
2017-02-01	815.24
2017-02-02	818.26
2017-02-03	820.13
2017-02-06	821.62
2017-02-07	829.23
2017-02-08	829.88
2017-02-09	830.06
2017-02-10	834.85
2017-02-13	838.96
2017-02-14	840.03
2017-02-15	837.32
2017-02-16	842.17
2017-02-17	846.55
2017-02-21	849.27
2017-02-22	851.36
2017-02-23	851.00
2017-02-24	847.81
2017-02-27	849.67
2017-02-28	844.93
2017-03-01	856.75
2017-03-02	849.85
2017-03-03	849.08
2017-03-06	847.27
2017-03-07	851.15
2017-03-08	853.64
2017-03-09	857.84
2017-03-10	861.40
2017-03-13	864.58
2017-03-14	865.91
2017-03-15	868.39
2017-03-16	870.00
2017-03-17	872.37
2017-03-20	867.91
2017-03-21	850.14
2017-03-22	849.80
2017-03-23	839.65
2017-03-24	835.14
2017-03-27	838.51
2017-03-28	840.63
2017-03-29	849.87
2017-03-30	849.48
2017-03-31	847.80
2017-04-03	856.75
2017-04-04	852.57
2017-04-05	848.91
2017-04-06	845.10
2017-04-07	842.10
2017-04-10	841.70
2017-04-11	839.88
2017-04-12	841.46
2017-04-13	840.18
2017-04-17	855.13
2017-04-18	853.99
2017-04-19	856.51
2017-04-20	860.08

 Notebook Data Output Comments

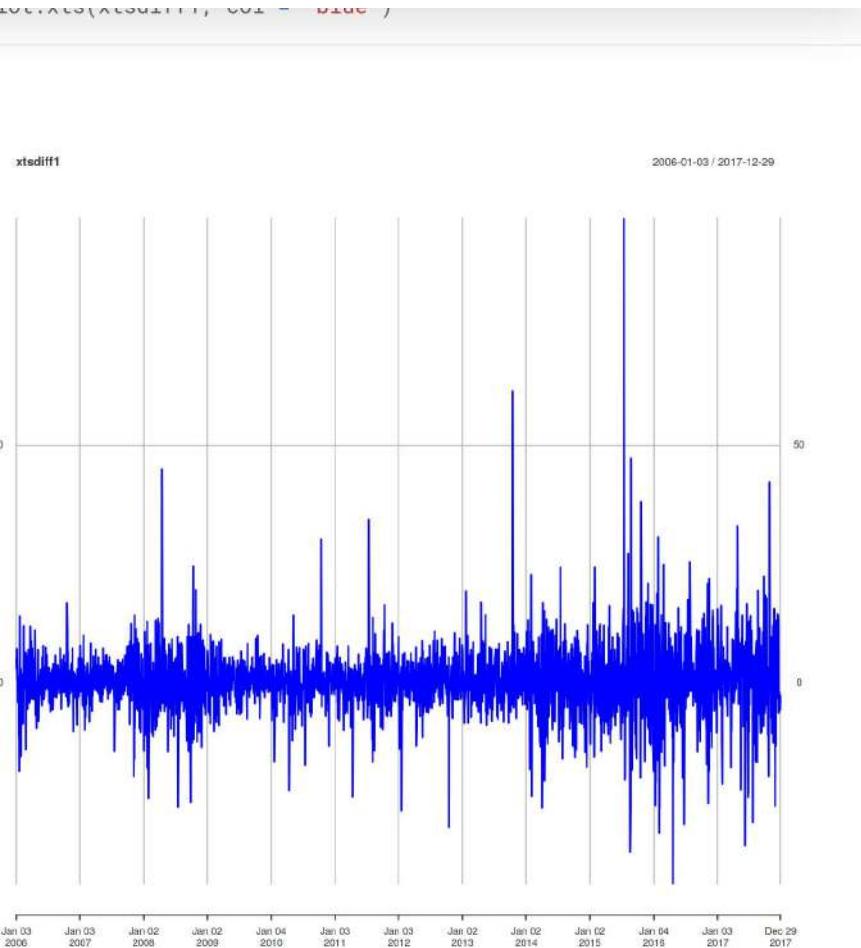
2017-04-25	888.84
2017-04-26	889.14
2017-04-27	891.44
2017-04-28	924.52
2017-05-01	932.82
2017-05-02	937.09
2017-05-03	948.45
2017-05-04	954.72
2017-05-05	950.28
2017-05-08	958.69
2017-05-09	956.71
2017-05-10	954.84
2017-05-11	955.89
2017-05-12	955.14
2017-05-15	959.22
2017-05-16	964.61
2017-05-17	942.17
2017-05-18	950.50
2017-05-19	954.65
2017-05-22	964.07
2017-05-23	970.55
2017-05-24	977.61
2017-05-25	991.86
2017-05-26	993.27
2017-05-30	996.17
2017-05-31	987.09
2017-06-01	988.29
2017-06-02	996.12
2017-06-05	1003.88
2017-06-06	996.68
2017-06-07	1001.59
2017-06-08	1004.28
2017-06-09	970.12
2017-06-12	961.81
2017-06-13	970.50
2017-06-14	967.93
2017-06-15	960.18
2017-06-16	958.62
2017-06-19	975.22
2017-06-20	968.99
2017-06-21	978.59
2017-06-22	976.62
2017-06-23	986.09
2017-06-26	972.09
2017-06-27	948.09
2017-06-28	961.01
2017-06-29	937.82
2017-06-30	929.68
2017-07-03	919.46
2017-07-05	932.26
2017-07-06	927.69
2017-07-07	940.81
2017-07-10	951.00
2017-07-11	953.53
2017-07-12	967.66
2017-07-13	968.85
2017-07-14	976.91

2017-07-20	992.19
2017-07-21	993.84
2017-07-24	998.31
2017-07-25	969.03
2017-07-26	965.31
2017-07-27	952.51
2017-07-28	958.33
2017-07-31	945.50
2017-08-01	946.56
2017-08-02	947.64
2017-08-03	940.30
2017-08-04	945.79
2017-08-07	945.75
2017-08-08	944.19
2017-08-09	940.08
2017-08-10	923.59
2017-08-11	930.09
2017-08-14	938.93
2017-08-15	938.08
2017-08-16	944.27
2017-08-17	927.66
2017-08-18	926.18
2017-08-21	920.87
2017-08-22	940.40
2017-08-23	942.58
2017-08-24	936.89
2017-08-25	930.50
2017-08-28	928.13
2017-08-29	935.75
2017-08-30	943.63
2017-08-31	955.24
2017-09-01	951.99
2017-09-05	941.48
2017-09-06	942.02
2017-09-07	949.89
2017-09-08	941.41
2017-09-11	943.29
2017-09-12	946.65
2017-09-13	950.44
2017-09-14	940.13
2017-09-15	935.29
2017-09-18	929.75
2017-09-19	936.86
2017-09-20	947.54
2017-09-21	947.55
2017-09-22	943.26
2017-09-25	934.28
2017-09-26	937.43
2017-09-27	959.90
2017-09-28	964.81
2017-09-29	973.72
2017-10-02	967.47
2017-10-03	972.08
2017-10-04	966.78
2017-10-05	985.19
2017-10-06	993.64
2017-10-09	992.31

```
2017-10-12 1005.55
2017-10-13 1007.87
2017-10-16 1009.35
2017-10-17 1011.00
2017-10-18 1012.74
2017-10-19 1001.84
2017-10-20 1005.07
2017-10-23 985.54
2017-10-24 988.49
2017-10-25 991.46
2017-10-26 991.42
2017-10-27 1033.67
2017-10-30 1033.13
2017-10-31 1033.04
2017-11-01 1042.60
2017-11-02 1042.97
2017-11-03 1049.99
2017-11-06 1042.68
2017-11-07 1052.39
2017-11-08 1058.29
2017-11-09 1047.72
2017-11-10 1044.15
2017-11-13 1041.20
2017-11-14 1041.64
2017-11-15 1036.41
2017-11-16 1048.47
2017-11-17 1035.89
2017-11-20 1034.66
2017-11-21 1050.30
2017-11-22 1051.92
2017-11-24 1056.52
2017-11-27 1072.01
2017-11-28 1063.29
2017-11-29 1037.38
2017-11-30 1036.17
2017-12-01 1025.07
2017-12-04 1011.87
2017-12-05 1019.60
2017-12-06 1032.72
2017-12-07 1044.57
2017-12-08 1049.38
2017-12-11 1051.97
2017-12-12 1048.77
2017-12-13 1051.39
2017-12-14 1057.47
2017-12-15 1072.00
2017-12-18 1085.09
2017-12-19 1079.78
2017-12-20 1073.56
2017-12-21 1070.85
2017-12-22 1068.86
2017-12-26 1065.85
2017-12-27 1060.20
2017-12-28 1055.95
2017-12-29 1053.40
```

In [37]:

[Notebook](#)[Data](#)[Output](#)[Comments](#)



In [38]:

```
adf.test(tsdiff1, alternative = "stationary", k = 0)
```

Warning message in adf.test(tsdiff1, alternative = "stationary",  
k = 0):  
"p-value smaller than printed p-value"

Augmented Dickey-Fuller Test

```
data: tsdiff1  
Dickey-Fuller = -53.448, Lag order = 0, p-value = 0.01  
alternative hypothesis: stationary
```

In [39]:

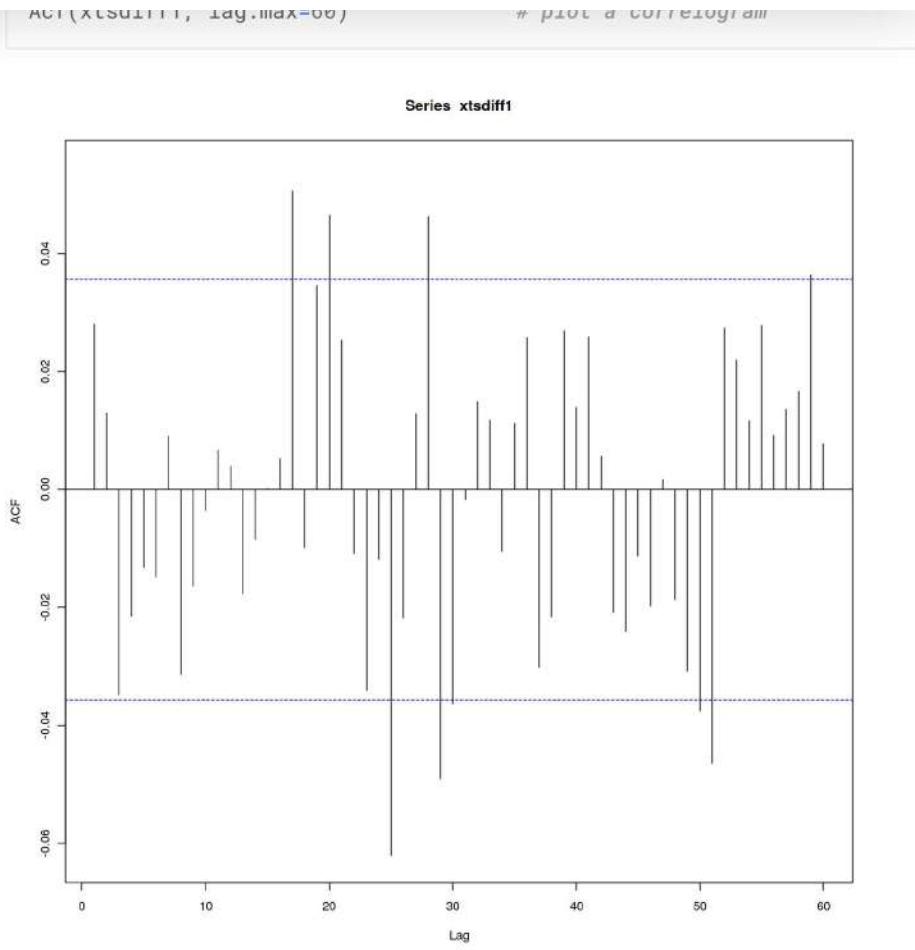
```
findfrequency(xts)      # find dominant frequency of original ti  
me series
```

1

In [40]:

```
findfrequency(xtsdiff1)    # find dominant frequency of differenced  
time series
```

18



In [42]:

```
install.packages("car")
install.packages("AER")
install.packages("dynlm")
install.packages("forecast")
install.packages("readxl")
install.packages("stargazer")
install.packages("scales")
install.packages("quantmod")
install.packages("urca")
install.packages("urca")
install.packages("vars")
install.packages("fpp")
install.packages("fpp2")
library(AER)
library(dynlm)
library(tidyverse)
library(forecast)
library(readxl)
library(stargazer)
library(fpp)
library(fpp2)
library(scales)
library(quantmod)
library(urca)
library(vars)
library(tseries)
library(ggplot2)
```

Notebook

Data

Output

Comments

```
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
    cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'car' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
    cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'AER' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
    cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'dynlm' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
    cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'forecast' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
    cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'readxl' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
    cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"
```

 Notebook Data Output Comments

```
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
  cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'scales' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
  cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'quantmod' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
  cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'urca' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
  cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'urca' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
  cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'vars' is not available (for R version 3.6.0)"  
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
  cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"
```



Notebook



Data



Output



Comments

```
Installing package into '/usr/local/lib/R/site-library'  
(as 'lib' is unspecified)

Warning message:  
"unable to access index for repository http://cran.rstudio.com/s  
rc/contrib:  
  cannot open URL 'http://cran.rstudio.com/src/contrib/PACKAGE  
S'"  
Warning message:  
"package 'fpp2' is not available (for R version 3.6.0)"  
Loading required package: car

Loading required package: carData
```

```
Attaching package: 'car'
```

```
The following object is masked from 'package:dplyr':
```

```
recode
```

```
The following object is masked from 'package:purrr':
```

```
some
```

```
Loading required package: lmtest
```

```
Loading required package: sandwich
```

```
Loading required package: survival
```

```
Please cite as:
```

Hlavac, Marek (2018). stargazer: Well-Formatted Regression and Summary Statistics Tables.

R package version 5.2.2. <https://CRAN.R-project.org/package=stargazer>

```
Loading required package: fma
```

```
Loading required package: expsmooth
```

```
Attaching package: 'fpp2'
```

```
The following objects are masked from 'package:fpp':
```

```
ausair, ausbeer, austaa, austourists, debitcards, departures,  
elecequip, euretail, guinearice, oil, sunspotarea, usmleec
```

```
Attaching package: 'scales'
```

```
The following object is masked from 'package:purrr':
```

```
discard
```

```
The following object is masked from 'package:readr':
```

```
col_factor
```

```
Version 0.4-0 included new data defaults. See ?getSymbols.
```

```
Loading required package: MASS
```

```
Attaching package: 'MASS'
```

```
The following objects are masked from 'package:fma':
```

```
cement, housing, petrol
```

```
The following object is masked from 'package:dplyr':
```

```
select
```

```
Loading required package: strucchange
```

```
Attaching package: 'strucchange'
```

```
The following object is masked from 'package:stringr':
```

```
boundary
```

In [43]:

```
Acf(xtsdiff1, lag.max=60, plot=FALSE) # get the autocorrelation values
```

```
Autocorrelations of series 'xtsdiff1', by lag
```

	0	1	2	3	4	5	6	7	8
9	10								
	1.000	0.028	0.013	-0.035	-0.021	-0.013	-0.015	0.009	-0.031
	0.016	-0.004							
	11	12	13	14	15	16	17	18	19
20	21								
	0.007	0.004	0.019	0.008	0.000	0.005	0.051	0.010	0.025

 Notebook

 Data

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 Comments

```

31      32
-0.011 -0.034 -0.012 -0.062 -0.022  0.013  0.046 -0.049 -0.036 -
0.002  0.015

33      34      35      36      37      38      39      40      41
42      43
0.012 -0.010  0.011  0.026 -0.030 -0.022  0.027  0.014  0.026
0.006 -0.021

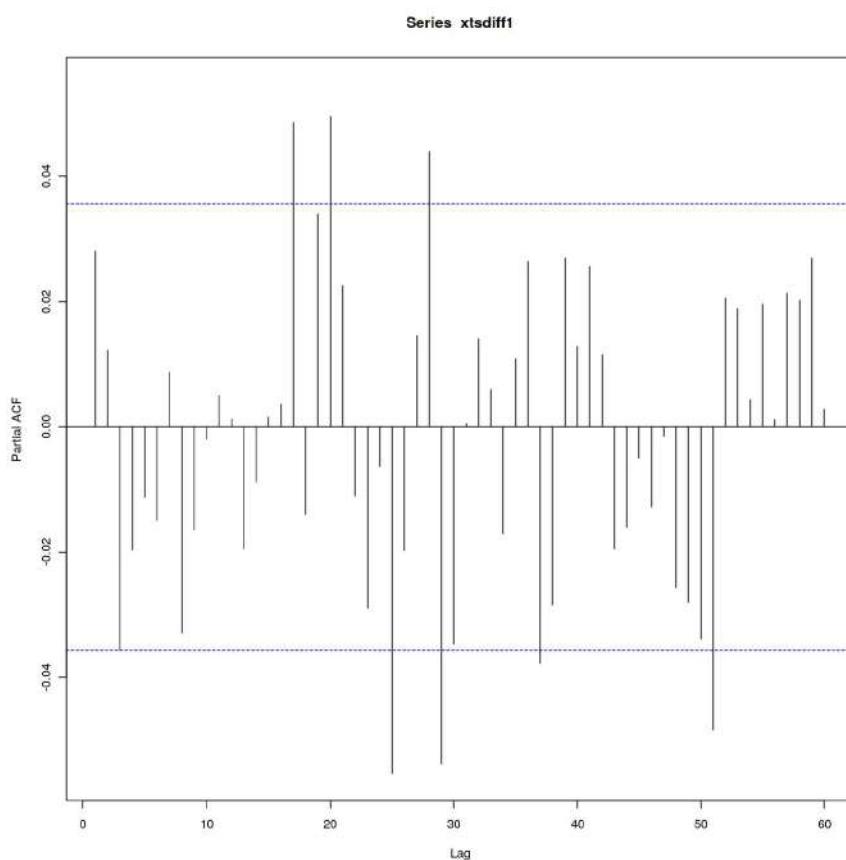
44      45      46      47      48      49      50      51      52
53      54
-0.024 -0.011 -0.020  0.002 -0.019 -0.031 -0.038 -0.046  0.027
0.022  0.012

55      56      57      58      59      60
0.028  0.009  0.014  0.017  0.036  0.008

```

In [44]:

```
Pacf(xtsdiff1, lag.max=60)          # plot a partial correlogram
```



In [45]:

```
Pacf(xtsdiff1, lag.max=60, plot=False) # get the partial autocorrelation values
```

Partial autocorrelations of series 'xtsdiff1', by lag

1	2	3	4	5	6	7	8	9
10	11							
0.028	0.012	-0.036	-0.020	-0.011	-0.015	0.009	-0.033	-0.016
0.002	0.005							
12	13	14	15	16	17	18	19	20
21	22							

	23	24	25	26	27	28	29	30	31
32	33								
	-0.029	-0.006	-0.055	-0.020	0.015	0.044	-0.054	-0.035	0.001
0.014	0.006								
34	35	36	37	38	39	40	41	42	
43	44								
	-0.017	0.011	0.026	-0.038	-0.028	0.027	0.013	0.026	0.011
0.019	-0.016								
45	46	47	48	49	50	51	52	53	
54	55								
	-0.005	-0.013	-0.002	-0.026	-0.028	-0.034	-0.048	0.021	0.019
0.004	0.020								
56	57	58	59	60					
	0.001	0.021	0.020	0.027	0.003				

In [46]:

```
tsarima240 <- auto.arima(head(xts, -240), max.p = 3, max.q = 3, ma.x.d = 3) # excluding last 240 time series as test data
print(tsarima240)
```

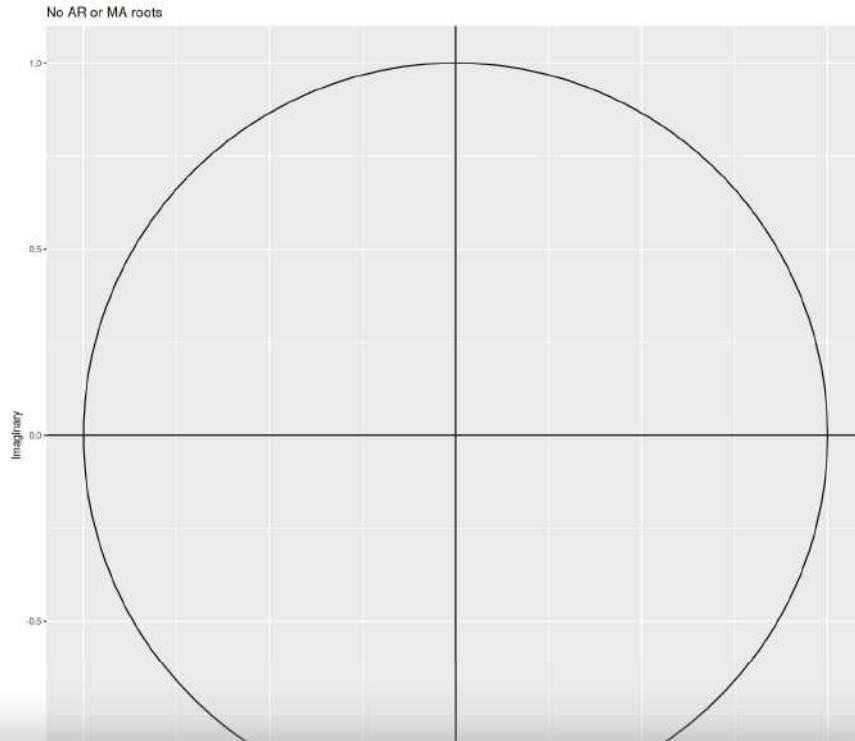
Series: head(xts, -240)  
ARIMA(0,1,0) with drift

Coefficients:  
drift  
0.2200  
s.e. 0.1264

sigma^2 estimated as 44.43: log likelihood=-9210.91  
AIC=18425.82 AICc=18425.82 BIC=18437.67

In [47]:

```
autoplot(tsarima240)
```





In [48]:

```
tsarima120 <- auto.arima(head(xts, -120), max.p = 3, max.q = 3, max.d = 3) #120
print(tsarima120)
```

Series: head(xts, -120)  
ARIMA(0,1,1) with drift

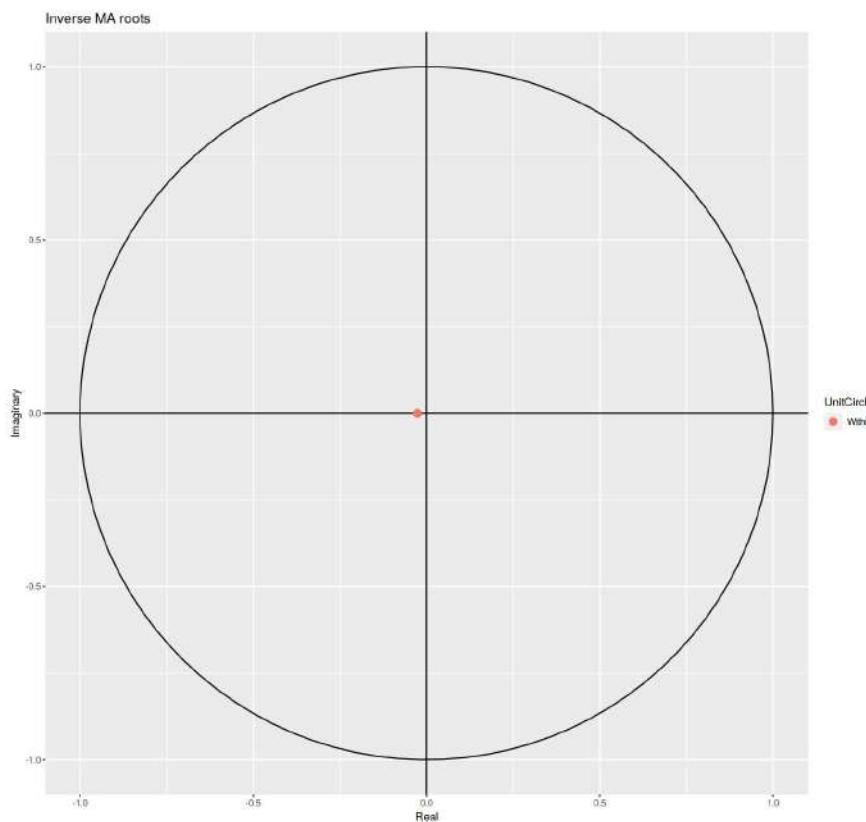
Coefficients:

	ma1	drift
0.0260	0.2539	
s.e.	0.0183	0.1291

sigma^2 estimated as 45.91: log likelihood=-9656  
AIC=19317.99 AICc=19318 BIC=19335.91

In [49]:

```
autoplot(tsarima120)
```



In [50]:

```
tsarima60 <- auto.arima(head(xts, -60), max.p = 3, max.q = 3, max.d = 3) #60
print(tsarima60)
```

Series: head(xts, -60)

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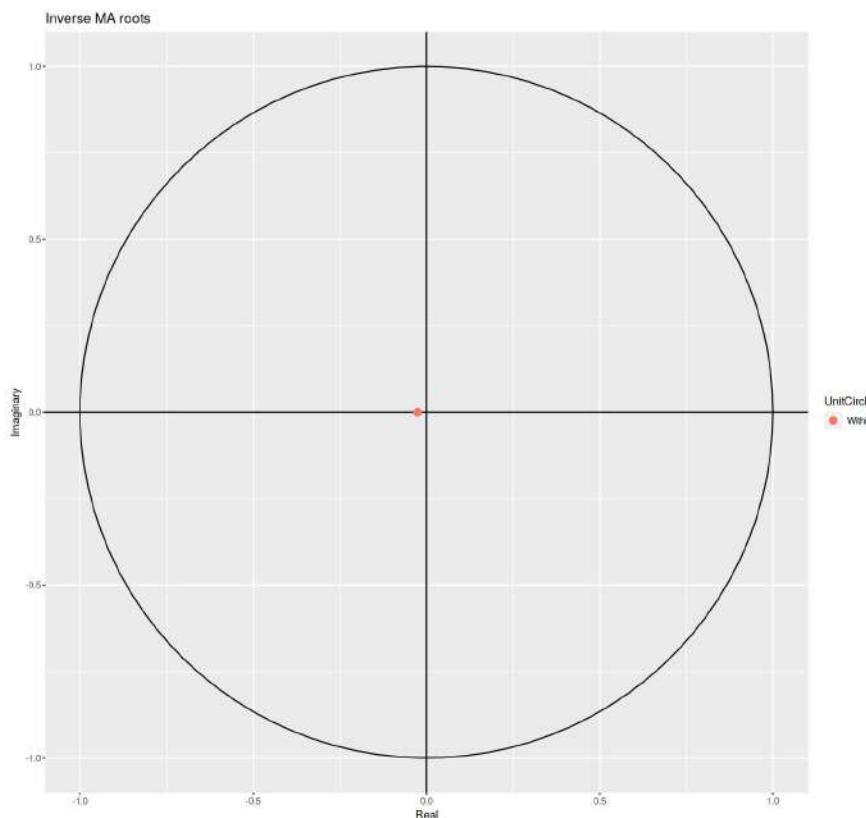
Comments

```
Coefficients:
      m1     drift
      0.0258  0.2532
  s.e.  0.0181  0.1286
```

$\sigma^2$  estimated as 46.55: log likelihood=-9876.46  
AIC=19758.93 AICc=19758.94 BIC=19776.9

In [51]:

```
autoplot(tsarima60)
```



In [52]:

```
tsarima30 <- auto.arima(head(xts, -30), max.p = 3, max.q = 3, max.d = 3) #30
print(tsarima30)
```

Series: head(xts, -30)  
ARIMA(0,1,0) with drift

Coefficients:

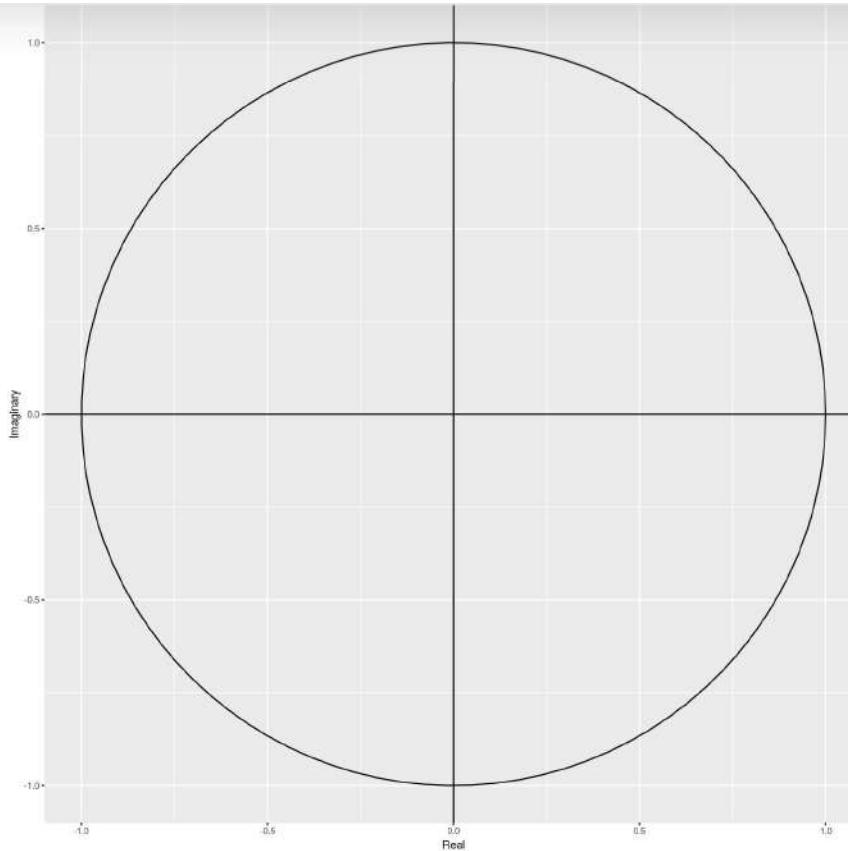
drift	
0.2740	
s.e.	0.1258

$\sigma^2$  estimated as 47.28: log likelihood=-10000.36  
AIC=20004.72 AICc=20004.72 BIC=20016.73

In [53]:

```
autoplot(tsarima30)
```

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In [54]:

```
tsarima7 <- auto.arima(head(xts, -7), max.p = 3, max.q = 3, max.d = 3) #7  
print(tsarima7)
```

Series: head(xts, -7)  
ARIMA(0,1,1) with drift

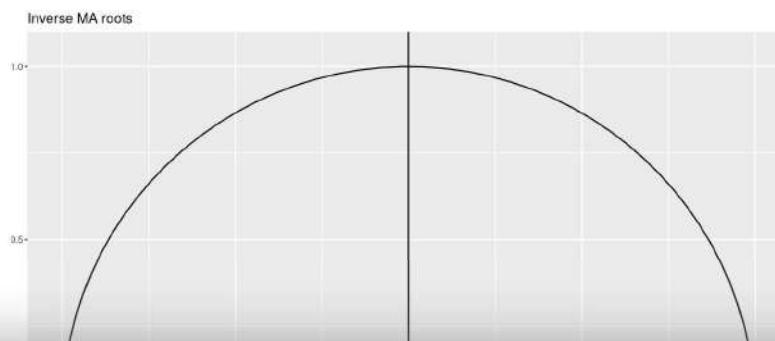
Coefficients:

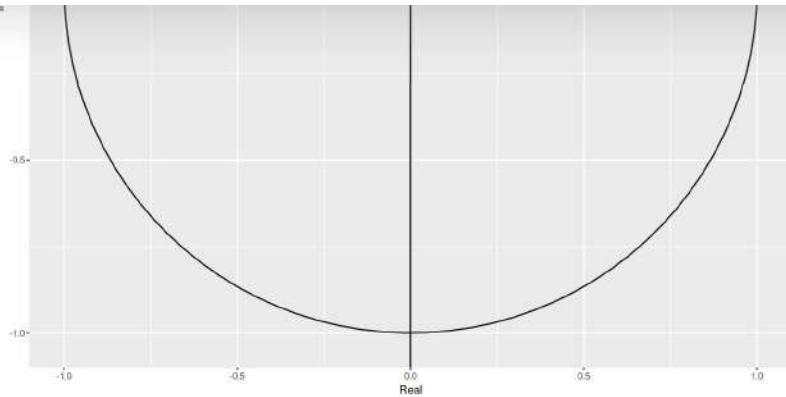
	ma1	drift
0.0264	0.2863	
s.e.	0.0179	0.1293

sigma^2 estimated as 47.8: log likelihood=-10093.26  
AIC=20192.53 AICc=20192.54 BIC=20210.56

In [55]:

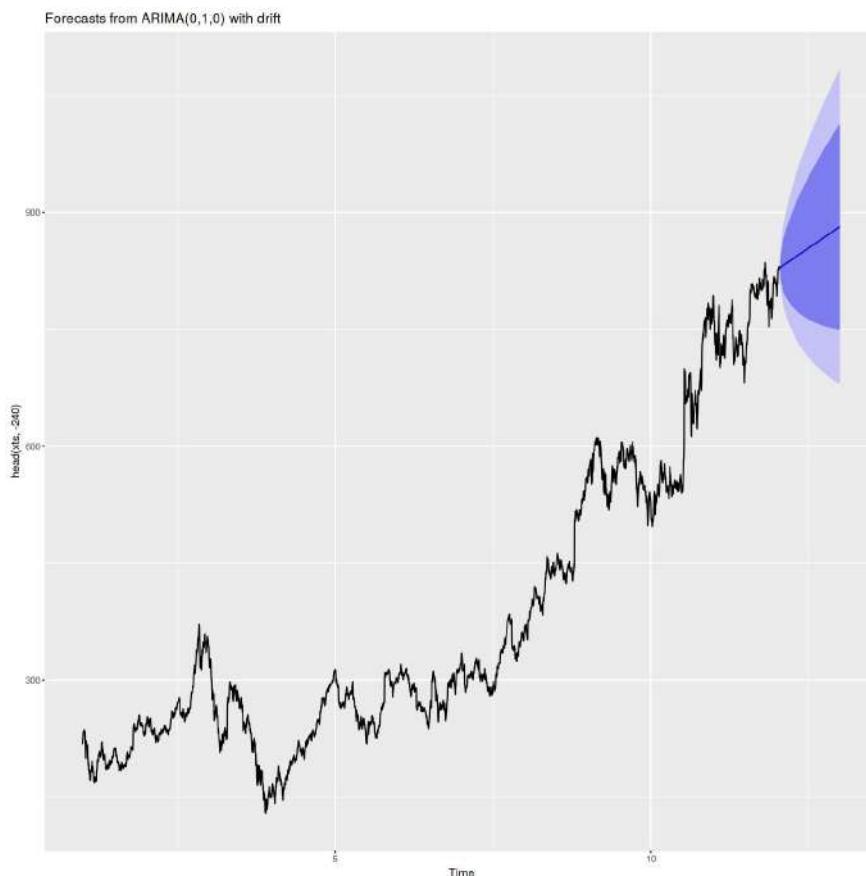
```
autoplot(tsarima7)
```





In [56]:

```
tsforecasts240 <- forecast(tsarima240, h = 240) # forecast the next  
# 240 time series  
tsforecasts120 <- forecast(tsarima120, h = 120) # forecast the next  
# 120 time series  
tsforecasts60 <- forecast(tsarima60, h = 60) # forecast the next 60  
# time series  
tsforecasts30 <- forecast(tsarima30, h = 30) # forecast the next 30  
# time series  
tsforecasts7 <- forecast(tsarima7, h = 7) # forecast the next 7 time  
# series  
  
autoplot(tsforecasts240)
```



In [57]:

```
accuracy(tsforecasts240, head(tail(xts, 240), 240))
```

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A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	7.830510e-05	6.662823	4.358564	-0.04023279	1.255910	0.05516
Test set	8.958999e+01	107.462582	90.356608	9.04790109	9.141123	1.14361

In [58]:

```
head(tail(xts, 240), 240)
```

```
[ ,1]
2017-01-19 824.37
2017-01-20 828.17
2017-01-23 844.43
2017-01-24 849.53
2017-01-25 858.45
2017-01-26 856.98
2017-01-27 845.03
2017-01-30 823.83
2017-01-31 820.19
2017-02-01 815.24
2017-02-02 818.26
2017-02-03 820.13
2017-02-06 821.62
2017-02-07 829.23
2017-02-08 829.88
2017-02-09 830.06
2017-02-10 834.85
2017-02-13 838.96
2017-02-14 840.03
2017-02-15 837.32
2017-02-16 842.17
2017-02-17 846.55
2017-02-21 849.27
2017-02-22 851.36
2017-02-23 851.00
2017-02-24 847.81
2017-02-27 849.67
2017-02-28 844.93
2017-03-01 856.75
2017-03-02 849.85
2017-03-03 849.08
2017-03-06 847.27
2017-03-07 851.15
2017-03-08 853.64
2017-03-09 857.84
2017-03-10 861.40
2017-03-13 864.58
2017-03-14 865.91
2017-03-15 868.39
2017-03-16 870.00
2017-03-17 872.37
2017-03-20 867.91
2017-03-21 850.14
2017-03-22 849.80
```

2017-03-27	838.51
2017-03-28	840.63
2017-03-29	849.87
2017-03-30	849.48
2017-03-31	847.80
2017-04-03	856.75
2017-04-04	852.57
2017-04-05	848.91
2017-04-06	845.10
2017-04-07	842.10
2017-04-10	841.70
2017-04-11	839.88
2017-04-12	841.46
2017-04-13	840.18
2017-04-17	855.13
2017-04-18	853.99
2017-04-19	856.51
2017-04-20	860.08
2017-04-21	858.95
2017-04-24	878.93
2017-04-25	888.84
2017-04-26	889.14
2017-04-27	891.44
2017-04-28	924.52
2017-05-01	932.82
2017-05-02	937.09
2017-05-03	948.45
2017-05-04	954.72
2017-05-05	950.28
2017-05-08	958.69
2017-05-09	956.71
2017-05-10	954.84
2017-05-11	955.89
2017-05-12	955.14
2017-05-15	959.22
2017-05-16	964.61
2017-05-17	942.17
2017-05-18	950.50
2017-05-19	954.65
2017-05-22	964.07
2017-05-23	970.55
2017-05-24	977.61
2017-05-25	991.86
2017-05-26	993.27
2017-05-30	996.17
2017-05-31	987.09
2017-06-01	988.29
2017-06-02	996.12
2017-06-05	1003.88
2017-06-06	996.68
2017-06-07	1001.59
2017-06-08	1004.28
2017-06-09	970.12
2017-06-12	961.81
2017-06-13	970.50
2017-06-14	967.93
2017-06-15	960.18
2017-06-16	959.62

 Notebook Data Output Comments

2017-06-21	978.59
2017-06-22	976.62
2017-06-23	986.09
2017-06-26	972.09
2017-06-27	948.09
2017-06-28	961.01
2017-06-29	937.82
2017-06-30	929.68
2017-07-03	919.46
2017-07-05	932.26
2017-07-06	927.69
2017-07-07	940.81
2017-07-10	951.00
2017-07-11	953.53
2017-07-12	967.66
2017-07-13	968.85
2017-07-14	976.91
2017-07-17	975.96
2017-07-18	986.95
2017-07-19	992.77
2017-07-20	992.19
2017-07-21	993.84
2017-07-24	998.31
2017-07-25	969.03
2017-07-26	965.31
2017-07-27	952.51
2017-07-28	958.33
2017-07-31	945.50
2017-08-01	946.56
2017-08-02	947.64
2017-08-03	940.30
2017-08-04	945.79
2017-08-07	945.75
2017-08-08	944.19
2017-08-09	940.08
2017-08-10	923.59
2017-08-11	930.09
2017-08-14	938.93
2017-08-15	938.08
2017-08-16	944.27
2017-08-17	927.66
2017-08-18	926.18
2017-08-21	920.87
2017-08-22	940.40
2017-08-23	942.58
2017-08-24	936.89
2017-08-25	930.50
2017-08-28	928.13
2017-08-29	935.75
2017-08-30	943.63
2017-08-31	955.24
2017-09-01	951.99
2017-09-05	941.48
2017-09-06	942.02
2017-09-07	949.89
2017-09-08	941.41
2017-09-11	943.29

2017-09-15	935.29
2017-09-18	929.75
2017-09-19	936.86
2017-09-20	947.54
2017-09-21	947.55
2017-09-22	943.26
2017-09-25	934.28
2017-09-26	937.43
2017-09-27	959.90
2017-09-28	964.81
2017-09-29	973.72
2017-10-02	967.47
2017-10-03	972.08
2017-10-04	966.78
2017-10-05	985.19
2017-10-06	993.64
2017-10-09	992.31
2017-10-10	987.80
2017-10-11	1005.65
2017-10-12	1005.65
2017-10-13	1007.87
2017-10-16	1009.35
2017-10-17	1011.00
2017-10-18	1012.74
2017-10-19	1001.84
2017-10-20	1005.07
2017-10-23	985.54
2017-10-24	988.49
2017-10-25	991.46
2017-10-26	991.42
2017-10-27	1033.67
2017-10-30	1033.13
2017-10-31	1033.04
2017-11-01	1042.60
2017-11-02	1042.97
2017-11-03	1049.99
2017-11-06	1042.68
2017-11-07	1052.39
2017-11-08	1058.29
2017-11-09	1047.72
2017-11-10	1044.15
2017-11-13	1041.20
2017-11-14	1041.64
2017-11-15	1036.41
2017-11-16	1048.47
2017-11-17	1035.89
2017-11-20	1034.66
2017-11-21	1050.30
2017-11-22	1051.92
2017-11-24	1056.52
2017-11-27	1072.01
2017-11-28	1063.29
2017-11-29	1037.38
2017-11-30	1036.17
2017-12-01	1025.07
2017-12-04	1011.87
2017-12-05	1019.60

```
2017-12-08 1049.38  
2017-12-11 1051.97  
2017-12-12 1048.77  
2017-12-13 1051.39  
2017-12-14 1057.47  
2017-12-15 1072.00  
2017-12-18 1085.09  
2017-12-19 1079.78  
2017-12-20 1073.56  
2017-12-21 1070.85  
2017-12-22 1068.86  
2017-12-26 1065.85  
2017-12-27 1060.20  
2017-12-28 1055.95  
2017-12-29 1053.40
```

In [ ]:

In [ ]:

In [59]:

```
accuracy(tsforecasts240, head(tail(xts, 240), 120))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	7.83051e-05	6.662823	4.358564	-0.04023279	1.255910	0.0551652
Test set	5.47361e+01	76.420359	56.269332	5.74033804	5.926781	0.7121892

In [60]:

```
accuracy(tsforecasts240, head(tail(xts, 240), 60))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	0.0000783051	6.662823	4.358564	-0.04023279	1.255910	0.0551652
Test set	9.1885039597	15.253580	12.254974	1.06607535	1.438961	0.155108

In [61]:

```
accuracy(tsforecasts240, head(tail(xts, 240), 30))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training						

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In [62]:

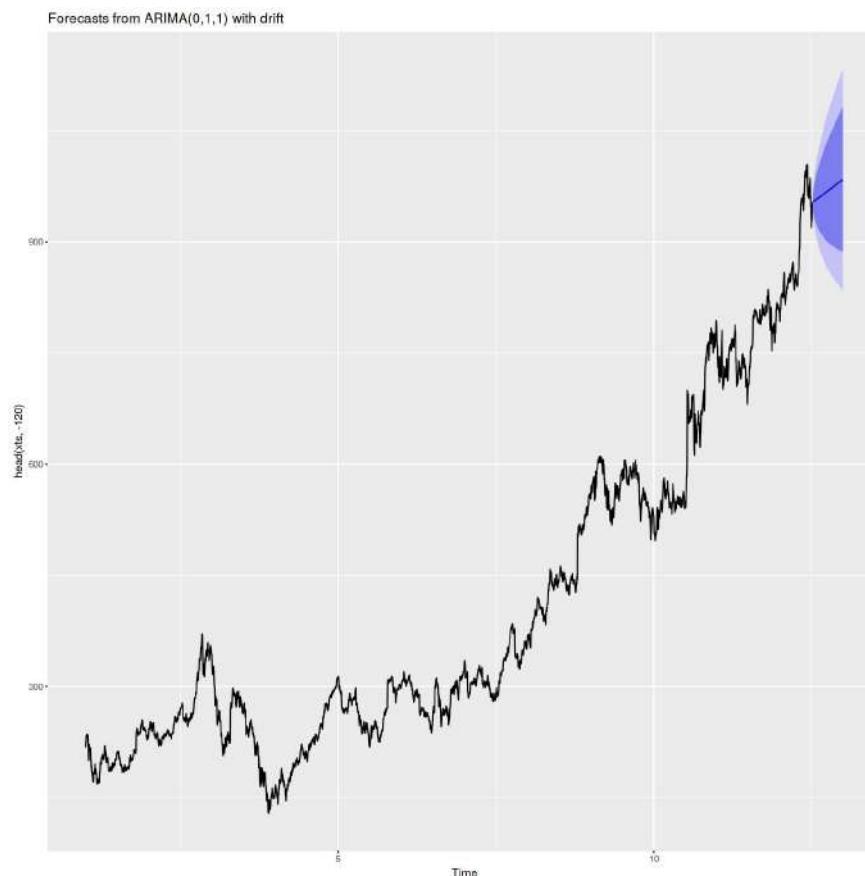
```
accuracy(tsforecasts240, head(tail(xts, 240), 7))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	7.830510e-05	6.662823	4.358564	-0.04023279	1.25591	0.0551654
Test set	1.395139e+01	18.322229	15.711395	1.63313782	1.84643	0.1988558

In [63]:

```
autoplot(tsforecasts120)
```



In [64]:

```
accuracy(tsforecasts120, head(tail(xts, 120), 120))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	8.622115e-05	6.77230	4.444226	-0.04438106	1.233619	0.0536555
Test set	2.423396e+01	47.76573	39.743165	2.24668716	3.900841	0.4798225

In [65]:

```
accuracy(tsforecasts120, head(tail(xts, 120), 60))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	8.622115e-05	6.77230	4.444226	-0.04438106	1.233619	0.053655
Test set	-1.063842e+01	23.06933	20.380001	-1.15983472	2.148473	0.246049

In [66]:

```
accuracy(tsforecasts120, head(tail(xts, 120), 30))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	8.622115e-05	6.77230	4.444226	-0.04438106	1.233619	0.053655
Test set	-2.701019e+00	24.38488	21.571816	-0.34178642	2.256133	0.260438

In [67]:

```
accuracy(tsforecasts120, head(tail(xts, 120), 7))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	8.622115e-05	6.77230	4.444226	-0.04438106	1.233619	0.053655
Test set	2.558612e+01	27.20241	25.586116	2.60125011	2.601250	0.308903

In [68]:

```
autoplot(tsforecasts60)
```

Forecasts from ARIMA(0,1,1) with drift

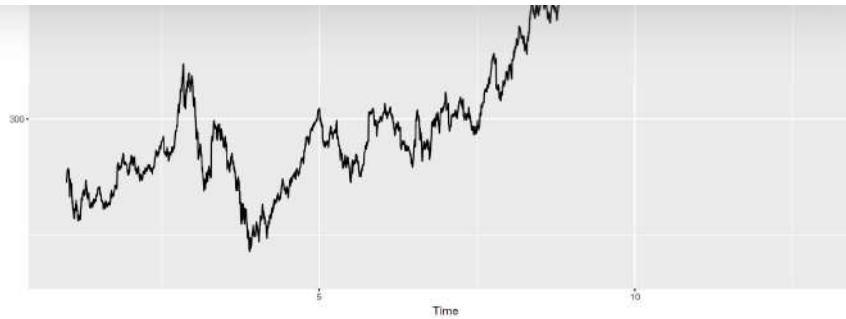


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In [69]:

```
accuracy(tsforecasts60, head(tail(xts, 60), 60))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	2.558875e-05	6.819537	4.490829	-0.04345203	1.222988	0.053108
Test set	6.130805e+01	65.547323	61.308054	5.86591739	5.865917	0.725029

In [70]:

```
accuracy(tsforecasts60, head(tail(xts, 60), 30))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	2.558875e-05	6.819537	4.490829	-0.04345203	1.222988	0.053108
Test set	4.860496e+01	53.330998	48.604964	4.72159500	4.721595	0.574801

In [71]:

```
accuracy(tsforecasts60, head(tail(xts, 60), 7))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	2.558875e-05	6.819537	4.490829	-0.04345203	1.222988	0.053108
Test set	2.922622e+01	30.361430	29.226218	2.92484821	2.924848	0.345629

In [72]:

```
autoplot(tsforecasts30)
```

Forecasts from ARIMA(0,1,0) with drift

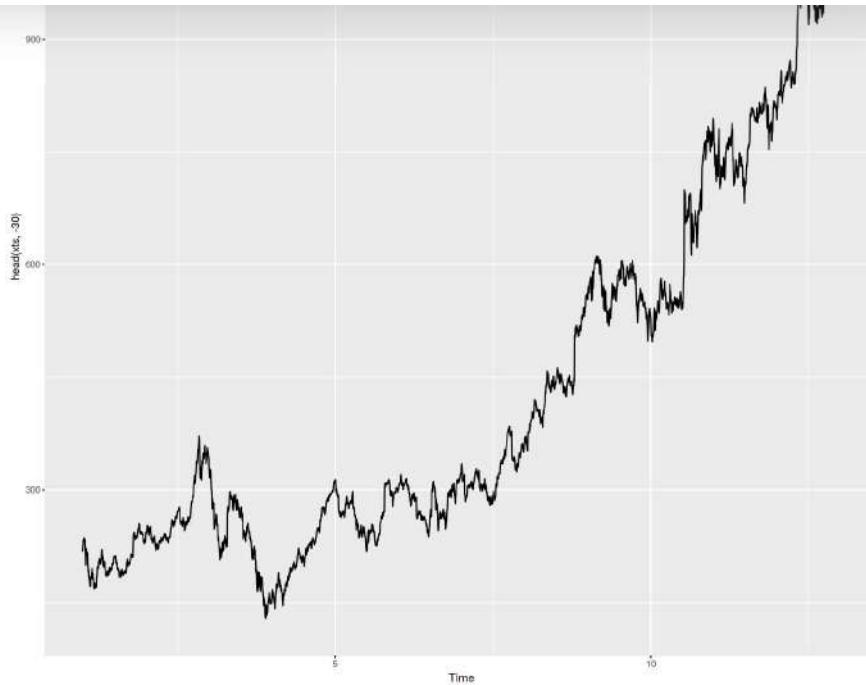


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```
In [73]: accuracy(tsforecasts30, head(tail(xts, 30), 30))
```

A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	7.278553e-05	6.873924	4.512587	-0.04844246	1.217538	0.052482
Test set	1.150902e+01	20.032703	16.721867	1.06840749	1.579102	0.194478

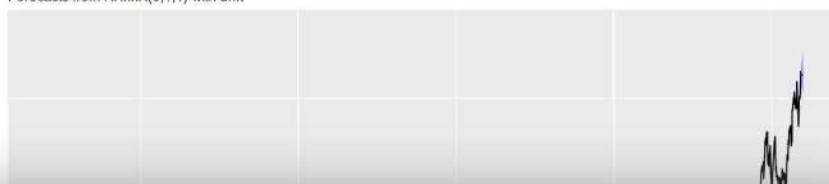
```
In [74]: accuracy(tsforecasts30, head(tail(xts, 30), 7))
```

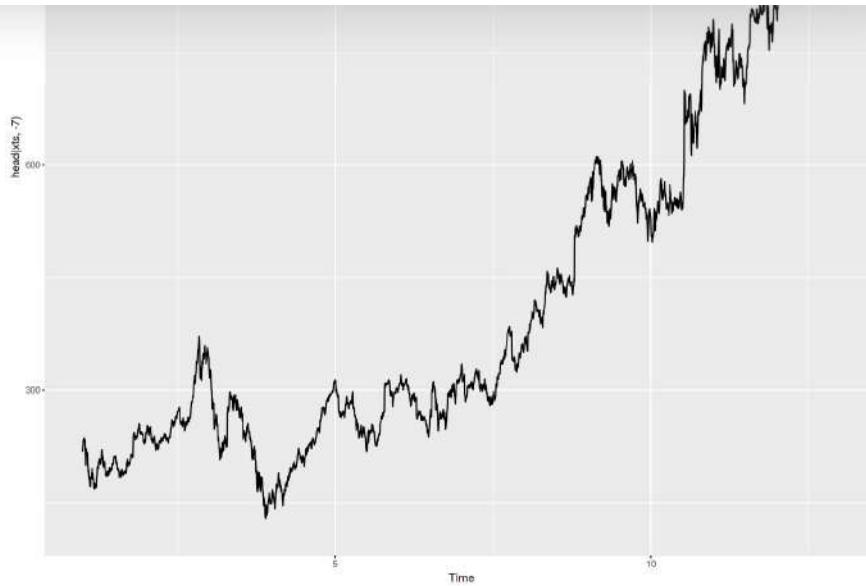
A matrix: 2 × 7 of type dbl

	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	7.278553e-05	6.873924	4.512587	-0.04844246	1.217538	0.052482
Test set	1.246132e+01	16.842987	13.501256	1.17494948	1.275424	0.157021

```
In [75]: autoplot(tsforecasts7)
```

Forecasts from ARIMA(0,1,1) with drift





```
In [76]: accuracy(tsforecasts7, head(tail(xts, 7), 7))
```

A matrix: 2 × 7 of type dbl

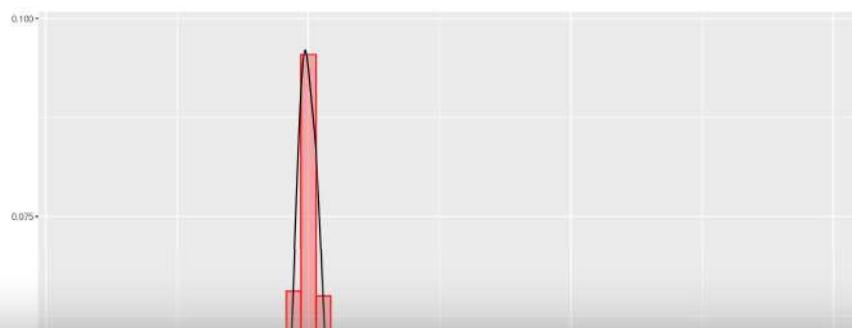
	ME	RMSE	MAE	MPE	MAPE	MASE
Training set	2.198881e-05	6.910389	4.548387	-0.04940408	1.215092	0.05203
Test set	-1.667274e+01	18.368058	16.672738	-1.57178382	1.571784	0.19072

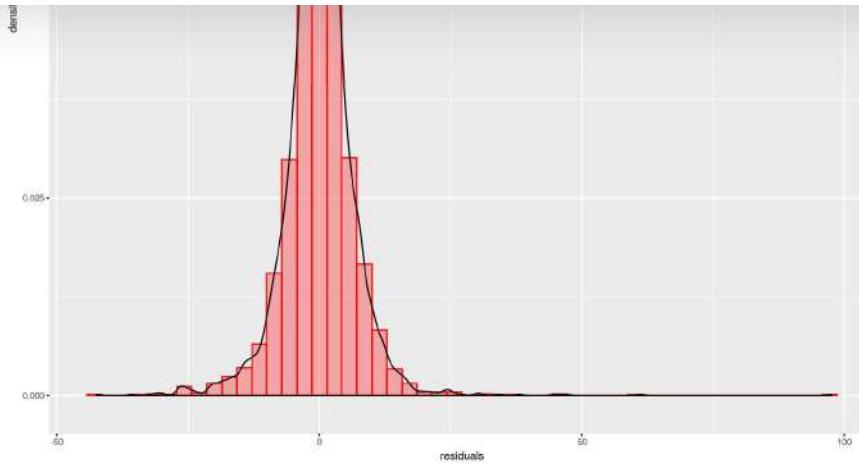
```
In [77]: print('tsforecasts240')
```

```
[1] "tsforecasts240"
```

```
In [78]: ggplot(data.frame(residuals = tsforecasts240$residuals), aes(residuals)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# make a histogram
```

Don't know how to automatically pick scale for object of type ts.  
s. Defaulting to continuous.



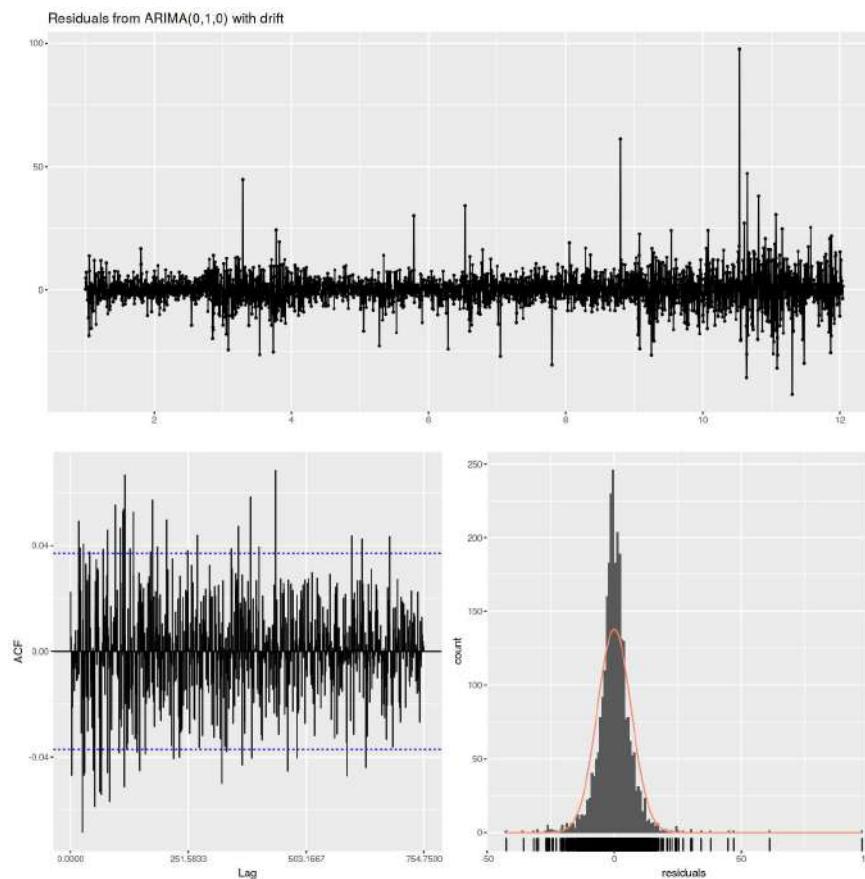


```
In [79]: checkresiduals(tsforecasts240)
```

Ljung-Box test

```
data: Residuals from ARIMA(0,1,0) with drift  
Q* = 726.5, df = 502.17, p-value = 1.98e-10
```

```
Model df: 1. Total lags used: 503.166666666667
```

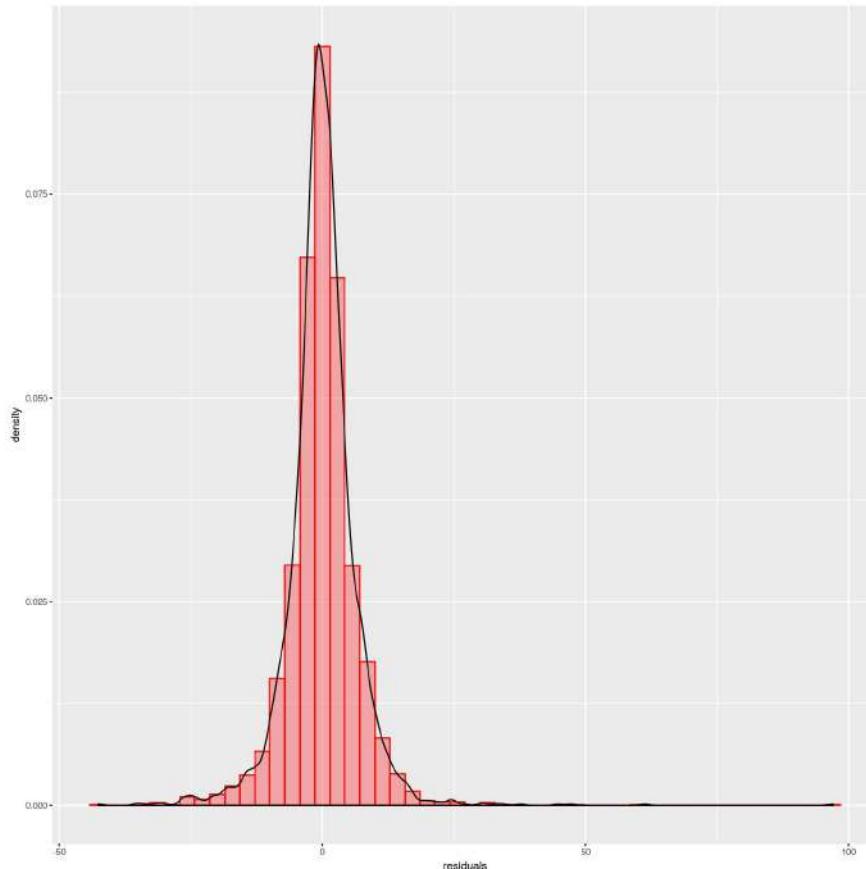


```
In [80]: print('tsforecasts120')
```

In [81]:

```
ggplot(data.frame(residuals = tsforecasts120$residuals), aes(residuals)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# make a histogram
```

Don't know how to automatically pick scale for object of type t  
s. Defaulting to continuous.



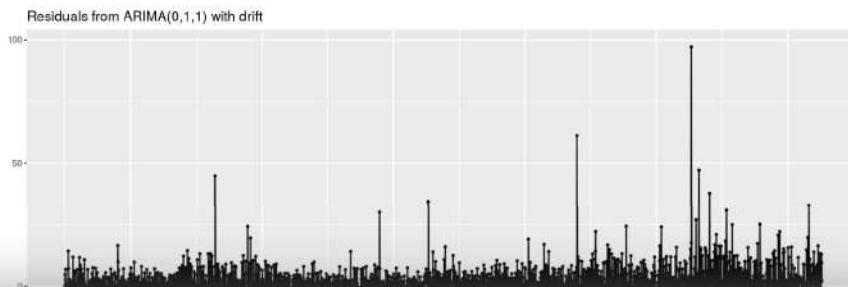
In [82]:

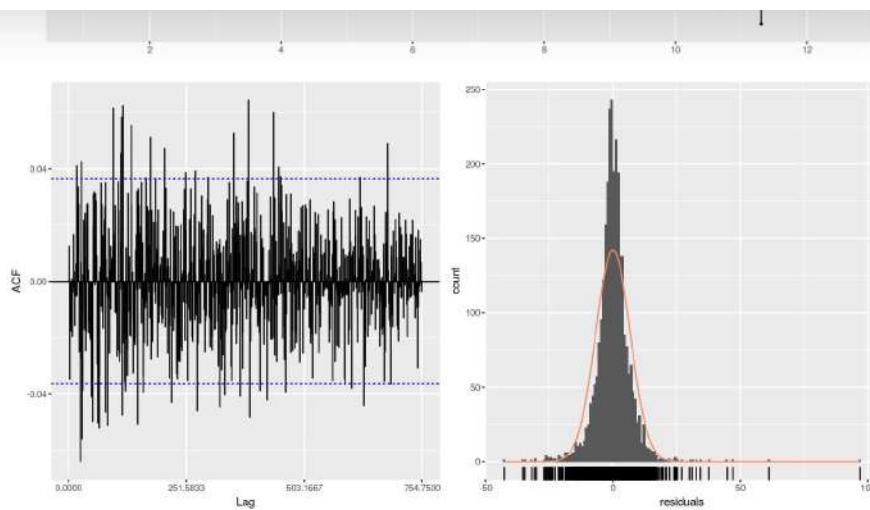
```
checkresiduals(tsforecasts120)
```

Ljung-Box test

data: Residuals from ARIMA(0,1,1) with drift  
Q\* = 748.08, df = 501.17, p-value = 4.732e-12

Model df: 2. Total lags used: 503.166666666667





In [83]:

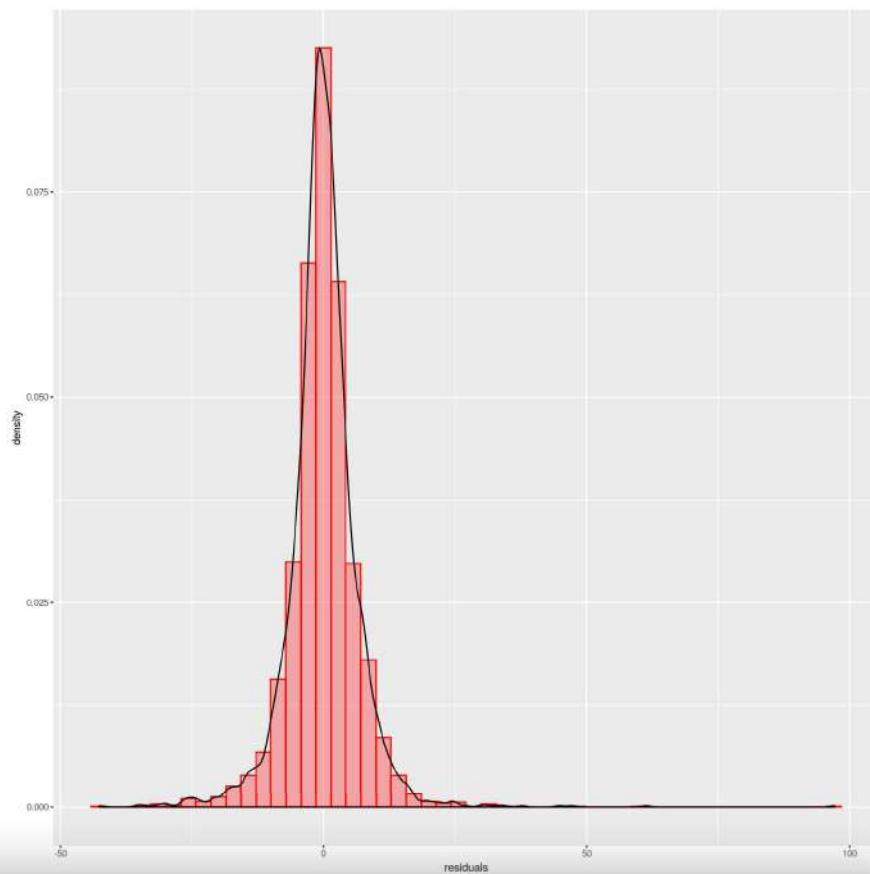
```
print('tsforecasts60')
```

```
[1] "tsforecasts60"
```

In [84]:

```
ggplot(data.frame(residuals = tsforecasts60$residuals), aes(residuals)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# make a histogram
```

Don't know how to automatically pick scale for object of type ts. Defaulting to continuous.



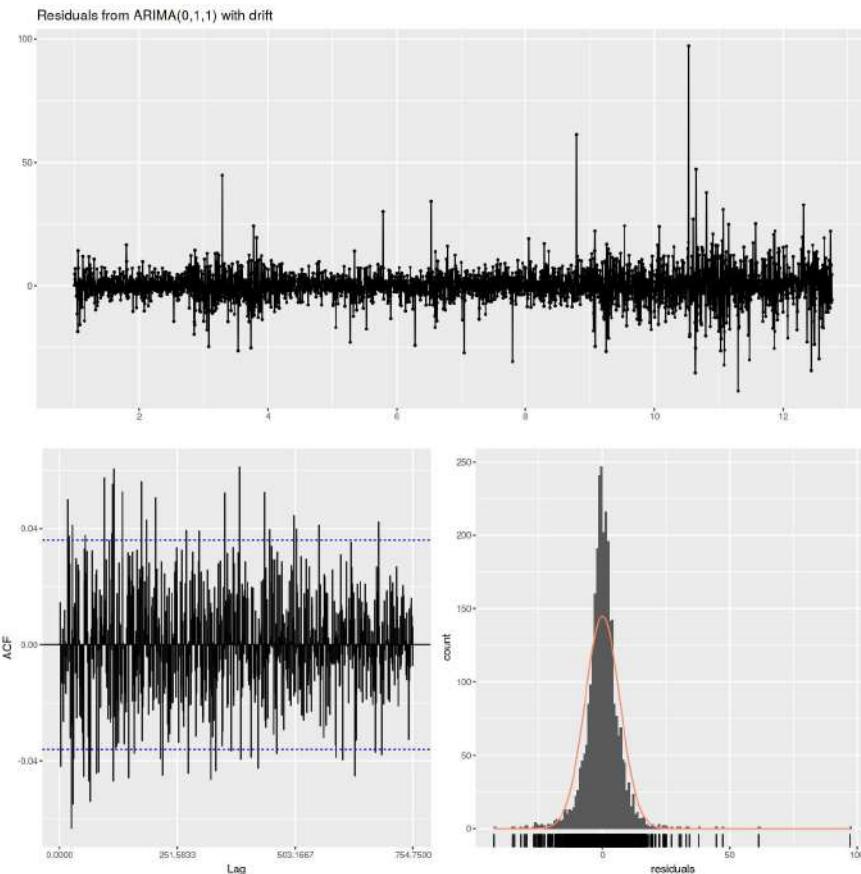
In [85]:

```
checkresiduals(tsforecasts60)
```

Ljung-Box test

data: Residuals from ARIMA(0,1,1) with drift  
 $Q^* = 741.62$ , df = 501.17, p-value = 1.395e-11

Model df: 2. Total lags used: 503.166666666667



In [86]:

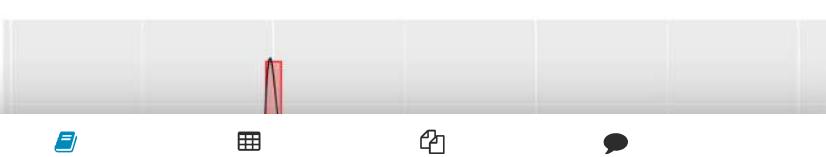
```
print('tsforecasts30')
```

[1] "tsforecasts30"

In [87]:

```
ggplot(data.frame(residuals = tsforecasts30$residuals), aes(residuals)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# make a histogram
```

Don't know how to automatically pick scale for object of type t  
s. Defaulting to continuous.

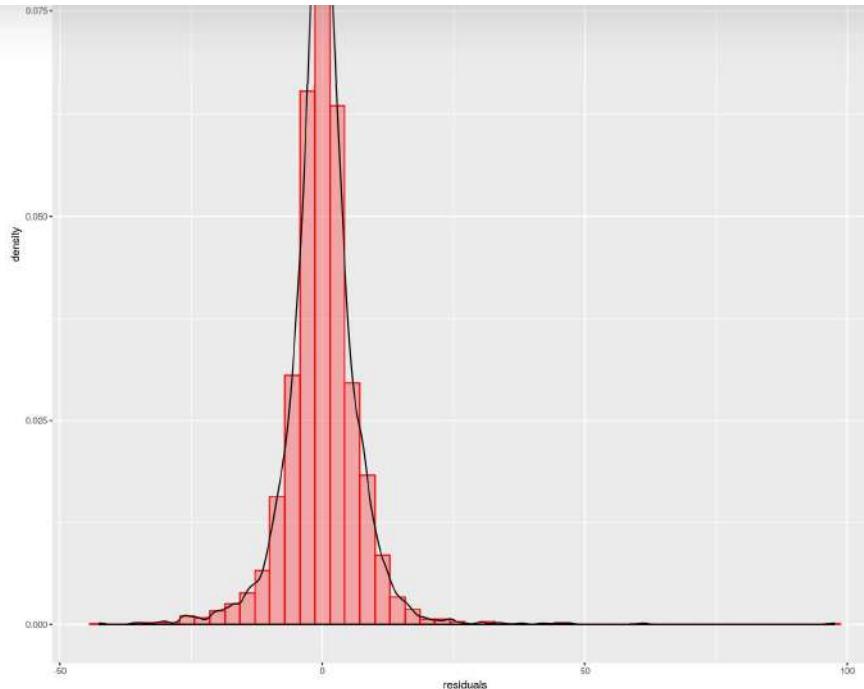


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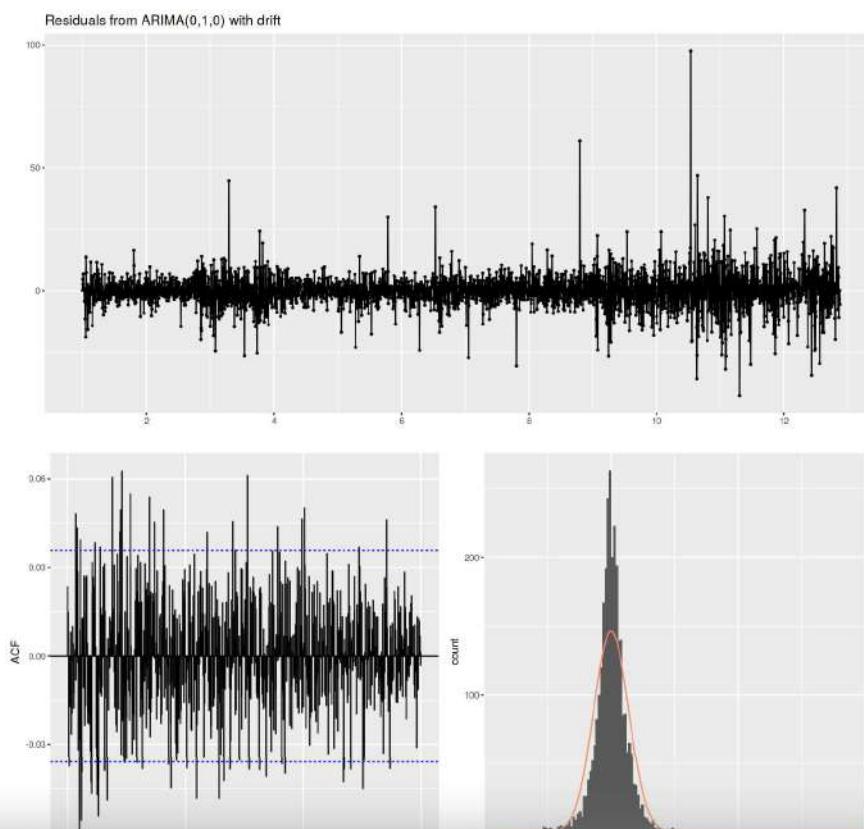


```
In [88]: checkresiduals(tsforecasts30)
```

Ljung-Box test

```
data: Residuals from ARIMA(0,1,0) with drift  
Q* = 744.82, df = 502.17, p-value = 1.002e-11
```

```
Model df: 1. Total lags used: 503.166666666667
```



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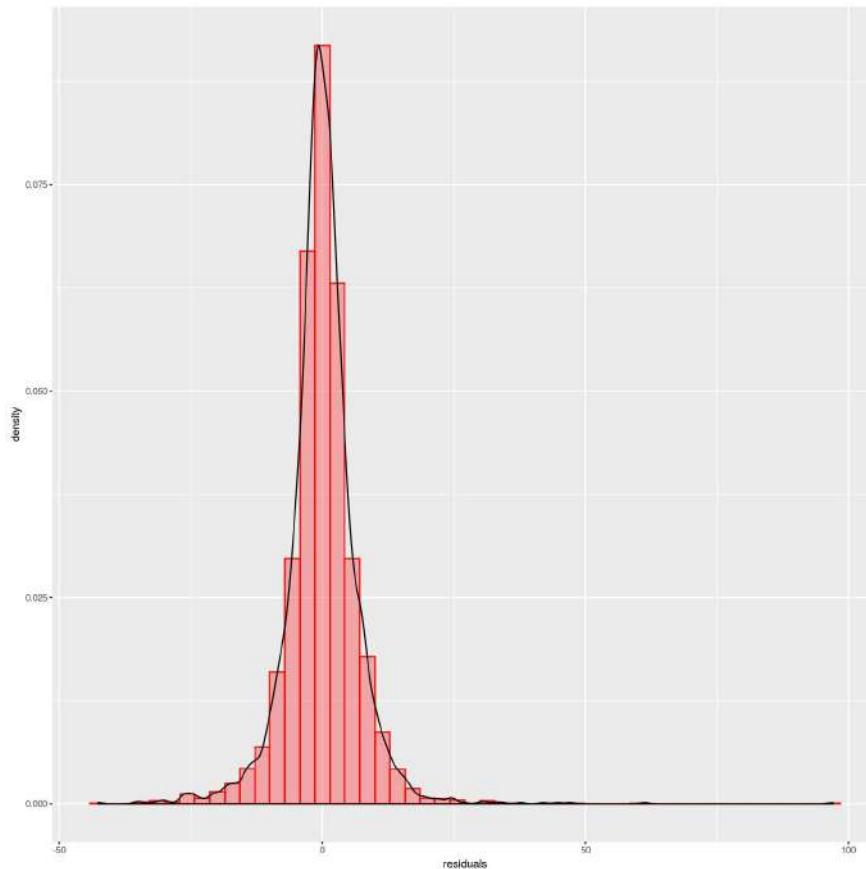
Comments

```
In [89]:  
print('tsforecasts7')
```

```
[1] "tsforecasts7"
```

```
In [90]:  
ggplot(data.frame(residuals = tsforecasts7$residuals), aes(residuals)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red",  
fill = "red", alpha = 0.3) + geom_density()# make a histogram
```

Don't know how to automatically pick scale for object of type ts.  
Defaulting to continuous.



```
In [91]:  
checkresiduals(tsforecasts7)
```

Ljung-Box test

```
data: Residuals from ARIMA(0,1,1) with drift  
Q* = 747.93, df = 501.17, p-value = 4.856e-12
```

```
Model df: 2. Total lags used: 503.1666666666667
```

Residuals from ARIMA(0,1,1) with drift

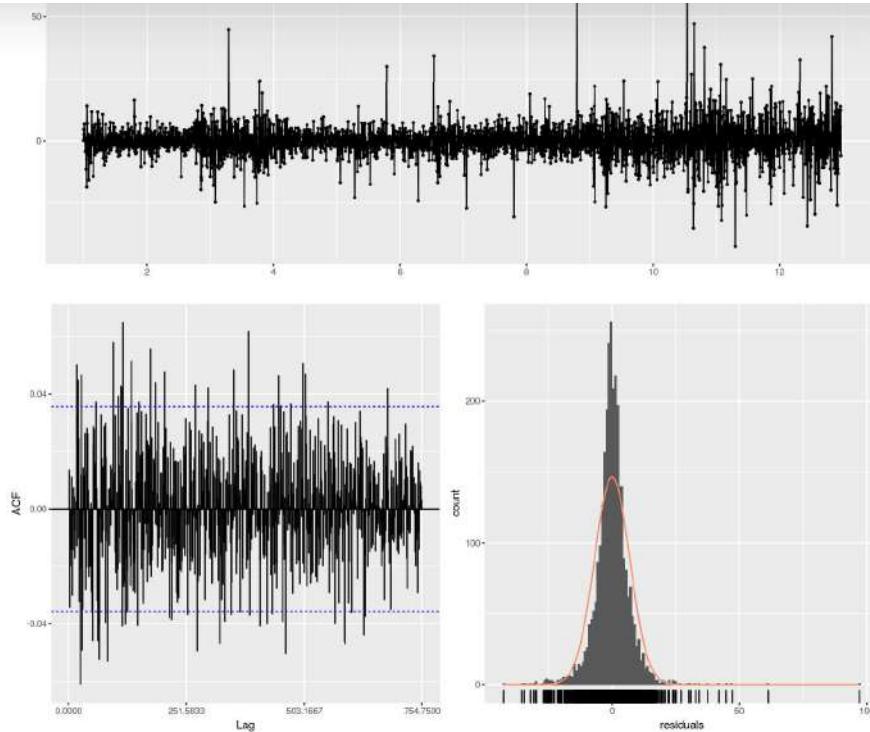
100-

Notebook

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In [92]:

```

arima_modeling <- function(xts, ts, ticker){
  ## Stationarity
  print(ticker)
  adf.test(xts, alternative = "stationary", k = 0)

  ## Decomposing Time Series
  tscomponents <- decompose(ts)
  plot(tscomponents, col = "red")

  ## Differencing a Time Series
  xtsdiff1 <- diff(xts, differences=1)
  tsdiff1 <- diff(ts, differences=1)
  plot.xts(xtsdiff1, col = "blue")
  findfrequency(xts)          # find dominant frequency of original
  time series
  findfrequency(xtsdiff1)     # find dominant frequency of differenc
  ed time series

  ## Selecting a Candidate ARIMA Model
  print(ticker)
  print("Selecting a candidate ARIMA Model")
  Acf(xtsdiff1, lag.max=60)           # plot a correlogram
  Acf(xtsdiff1, lag.max=60, plot=FALSE) # get the autocorrelation va
  lues

  Pacf(xtsdiff1, lag.max=60)          # plot a partial correlogra
  m
  Pacf(xtsdiff1, lag.max=60, plot=FALSE) # get the partial autocorre
  lation values

  ## Fitting an ARIMA Model
  tsarima <- auto.arima(head(xts, -30), max.p = 3, max.q = 3, max.d
  = 2)

```

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[Data](#)
[Output](#)
[Comments](#)

```
print(tsarima)
autoplot(tsarima)
print(ticker)

## Forecasting using an ARIMA Model
print(ticker)
tsforecasts <- forecast(tsarima, h = 30) # forecast the next 120 time series
acc <- accuracy(tsforecasts, head(tail(xts, 30), 7))
print(acc)
autoplot(tsforecasts)

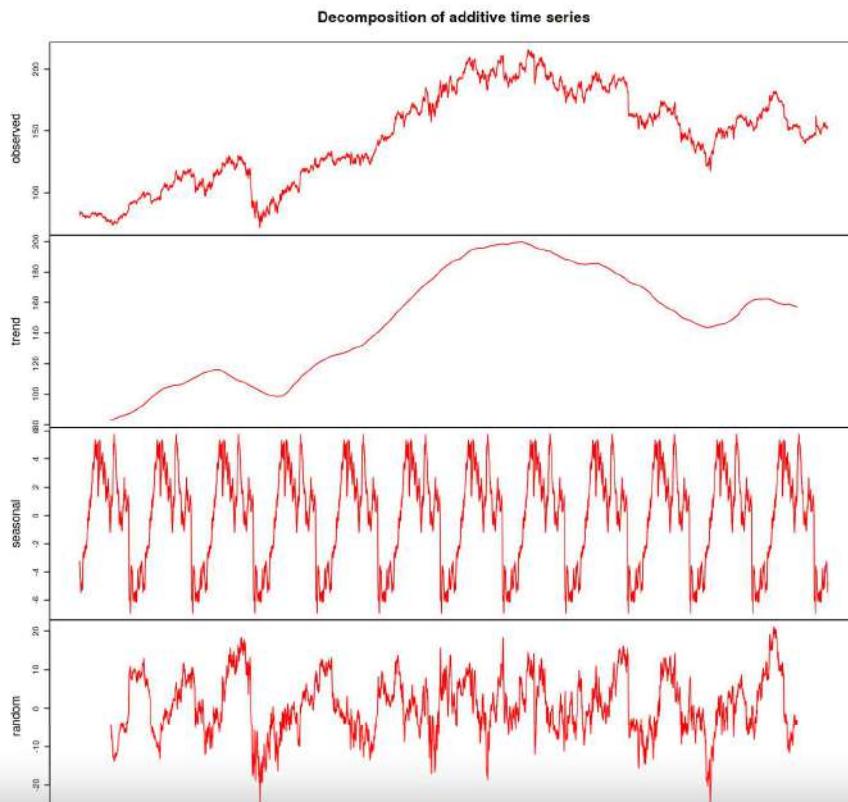
autoplot(tsforecasts)

print(ticker)

ggplot(data.frame(residuals = tsforecasts$residuals), aes(residuals)) + geom_histogram(bins = 50, aes(y = ..density..), col = "red", fill = "red", alpha = 0.3) + geom_density()# make a histogram
checkresiduals(tsforecasts)
}

for (ticker in candidate_ticker){
  if (ticker != 'GOOGL'){
    arima_modeling(xts_list[[ticker]], ts_list[[ticker]], as.character(ticker))
  }
}
```

```
[1] "IBM"
[1] "IBM"
[1] "Selecting a candidate ARIMA Model"
```

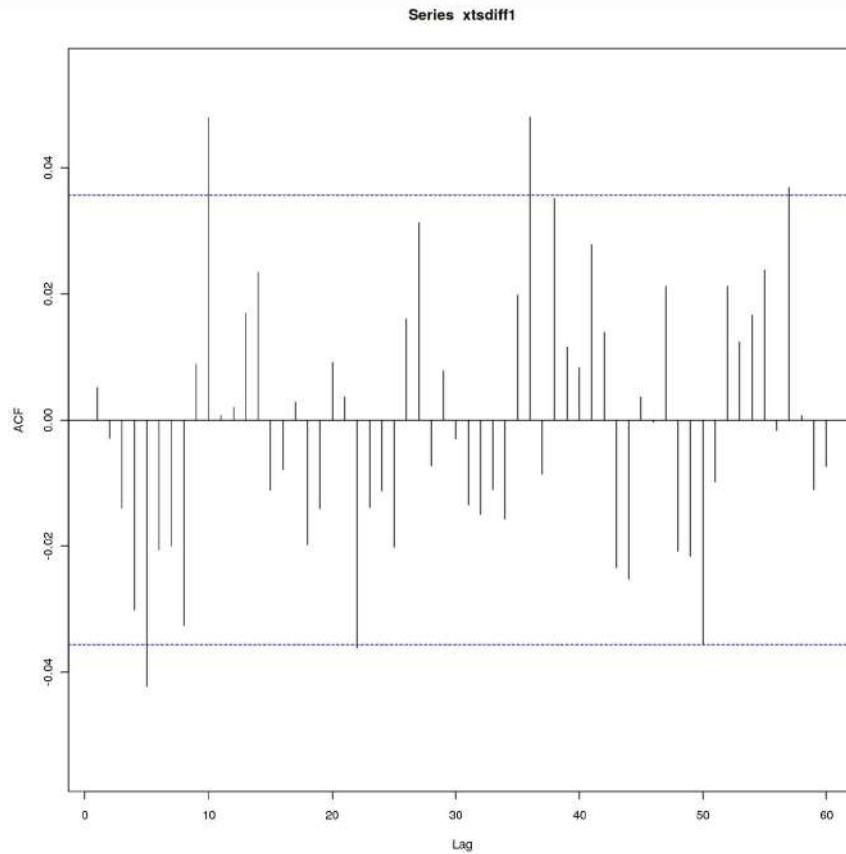


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```
Series: head(xts, -30)
```

```
ARIMA(0,1,0)
```

```
sigma^2 estimated as 3.488: log likelihood=-6108.41
```

```
AIC=12218.82 AICc=12218.82 BIC=12224.82
```

```
[1] "IBM"
```

```
[1] "IBM"
```

ME	RMSE	MAE	MPE	MAPE
----	------	-----	-----	------

MASE

```
Training set 0.02177995 1.867356 1.307867 0.01033524 0.9398062
```

```
0.06090065
```

```
Test set 3.77714286 3.978851 3.777143 2.49672142 2.4967214
```

```
0.17588217
```

ACF1

```
Training set 0.005630018
```

```
Test set NA
```

```
[1] "IBM"
```

Ljung-Box test

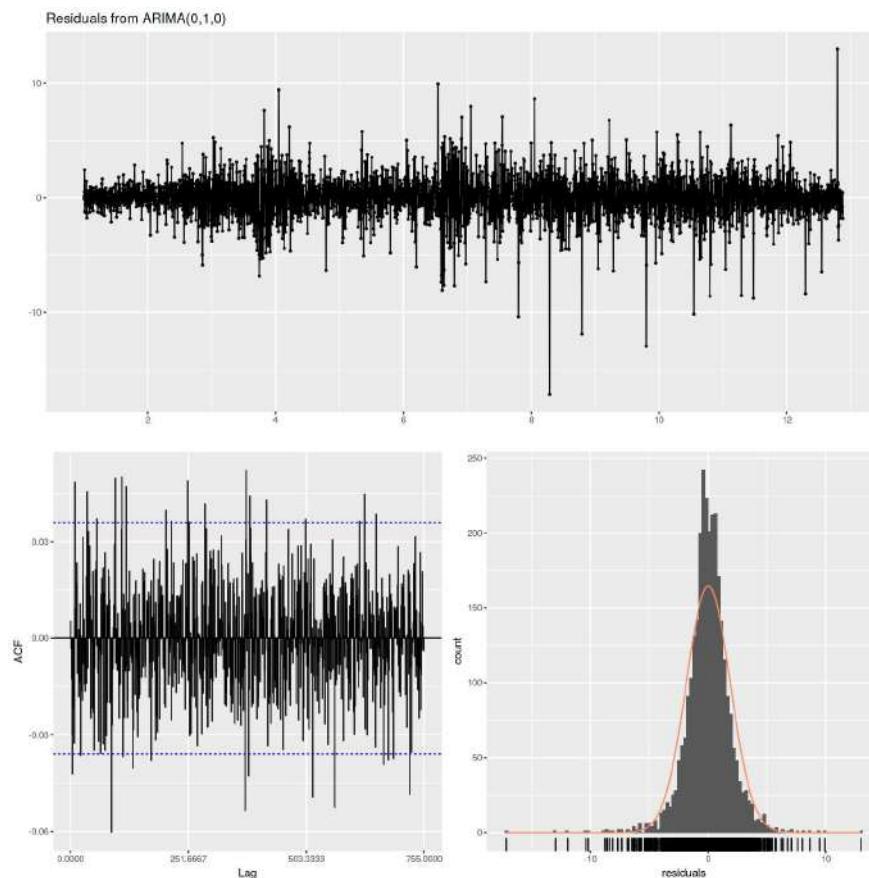
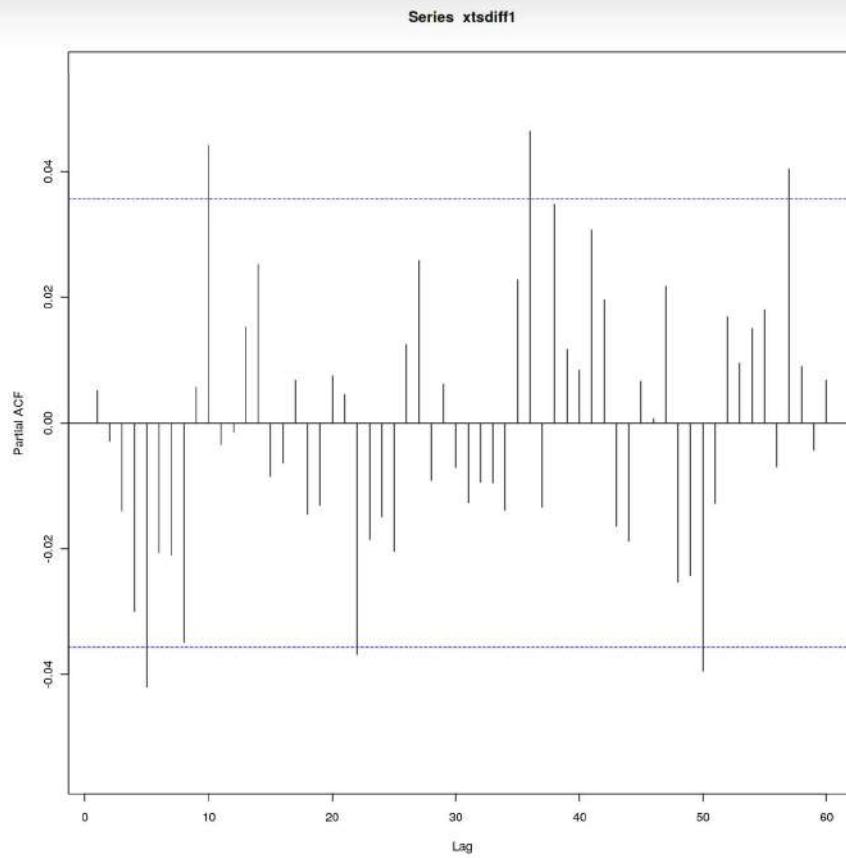
```
data: Residuals from ARIMA(0,1,0)
```

```
Q* = 550.98, df = 503.33, p-value = 0.06975
```

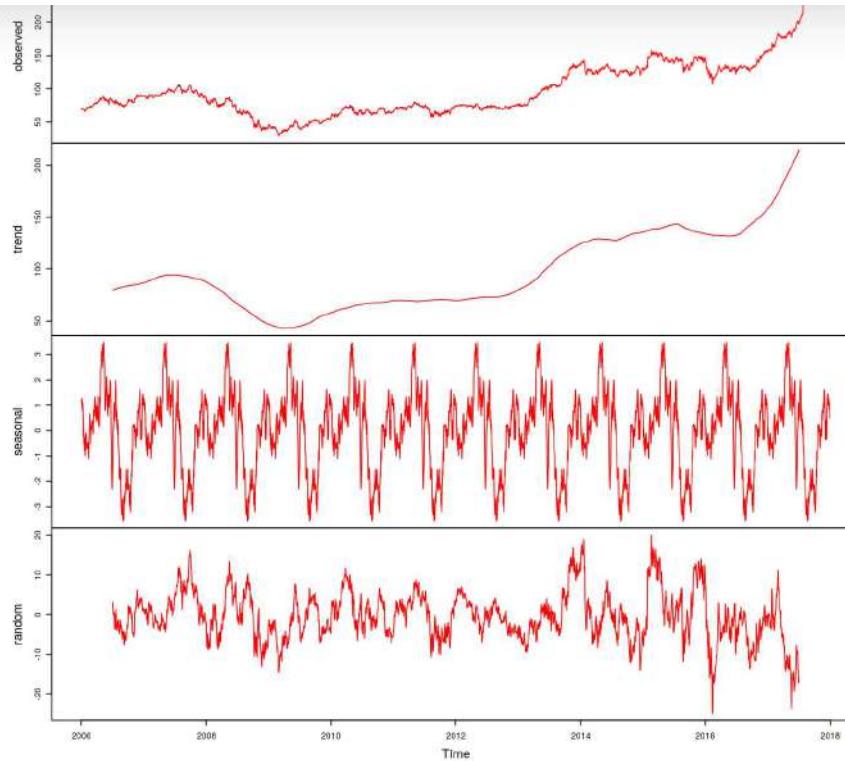
```
Model df: 0. Total lags used: 503.333333333333
```

```
[1] "BA"
```

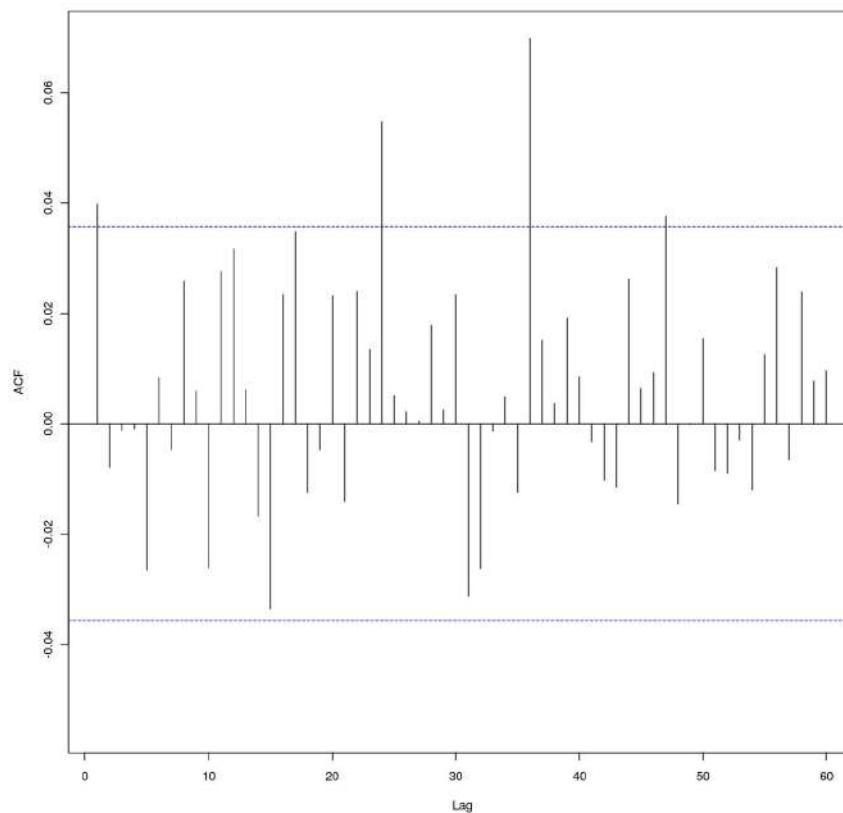
```
Warning message in adf.test(xts, alternative = "stationary", k = 0):
```



```
[1] "BA"  
[1] "Selecting a candidate ARIMA Model"
```



Series xtsdiff1



```
Series: head(xts, -30)
ARIMA(3, 2, 0)
```

Coefficients:

	ar1	ar2	ar3
-	-0.6921	-0.4799	-0.2375
s.e.	0.0178	0.0200	0.0178

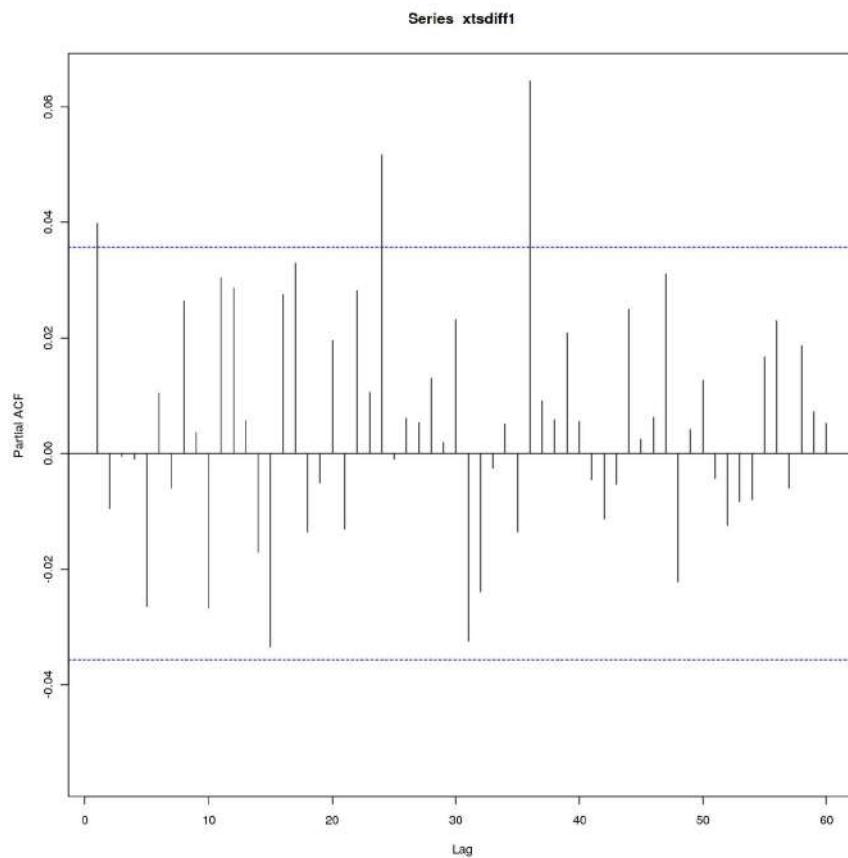
Notebook

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Comments

```
AIC=11704.05 AICc=11704.06 BIC=11728.06
[1] "BA"
[1] "BA"
          ME      RMSE      MAE      MPE      MA
PE      MASE
Training set 3.813704e-05 1.712217 1.235288 6.249955e-06 1.38636
92 0.05283613
Test set     6.522660e-01 1.261759 1.003473 2.444168e-01 0.37833
24 0.04292087
ACF1
Training set -0.0444802
Test set       NA
[1] "BA"
```

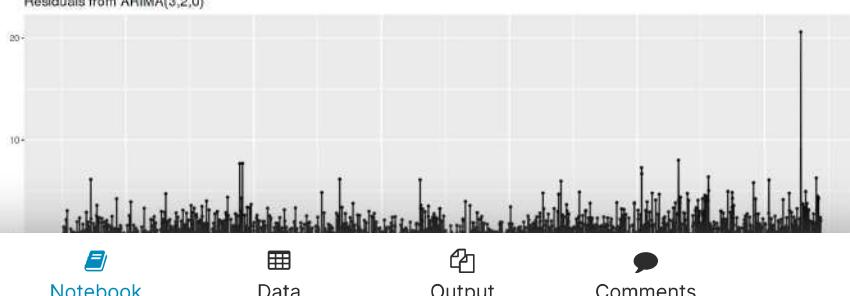


#### Ljung-Box test

```
data: Residuals from ARIMA(3,2,0)
Q* = 957.35, df = 500.33, p-value < 2.2e-16

Model df: 3. Total lags used: 503.333333333333
```

```
[1] "AAPL"
```

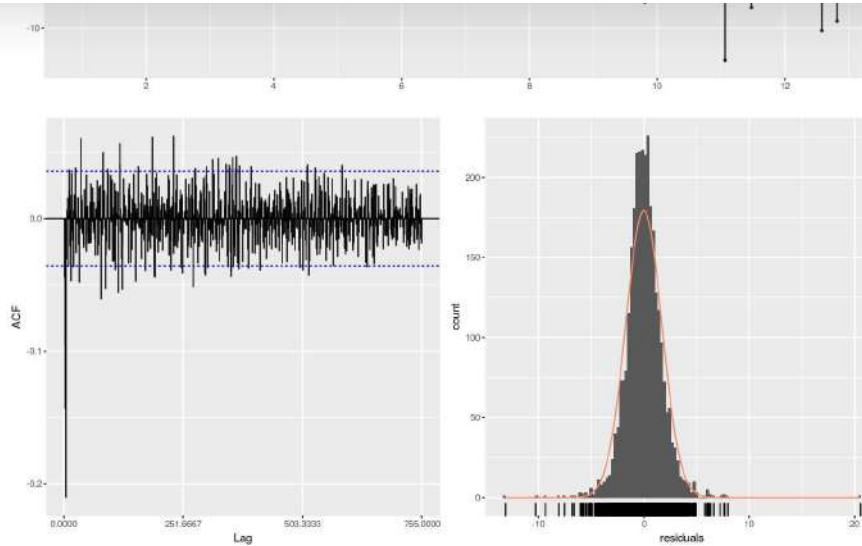


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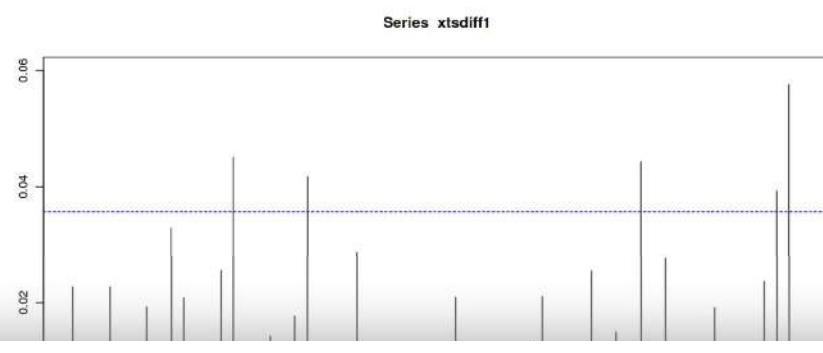
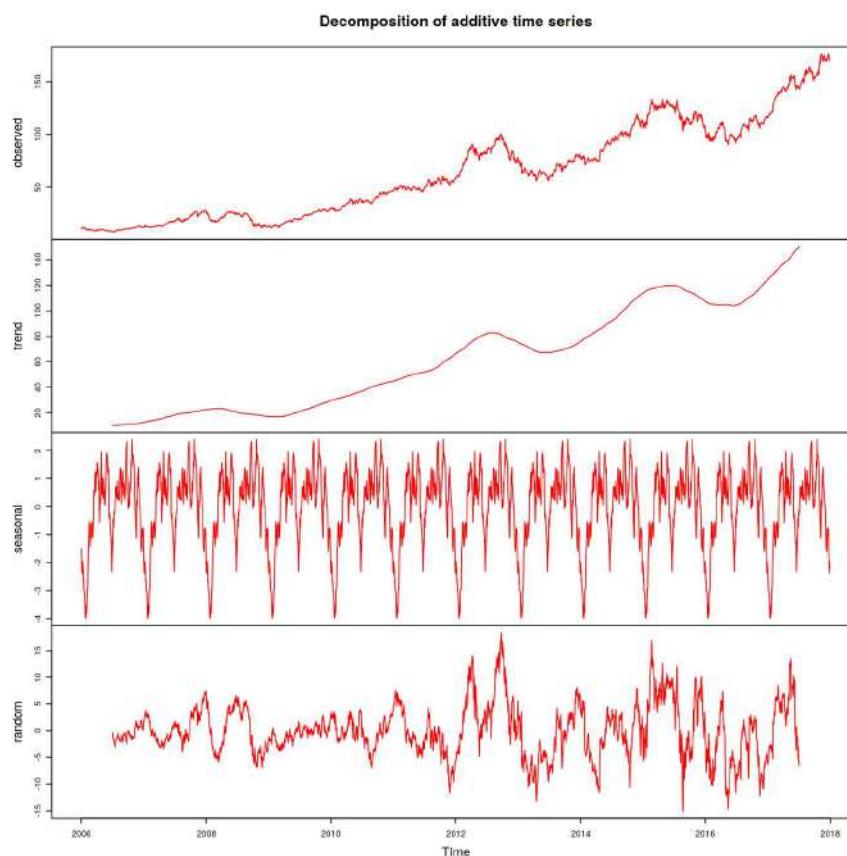
Data

Output

Comments



```
[1] "AAPL"  
[1] "Selecting a candidate ARIMA Model"
```

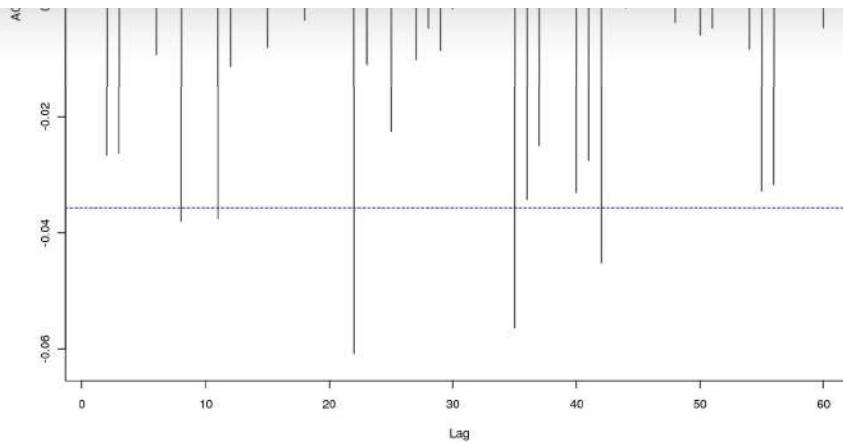


Notebook

Data

Output

Comments



Series: head(xts, -30)  
ARIMA(0,1,1) with drift

Coefficients:

ma1	drift
0.0271	0.0530
s.e.	0.0187 0.0218

$\sigma^2$  estimated as 1.342: log likelihood=-4678.4

AIC=9362.8 AICc=9362.81 BIC=9380.81

[1] "AAPL"

[1] "AAPL"

ME	RMSE	MAE	MPE	MAPE
----	------	-----	-----	------

MASE

Training set -1.426077e-05 1.157919 0.7466738 -0.0923504 1.43854  
0.03844376

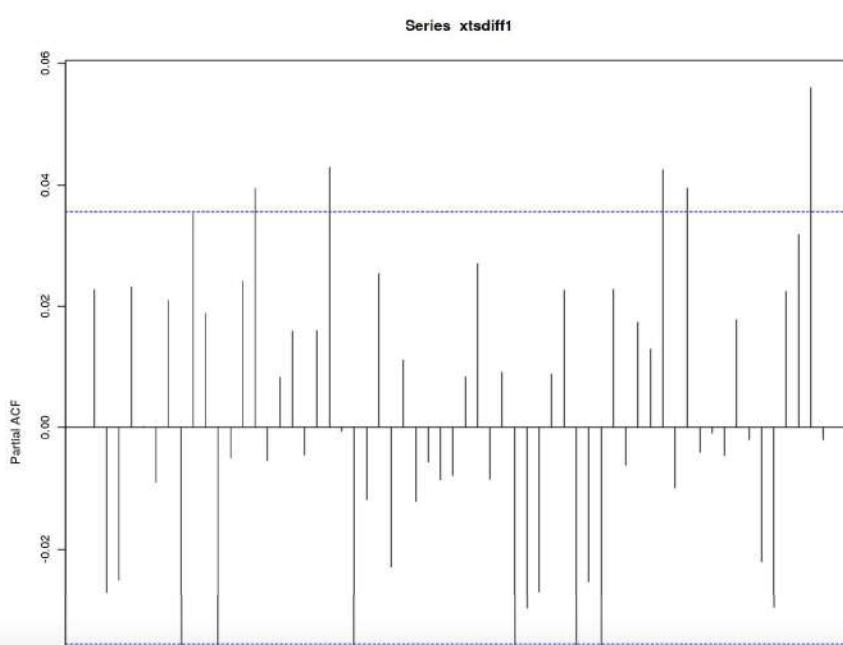
Test set 3.395825e+00 3.911686 3.3958252 1.9541796 1.95418  
0.17483980

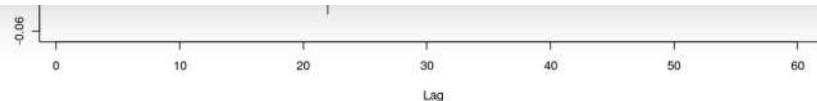
ACF1

Training set -0.0005956725

Test set NA

[1] "AAPL"





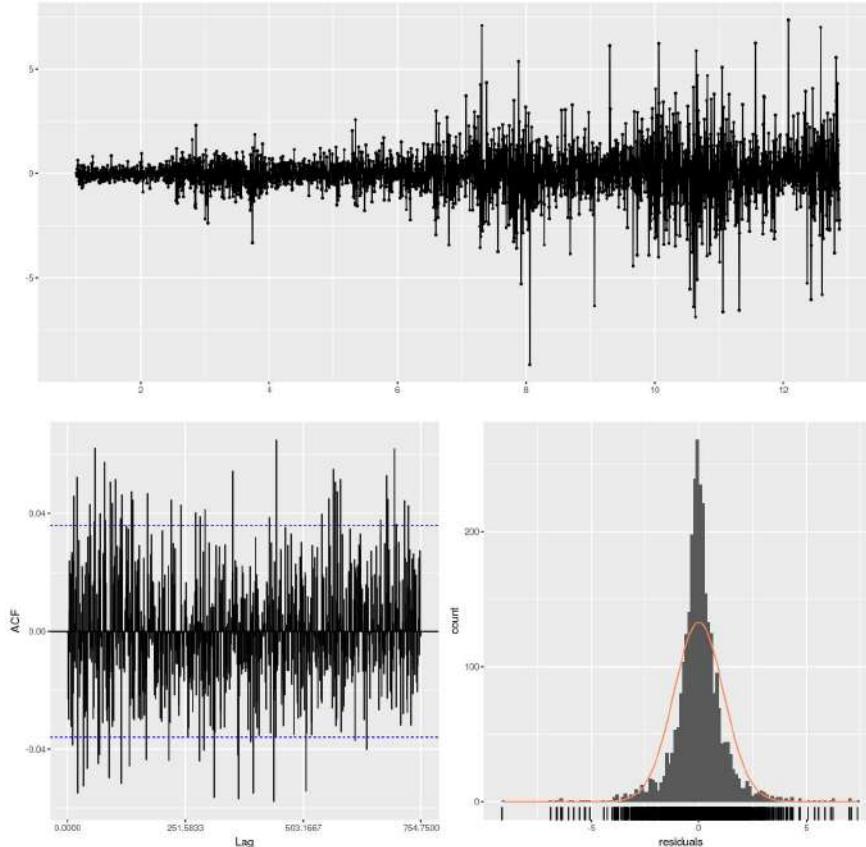
Ljung-Box test

```
data: Residuals from ARIMA(0,1,1) with drift
Q* = 760.19, df = 501.17, p-value = 5.924e-13
```

Model df: 2. Total lags used: 503.166666666667

[1] "GS"

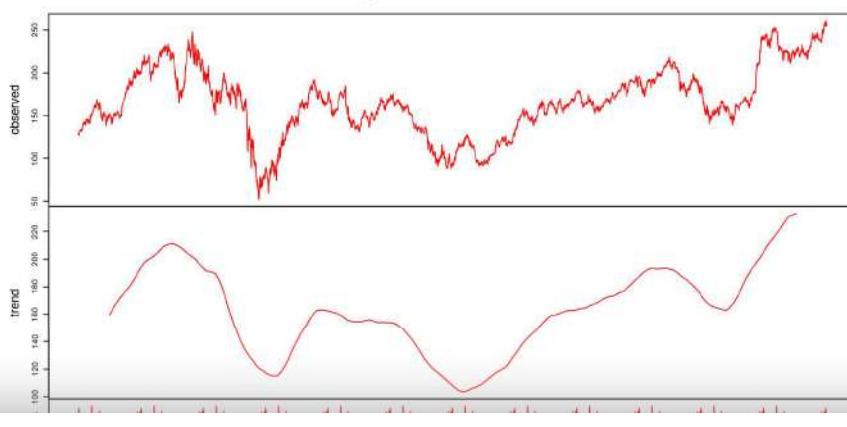
Residuals from ARIMA(0,1,1) with drift



[1] "GS"

[1] "Selecting a candidate ARIMA Model"

Decomposition of additive time series

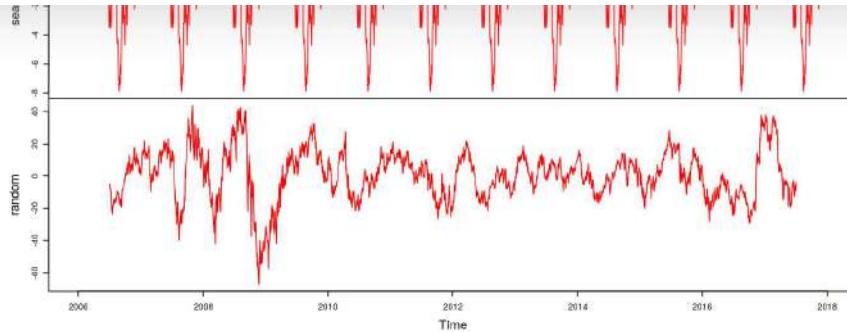


Notebook

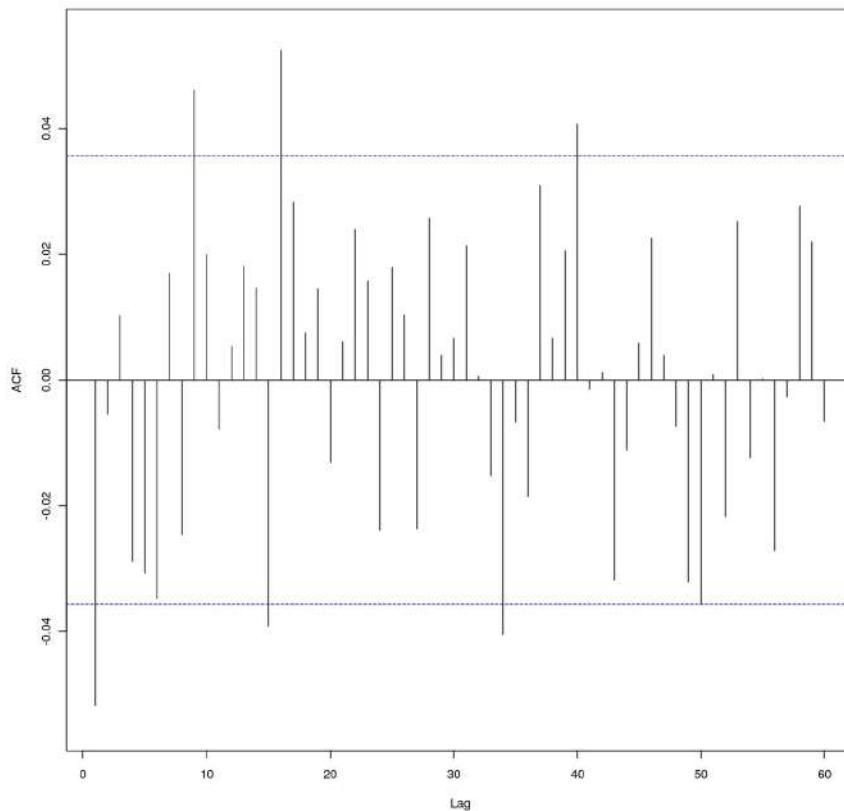
Data

Output

Comments



Series xtsdiff1



```
Series: head(xts, -30)
ARIMA(0,1,1)
```

Coefficients:

ma1	
-0.0524	
s.e.	0.0183

```
sigma^2 estimated as 10.81: log likelihood=-7798.97
AIC=15601.95 AICc=15601.95 BIC=15613.95
[1] "GS"
[1] "GS"
      ME      RMSE      MAE      MPE      MAP
E      MASE
Training set 0.03841759 3.287472 2.296009 -0.008172832 1.515737
1 0.05571291
Test set    -0.30892129 1.416909 1.207297 -0.133591163 0.509799
8 0.02929519
```

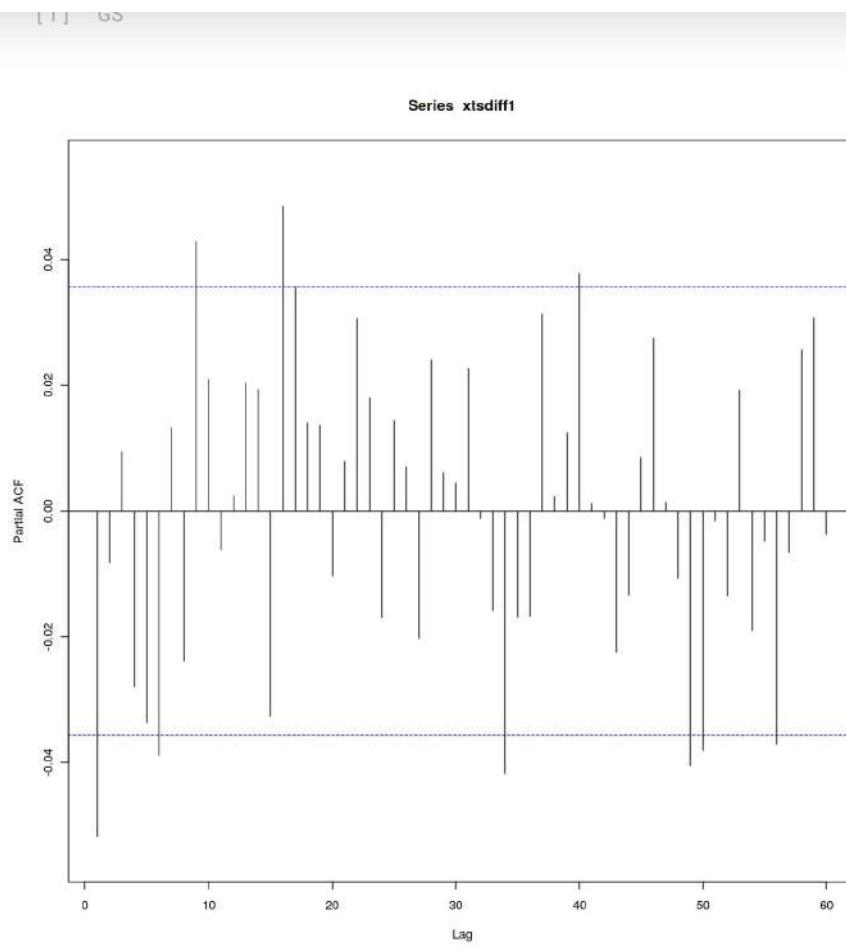
### ACF1

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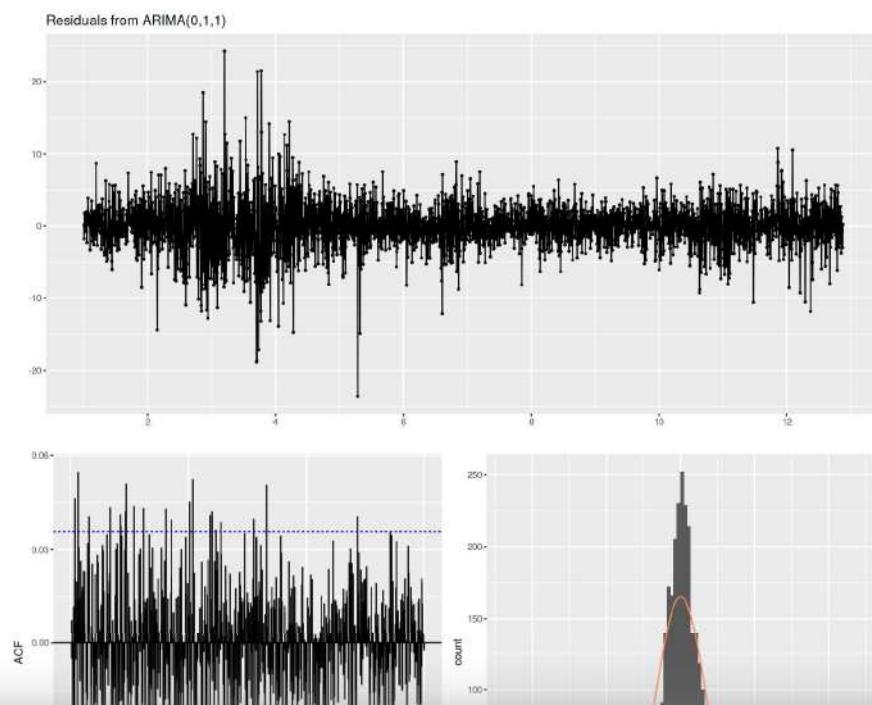
Comments



#### Ljung-Box test

```
data: Residuals from ARIMA(0,1,1)
Q* = 709.72, df = 502.33, p-value = 2.735e-09
```

Model df: 1. Total lags used: 503.333333333333



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Comments



In [ ]:

In [ ]:

In [ ]:

In [ ]:



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Show your appreciation with an upvote



## Data

### Data Sources

#### ▼ DJIA 30 Stock Time Series

■■■ AABA_2006-01-01_to_2018-01-01.csv	7 columns
■■■ AAPL_2006-01-01_to_2018-01-01.csv	7 columns
■■■ AMZN_2006-01-01_to_2018-01-01.csv	7 columns
■■■ AXP_2006-01-01_to_2018-01-01.csv	7 columns
■■■ BA_2006-01-01_to_2018-01-01.csv	7 columns
■■■ CAT_2006-01-01_to_2018-01-01.csv	7 columns
■■■ CSCO_2006-01-01_to_2018-01-01.csv	7 columns
■■■ CVX_2006-01-01_to_2018-01-01.csv	7 columns
■■■ DIS_2006-01-01_to_2018-01-01.csv	7 columns
■■■ GE_2006-01-01_to_2018-01-01.csv	7 columns
■■■ 10 more	



### DJIA 30 Stock Time Series

Historical stock data for DJIA 30 companies (2006-01-01 to 2018-01-01)

Last Updated: 2 years ago (Version 3)

#### About this Dataset

#### Context

The script used to acquire all of the following data can be found [in this GitHub repository](#). This repository also contains the modeling codes and will be updated continually, so welcome starring or watching!

Stock market data can be interesting to analyze and as a further incentive, strong predictive models can have large financial payoff. The amount of financial data on the web is seemingly endless. A large and well structured dataset on a wide array of companies can be hard to come by. Here provided a dataset with historical stock prices (last 12 years) for 29 of 30 DJIA companies (excluding 'V' because it does not have the whole 12 years data).

```
[ 'MMM', 'AXP', 'AAPL', 'BA', 'CAT', 'CVX',
'CSCO', 'KO', 'DIS', 'XOM', 'GE',
'GS', 'HD', 'IBM', 'INTC', 'JNJ', 'JPM',
'MCD', 'MRK', 'MSFT', 'NKE', 'PFE',
'PG', 'TRV', 'UTX', 'UNH', 'VZ', 'WMT',
'GOOGL', 'AMZN', 'AABA' ]
```

In the future if you wish for a more up to date dataset, this can be

the .csv files.



Notebook



Data



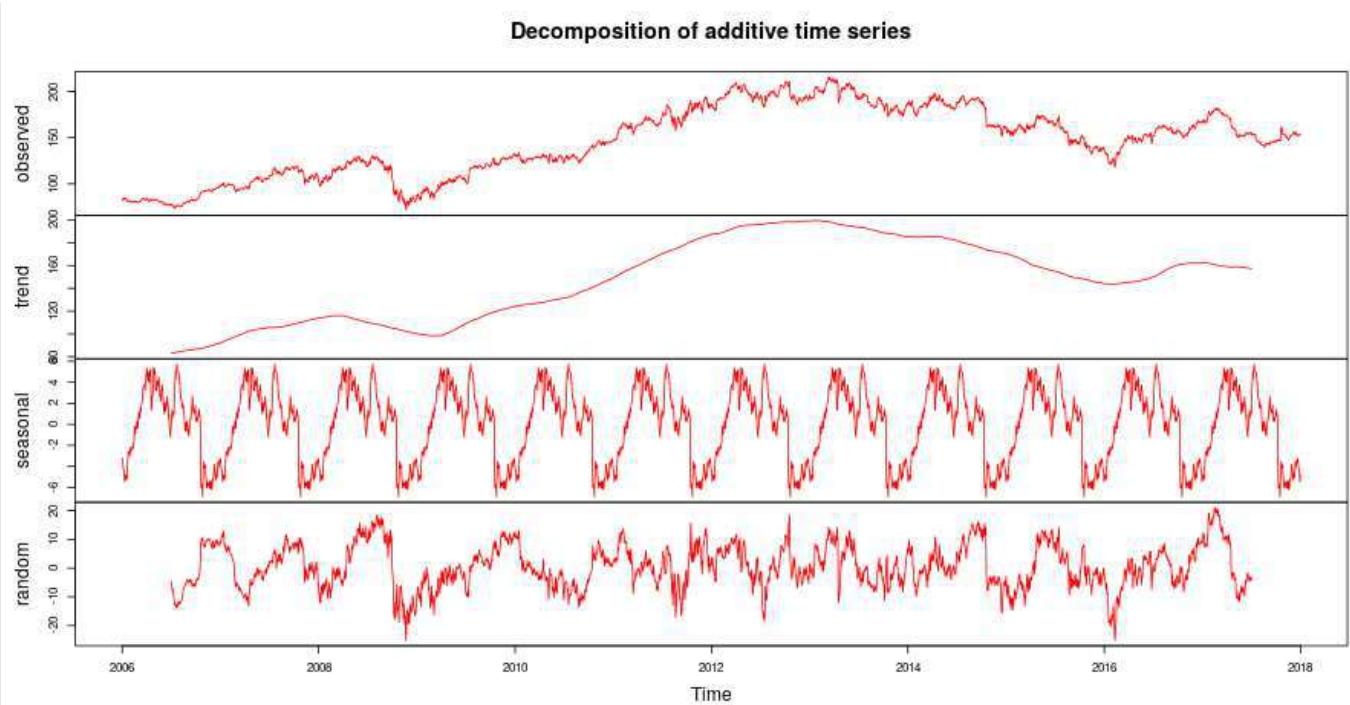
Output



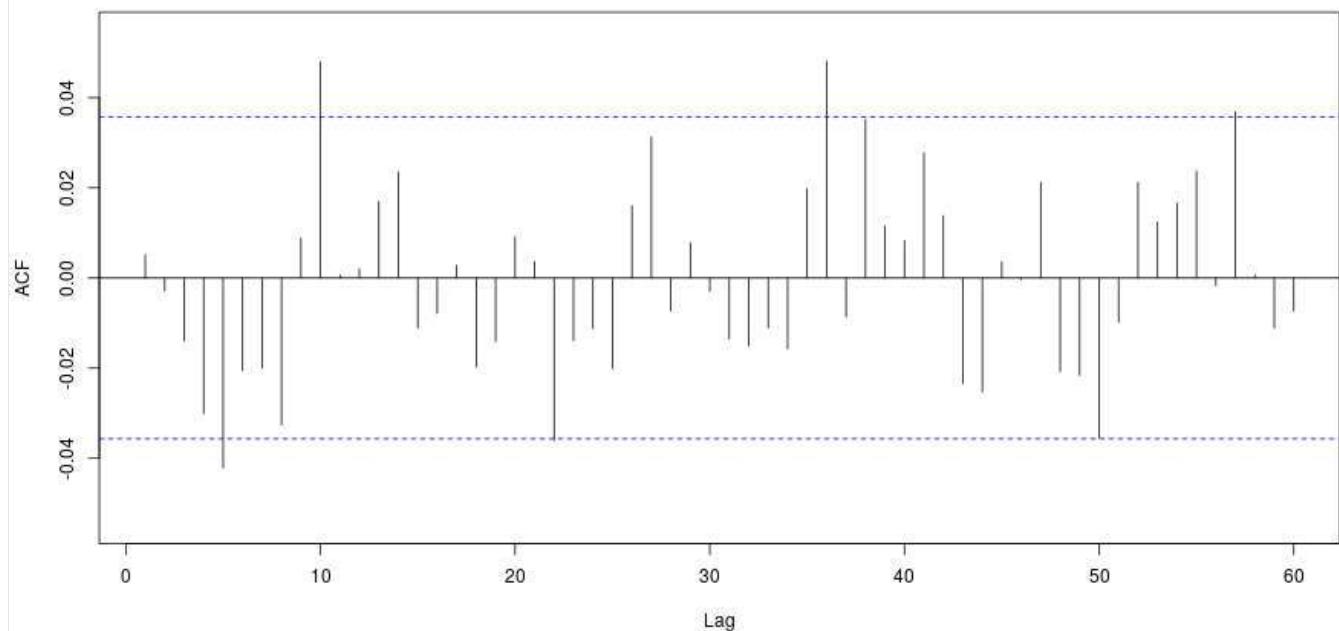
Comments

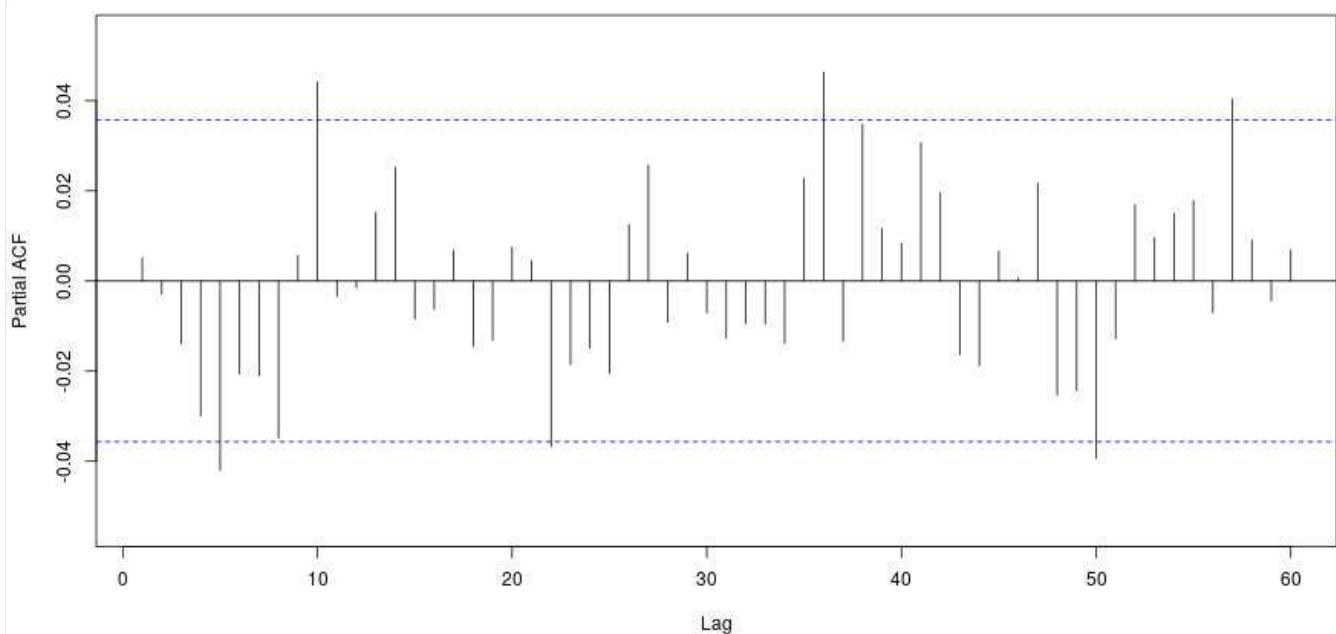
## Content

### Output Visualizations

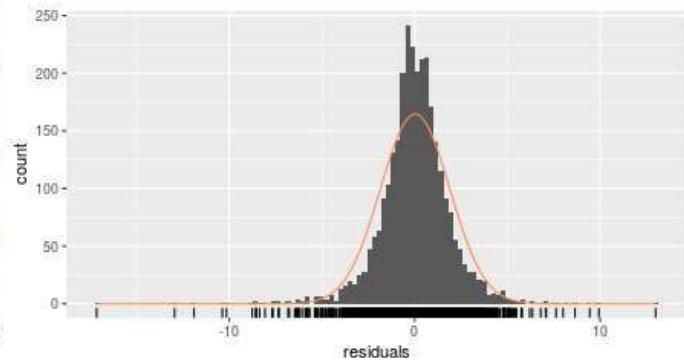
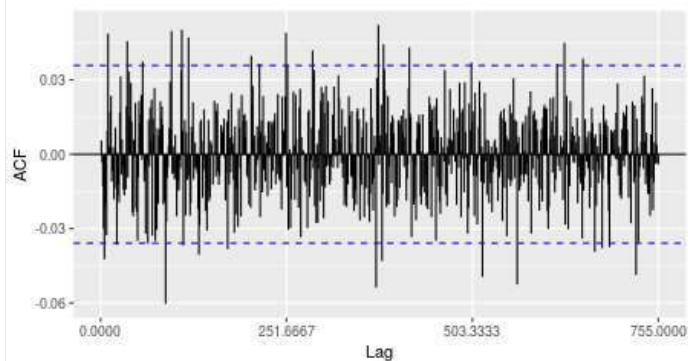
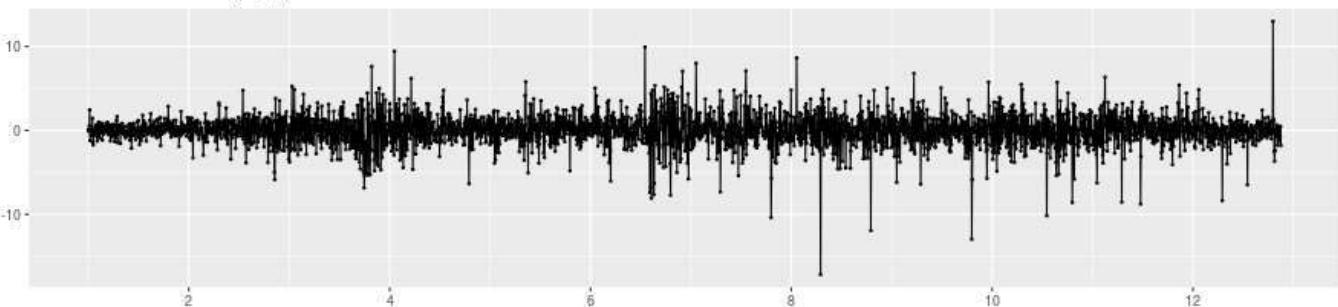


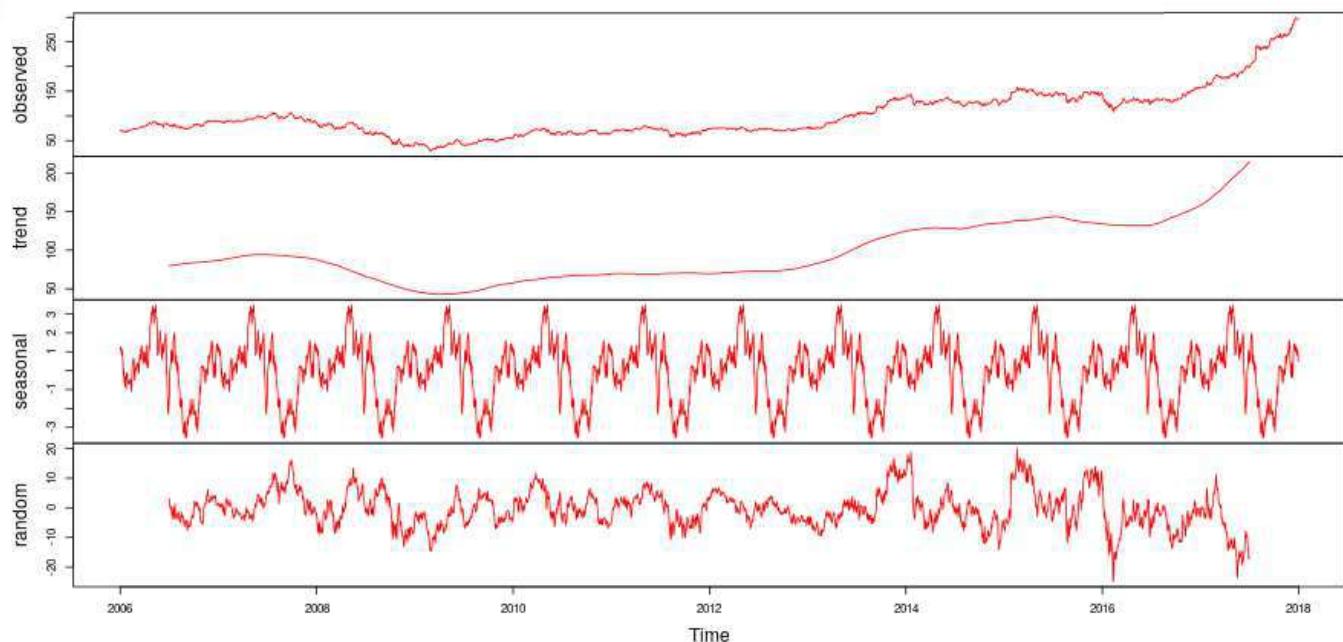
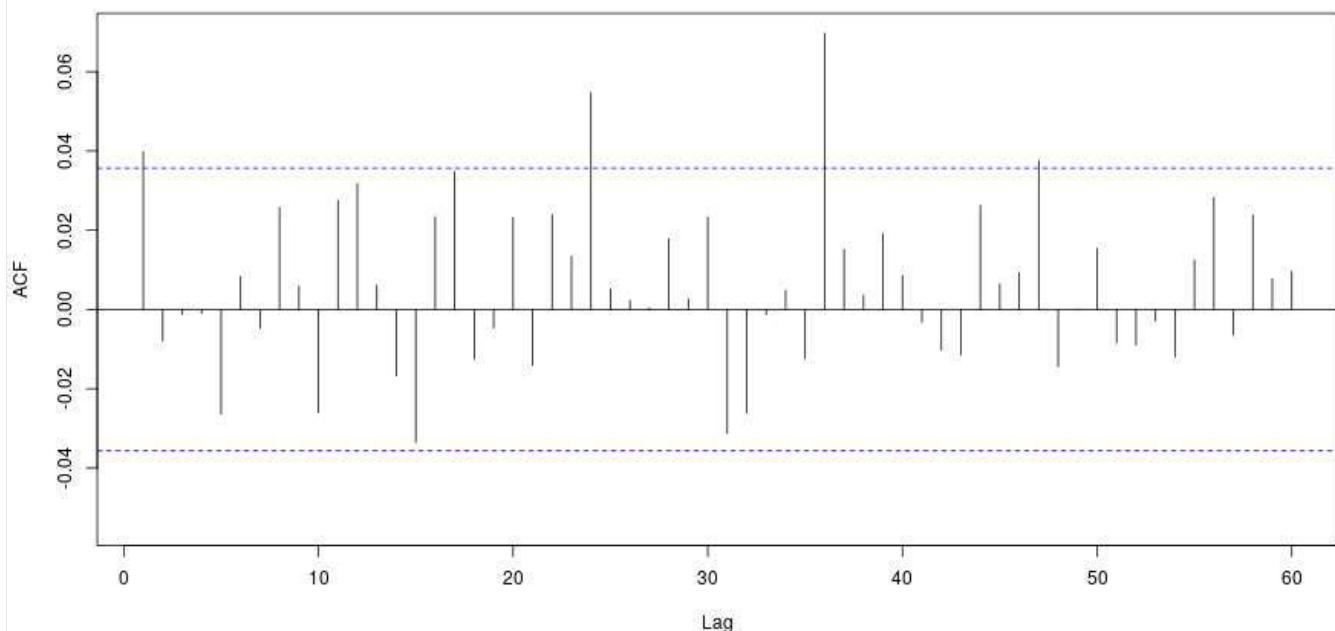
**Series xtsdiff1**

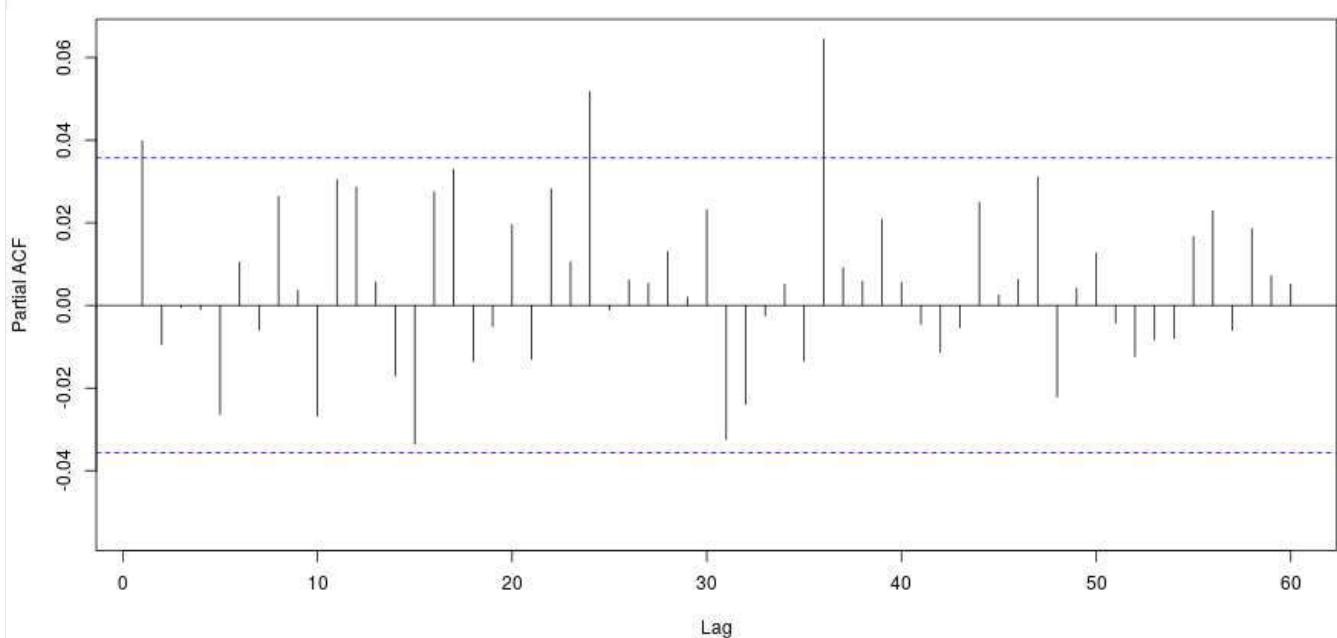


**Series xtsdiff1**

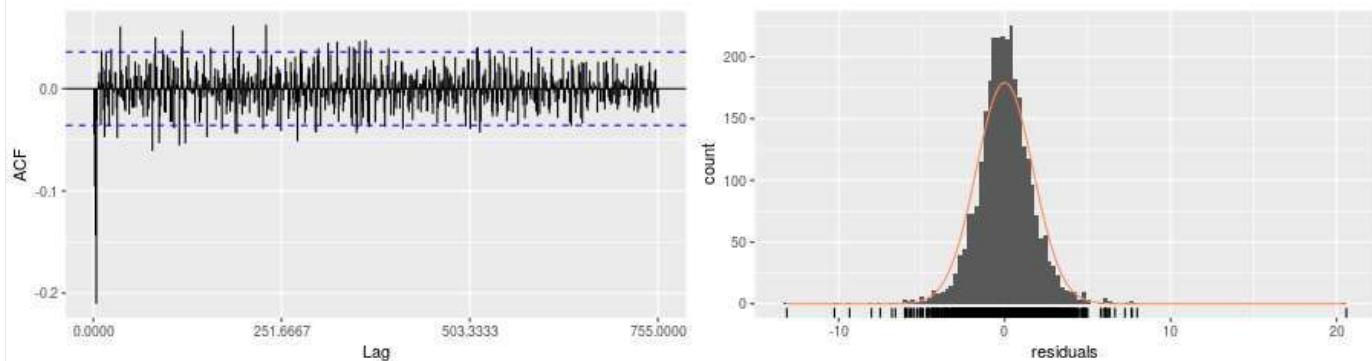
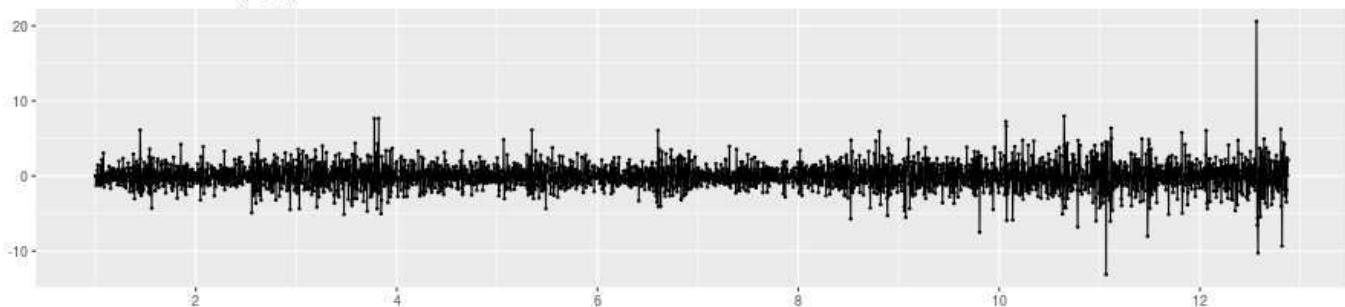
Residuals from ARIMA(0,1,0)

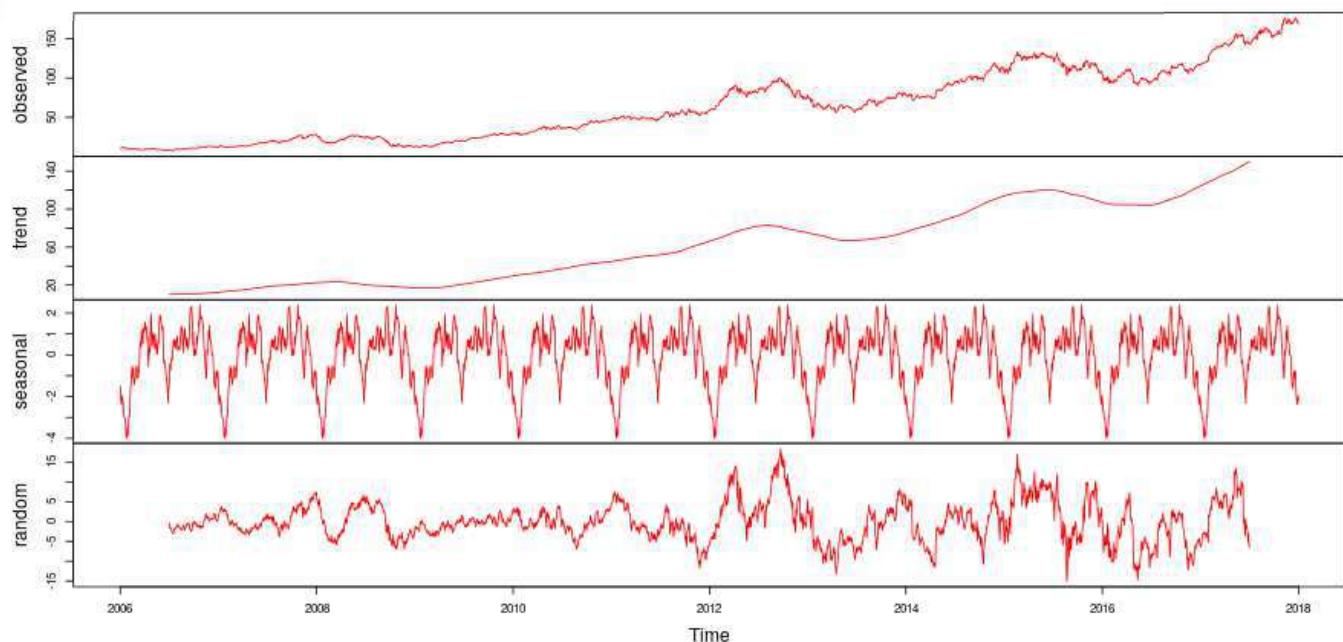
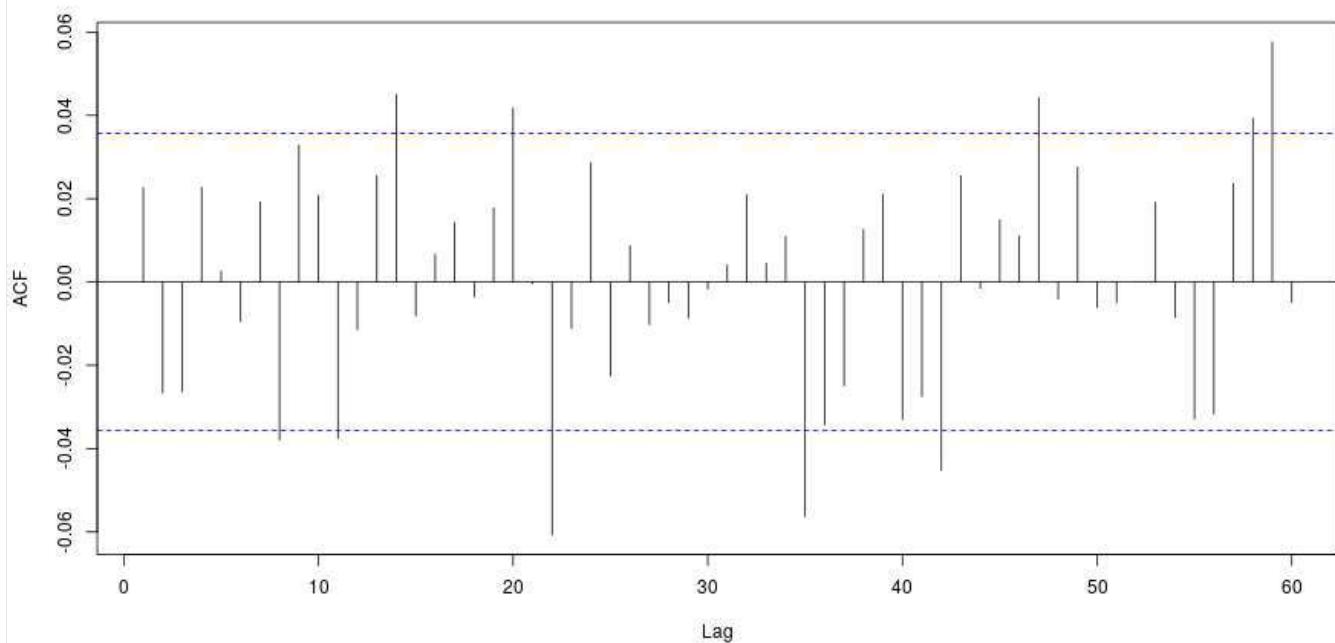


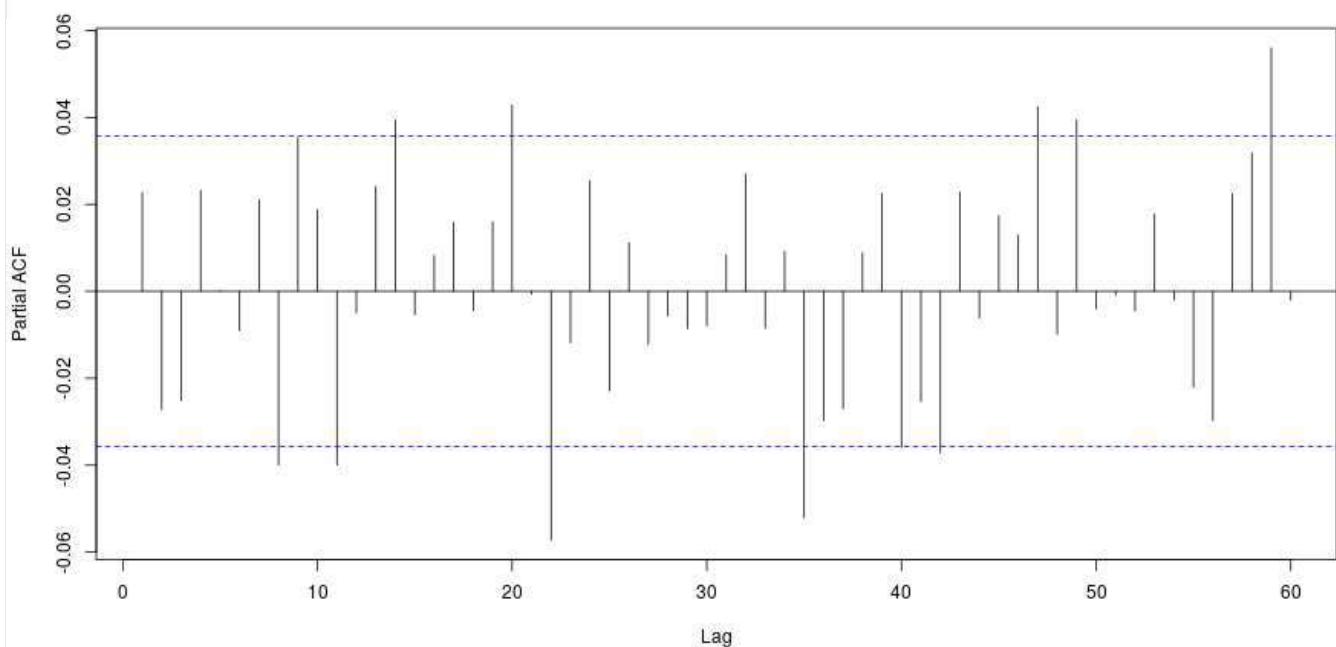
**Decomposition of additive time series****Series xtsdiff1**

**Series xtsdiff1**

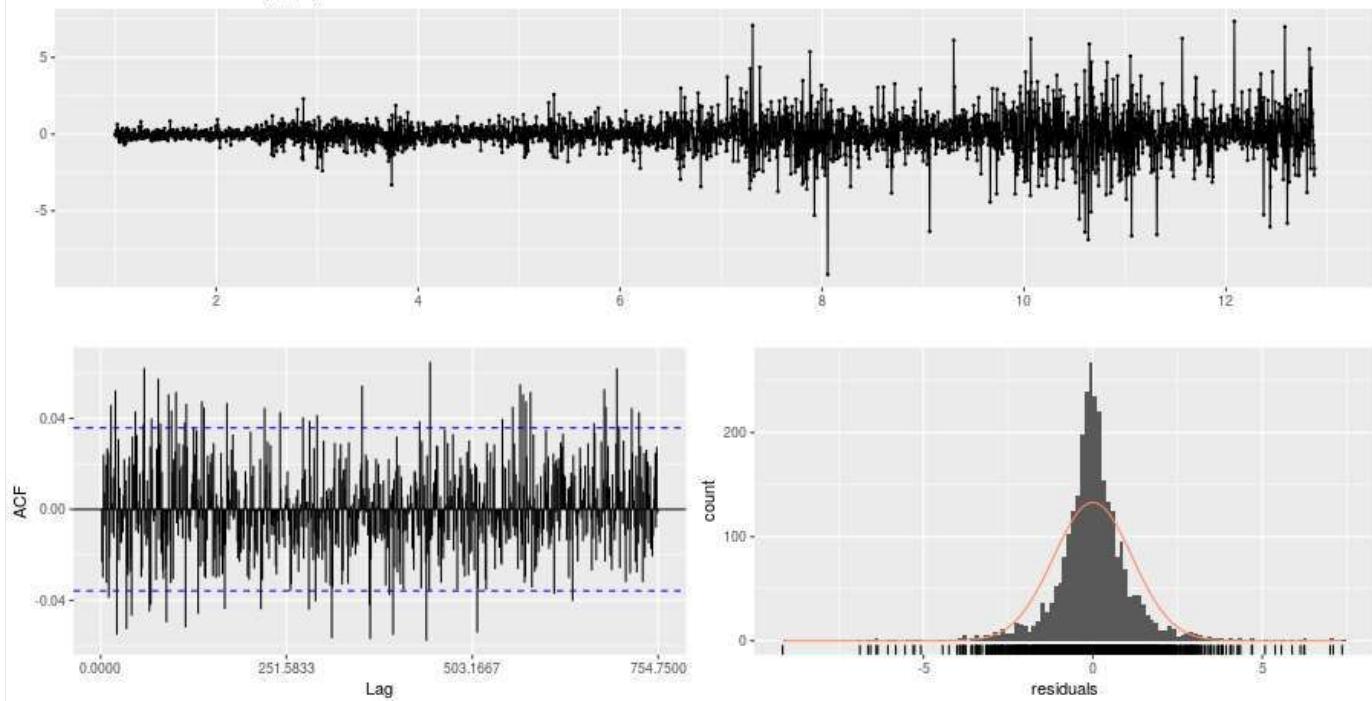
Residuals from ARIMA(3,2,0)

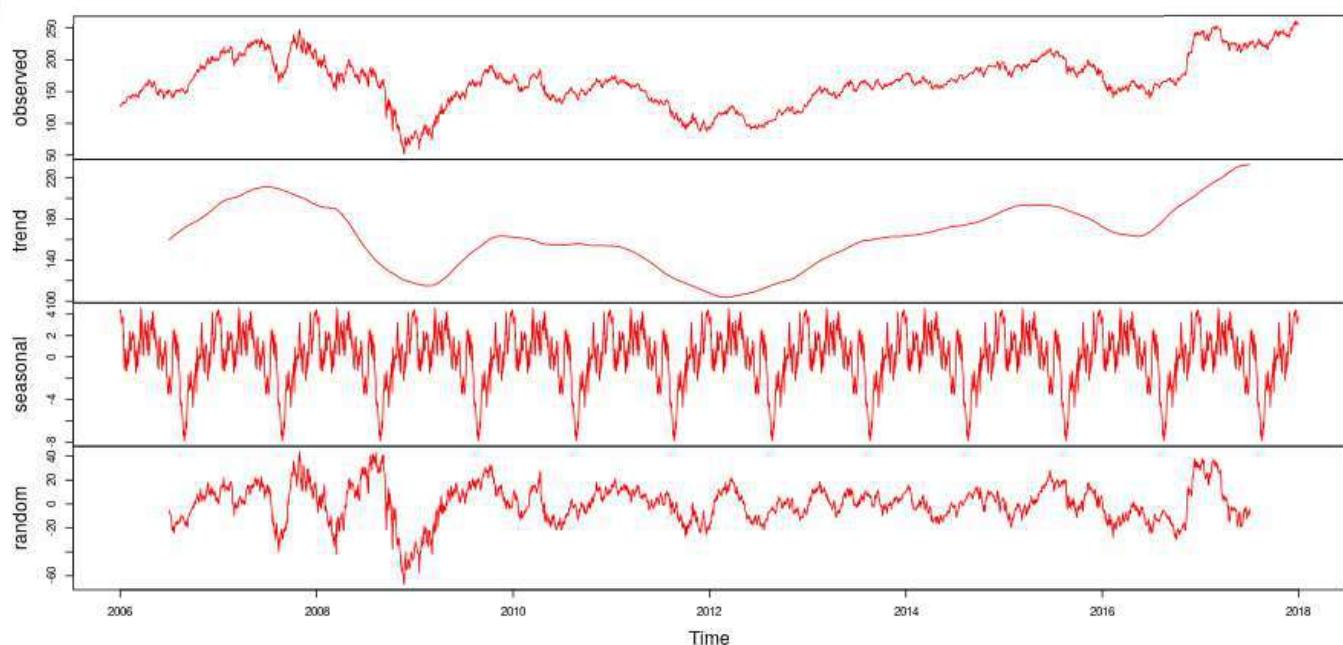
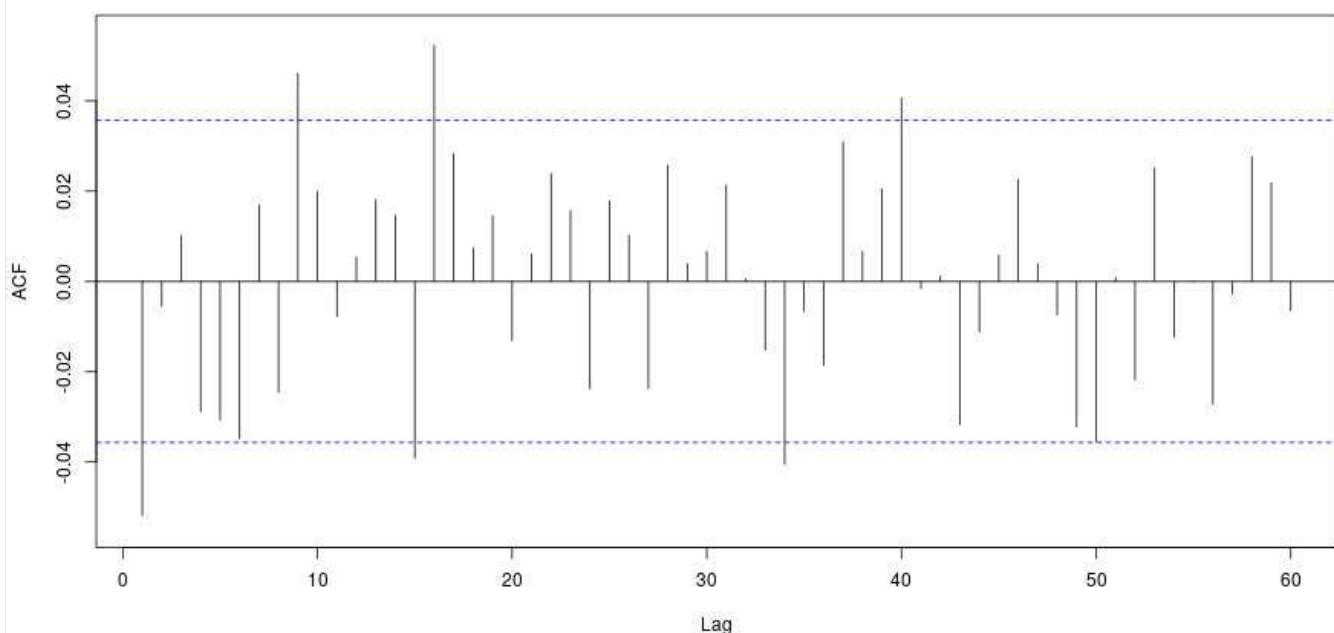


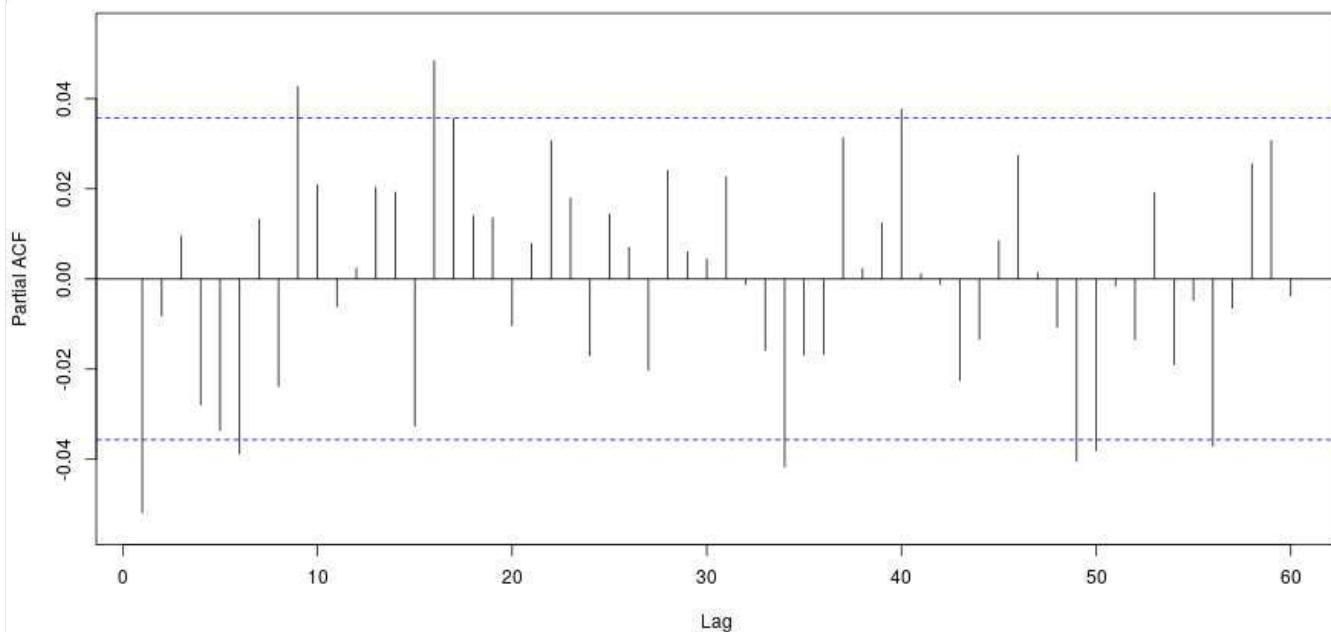
**Decomposition of additive time series****Series xtsdiff1**

**Series xtsdiff1**

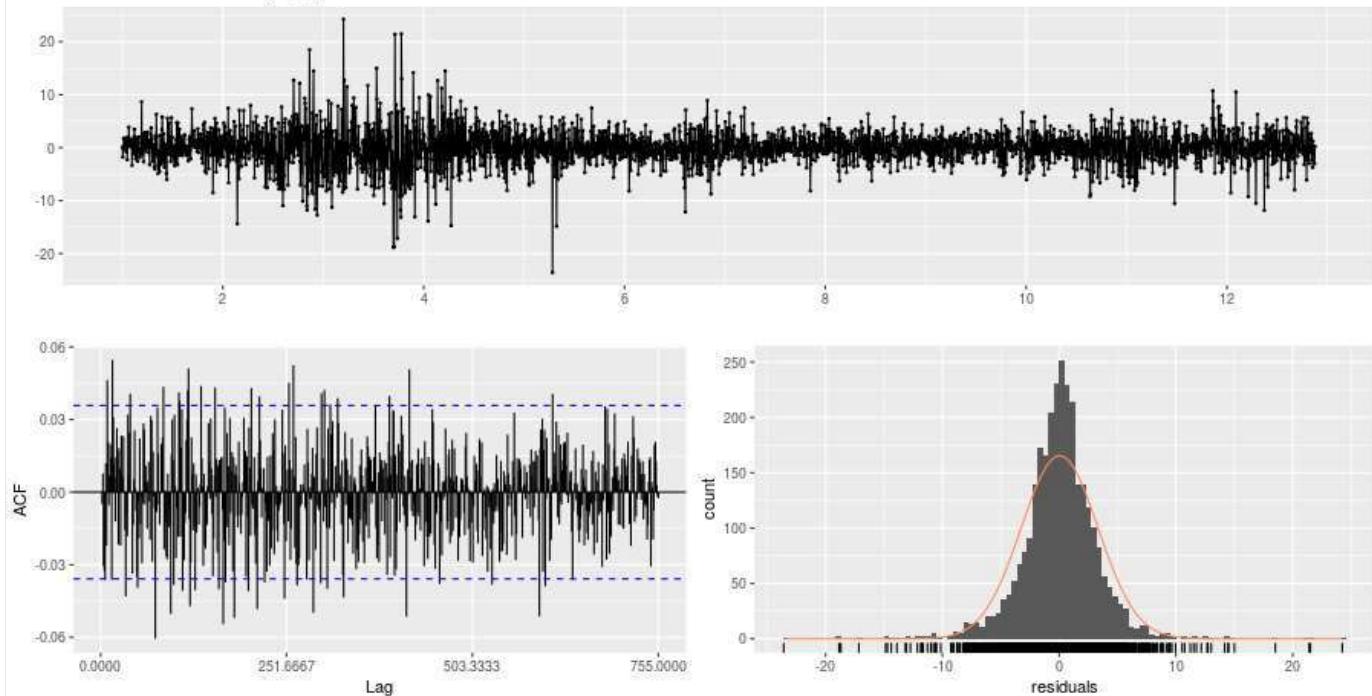
Residuals from ARIMA(0,1,1) with drift



**Decomposition of additive time series****Series xtsdiff1**

**Series xtsdiff1**

Residuals from ARIMA(0,1,1)



## Comments (0)



Click to comment. Be patient, be friendly, and focus on ideas. We are all here to learn and improve!