

Part two: Associative Analysis and Anomaly detection.

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3) Associative Analysis.

```
# Load libraries
#
library(data.table)
library(tibble)
library(tidyverse)

## -- Attaching packages ----- tidyverse 1.3.1 --

## v ggplot2 3.3.6      v dplyr  1.0.9
## v tidyr  1.2.0       v stringr 1.4.0
## v readr  2.1.2       v forcats 0.5.1
## v purrr  0.3.4

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::between()   masks data.table::between()
## x dplyr::filter()    masks stats::filter()
## x dplyr::first()     masks data.table::first()
## x dplyr::lag()       masks stats::lag()
## x dplyr::last()      masks data.table::last()
## x purrr::transpose() masks data.table::transpose()

library(corrplot)

## corrplot 0.92 loaded

library(ggplot2)
library(GGally)

## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg      ggplot2

library(moments)
library(plyr)

## -----
```

```

## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first, then dplyr:
## library(plyr); library(dplyr)

## -----

##
## Attaching package: 'plyr'

## The following objects are masked from 'package:dplyr':
##
##   arrange, count, desc, failwith, id, mutate, rename, summarise,
##   summarize

## The following object is masked from 'package:purrr':
##
##   compact

library(dplyr)
library(datasets)
library(MixGHD)

## Loading required package: MASS

##
## Attaching package: 'MASS'

## The following object is masked from 'package:dplyr':
##
##   select

library(devtools)

## Loading required package: usethis

library(ggbiplot)

## Loading required package: scales

##
## Attaching package: 'scales'

## The following object is masked from 'package:purrr':
##
##   discard

## The following object is masked from 'package:readr':
##
##   col_factor

## Loading required package: grid

```

```
library(arules)
```

```
## Loading required package: Matrix
```

```
##
```

```
## Attaching package: 'Matrix'
```

```
## The following objects are masked from 'package:tidyr':
```

```
##
```

```
##     expand, pack, unpack
```

```
##
```

```
## Attaching package: 'arules'
```

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

```
##
```

```
##     recode
```

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

```
##
```

```
##     abbreviate, write
```

```
library(anomalize)
```

```
## == Use anomalize to improve your Forecasts by 50%! =====  
## Business Science offers a 1-hour course - Lab #18: Time Series Anomaly Detection!  
## </> Learn more at: https://university.business-science.io/p/learning-labs-pro </>
```

```
library(tibbletime)
```

```
##
```

```
## Attaching package: 'tibbletime'
```

```
## The following object is masked from 'package:stats':
```

```
##
```

```
##     filter
```

```
library(purrr)
```

```
# load data set
```

```
#
```

```
data <- "http://bit.ly/SupermarketDatasetII"
```

```
transaction<-read.transactions(data, sep = ",",)
```

```
## Warning in asMethod(object): removing duplicated items in transactions
```

```
transaction
```

```
## transactions in sparse format with  
## 7501 transactions (rows) and  
## 119 items (columns)
```

```
# Checking the data class.  
#  
class(transaction)
```

```
## [1] "transactions"  
## attr(,"package")  
## [1] "arules"
```

```
# Previewing our first 5 transactions  
#  
inspect(transaction[1:5])
```

```
##      items  
## [1] {almonds,  
##      antioxydant juice,  
##      avocado,  
##      cottage cheese,  
##      energy drink,  
##      frozen smoothie,  
##      green grapes,  
##      green tea,  
##      honey,  
##      low fat yogurt,  
##      mineral water,  
##      olive oil,  
##      salad,  
##      salmon,  
##      shrimp,  
##      spinach,  
##      tomato juice,  
##      vegetables mix,  
##      whole weat flour,  
##      yams}  
## [2] {burgers,  
##      eggs,  
##      meatballs}  
## [3] {chutney}  
## [4] {avocado,  
##      turkey}  
## [5] {energy bar,  
##      green tea,  
##      milk,  
##      mineral water,  
##      whole wheat rice}
```

```
# checking the data summary
```

```
#
```

```
summary(transaction)
```

```
## transactions as itemMatrix in sparse format with
```

```
## 7501 rows (elements/itemsets/transactions) and
```

```
## 119 columns (items) and a density of 0.03288973
```

```
##
```

```
## most frequent items:
```

```
## mineral water      eggs      spaghetti french fries      chocolate
```

```
##           1788      1348          1306          1282          1229
```

```
##           (Other)
```

```
##           22405
```

```
##
```

```
## element (itemset/transaction) length distribution:
```

```
## sizes
```

```
##      1      2      3      4      5      6      7      8      9     10     11     12     13     14     15     16
```

```
## 1754 1358 1044  816  667  493  391  324  259  139  102   67   40   22   17    4
```

```
##      18     19     20
```

```
##       1      2      1
```

```
##
```

```
##      Min. 1st Qu.  Median      Mean 3rd Qu.      Max.
```

```
##      1.000   2.000   3.000   3.914   5.000  20.000
```

```
##
```

```
## includes extended item information - examples:
```

```
##           labels
```

```
## 1           almonds
```

```
## 2 antioxydant juice
```

```
## 3           asparagus
```

```
# creating a data frame
```

```
#
```

```
items<-as.data.frame(itemLabels(transaction))
```

```
colnames(items) <- "Item"
```

```
head(items, 10)
```

```
##           Item
```

```
## 1           almonds
```

```
## 2 antioxydant juice
```

```
## 3           asparagus
```

```
## 4           avocado
```

```
## 5           babies food
```

```
## 6           bacon
```

```
## 7           barbecue sauce
```

```
## 8           black tea
```

```
## 9           blueberries
```

```
## 10          body spray
```

```
# Exploring the frequency of some articles
```

```
#
```

```
itemFrequency(transaction[, 8:10],type = "absolute")
```

```
## black tea blueberries body spray
##      107          69          86
```

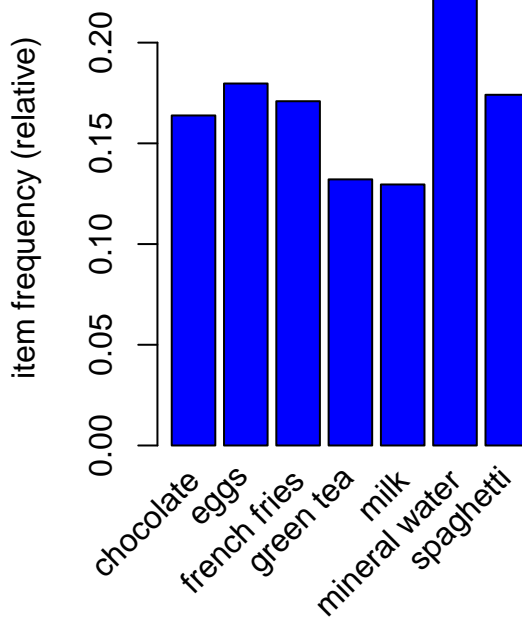
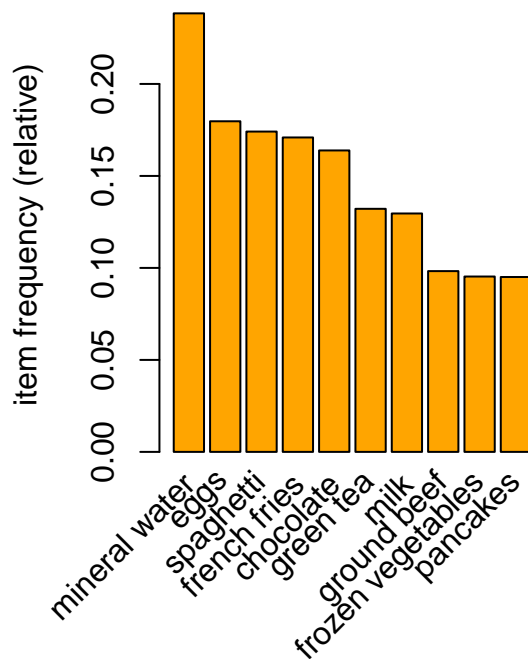
```
round(itemFrequency(transaction[, 8:10], type = "relative")*100,2)
```

```
## black tea blueberries body spray
##      1.43          0.92          1.15
```

```
# Displaying top 10 most common items in the data set
# and the items that have at least 10% importance
#
```

```
par(mfrow = c(1, 2))
```

```
itemFrequencyPlot(transaction, topN = 10, col="orange")
itemFrequencyPlot(transaction, support = 0.1, col="blue")
```



```
# Least popular items
```

```
#
```

```
least = itemFrequency(transaction, type = "absolute")
head(sort(least), 5)
```

```
## water spray    napkins    cream    bramble    tea
##           3         5         7         14         29
```

Implementing the solution with the apriori function.

```
# Building a model using the apriori function
#
rules <- apriori (transaction, parameter = list(supp = 0.001, conf = 0.8))

## Apriori
##
## Parameter specification:
## confidence minval smax arem aval originalSupport maxtime support minlen
##          0.8   0.1   1 none FALSE             TRUE     5   0.001     1
## maxlen target  ext
##          10  rules TRUE
##
## Algorithmic control:
## filter tree heap memopt load sort verbose
##    0.1 TRUE TRUE  FALSE TRUE    2    TRUE
##
## Absolute minimum support count: 7
##
## set item appearances ...[0 item(s)] done [0.00s].
## set transactions ...[119 item(s), 7501 transaction(s)] done [0.01s].
## sorting and recoding items ... [116 item(s)] done [0.00s].
## creating transaction tree ... done [0.00s].
## checking subsets of size 1 2 3 4 5 6 done [0.01s].
## writing ... [74 rule(s)] done [0.00s].
## creating S4 object ... done [0.00s].

rules

## set of 74 rules

# Summary of the model
#
summary(rules)

## set of 74 rules
##
## rule length distribution (lhs + rhs):sizes
##  3  4  5  6
## 15 42 16  1
##
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   3.000  4.000  4.000  4.041  4.000  6.000
##
## summary of quality measures:
##      support      confidence      coverage      lift
##   Min. :0.001067   Min. :0.8000   Min. :0.001067   Min. : 3.356
##   1st Qu.:0.001067   1st Qu.:0.8000   1st Qu.:0.001333   1st Qu.: 3.432
##   Median :0.001133   Median :0.8333   Median :0.001333   Median : 3.795
##   Mean  :0.001256   Mean  :0.8504   Mean  :0.001479   Mean  : 4.823
```

```
## 3rd Qu.:0.001333 3rd Qu.:0.8889 3rd Qu.:0.001600 3rd Qu.: 4.877
## Max. :0.002533 Max. :1.0000 Max. :0.002666 Max. :12.722
## count
## Min. : 8.000
## 1st Qu.: 8.000
## Median : 8.500
## Mean : 9.419
## 3rd Qu.:10.000
## Max. :19.000
##
## mining info:
## data ntransactions support confidence
## transaction 7501 0.001 0.8
##
## call
## apriori(data = transaction, parameter = list(supp = 0.001, conf = 0.8))
```

```
# Observing the first 5 model rules
#
inspect(rules[1:5])
```

```
## lhs rhs support confidence
## [1] {frozen smoothie, spinach} => {mineral water} 0.001066524 0.8888889
## [2] {bacon, pancakes} => {spaghetti} 0.001733102 0.8125000
## [3] {nonfat milk, turkey} => {mineral water} 0.001199840 0.8181818
## [4] {ground beef, nonfat milk} => {mineral water} 0.001599787 0.8571429
## [5] {mushroom cream sauce, pasta} => {escalope} 0.002532996 0.9500000
## coverage lift count
## [1] 0.001199840 3.729058 8
## [2] 0.002133049 4.666587 13
## [3] 0.001466471 3.432428 9
## [4] 0.001866418 3.595877 12
## [5] 0.002666311 11.976387 19
```

```
# Ordering these rules by level of confidence
#
rules<-sort(rules, by="confidence", decreasing=TRUE)
inspect(rules[1:5])
```

```
## lhs rhs support confidence coverage lift count
## [1] {french fries,
## mushroom cream sauce,
## pasta} => {escalope} 0.001066524 1.00 0.001066524 12.606723 8
## [2] {ground beef,
## light cream,
## olive oil} => {mineral water} 0.001199840 1.00 0.001199840 4.195190 9
## [3] {cake,
## meatballs,
## mineral water} => {milk} 0.001066524 1.00 0.001066524 7.717078 8
## [4] {cake,
## olive oil,
## shrimp} => {mineral water} 0.001199840 1.00 0.001199840 4.195190 9
## [5] {mushroom cream sauce,
## pasta} => {escalope} 0.002532996 0.95 0.002666311 11.976387 19
```



```
# Mineral water is one of the most popular items bought
# checking items that the customers bought before purchasing mineral water
# ---
#
water <- subset(rules, subset = rhs %pin% "mineral water")
water<-sort(water, by="confidence", decreasing=TRUE)
inspect(water[1:5])
```

##	lhs	rhs	support	confidence	coverage	lift	count
## [1]	{ground beef,						
##	light cream,						
##	olive oil}	=> {mineral water}	0.001199840	1.0000000	0.001199840	4.195190	9
## [2]	{cake,						
##	olive oil,						
##	shrimp}	=> {mineral water}	0.001199840	1.0000000	0.001199840	4.195190	9
## [3]	{red wine,						
##	soup}	=> {mineral water}	0.001866418	0.9333333	0.001999733	3.915511	14
## [4]	{ground beef,						
##	pancakes,						
##	whole wheat rice}	=> {mineral water}	0.001333156	0.9090909	0.001466471	3.813809	10
## [5]	{frozen vegetables,						
##	milk,						
##	spaghetti,						
##	turkey}	=> {mineral water}	0.001199840	0.9000000	0.001333156	3.775671	9

```
# determining what customers who already bought mineral water will buy
#
water <- subset(rules, subset = lhs %pin% "mineral water")
water<-sort(water, by="confidence", decreasing=TRUE)
inspect(water[1:5])
```

##	lhs	rhs	support
## [1]	{cake, meatballs, mineral water}	=> {milk}	0.001066524
## [2]	{eggs, mineral water, pasta}	=> {shrimp}	0.001333156
## [3]	{herb & pepper, mineral water, rice}	=> {ground beef}	0.001333156
## [4]	{light cream, mineral water, shrimp}	=> {spaghetti}	0.001066524
## [5]	{grated cheese, mineral water, rice}	=> {ground beef}	0.001066524

##	confidence	coverage	lift	count
## [1]	1.0000000	0.001066524	7.717078	8
## [2]	0.9090909	0.001466471	12.722185	10
## [3]	0.9090909	0.001466471	9.252498	10
## [4]	0.8888889	0.001199840	5.105326	8
## [5]	0.8888889	0.001199840	9.046887	8

Recommendation:

i) Of the top ten most popular goods, have offers for those that classify as price elastic goods, this will boost sales as they are sensitive to a change in price. This includes most of the lesser popular goods.

ii) For popular goods with complements, stock them next to each other e.g eggs would be bought together with bread and milk most of the time.

) Anomaly Detection.

Loading and Reading the Data.

```
# Load data
#
logs <- read.csv('http://bit.ly/CarreFourSalesDataset')
logs
```

##	Date	Sales
## 1	1/5/2019	548.9715
## 2	3/8/2019	80.2200
## 3	3/3/2019	340.5255
## 4	1/27/2019	489.0480
## 5	2/8/2019	634.3785
## 6	3/25/2019	627.6165
## 7	2/25/2019	433.6920
## 8	2/24/2019	772.3800
## 9	1/10/2019	76.1460
## 10	2/20/2019	172.7460
## 11	2/6/2019	60.8160
## 12	3/9/2019	107.1420
## 13	2/12/2019	246.4875
## 14	2/7/2019	453.4950
## 15	3/29/2019	749.4900
## 16	1/15/2019	590.4360
## 17	3/11/2019	506.6355
## 18	1/1/2019	457.4430
## 19	1/21/2019	172.2105
## 20	3/11/2019	84.6300
## 21	2/25/2019	451.7100
## 22	3/5/2019	277.1370
## 23	3/15/2019	69.7200
## 24	2/17/2019	181.4400
## 25	3/2/2019	279.1845
## 26	3/22/2019	441.7560
## 27	2/8/2019	35.1960
## 28	3/10/2019	184.1070
## 29	1/25/2019	463.8900
## 30	3/15/2019	235.2105
## 31	2/25/2019	494.1825
## 32	1/28/2019	737.7615
## 33	1/10/2019	703.7520
## 34	3/15/2019	202.8180
## 35	2/6/2019	417.5640
## 36	1/7/2019	71.5260
## 37	3/10/2019	328.7550
## 38	1/15/2019	575.3160
## 39	3/23/2019	461.3280
## 40	3/3/2019	253.0080

## 41	1/17/2019	91.0560
## 42	2/2/2019	117.8310
## 43	2/8/2019	435.4560
## 44	3/4/2019	829.0800
## 45	3/16/2019	32.2770
## 46	3/9/2019	394.6320
## 47	2/27/2019	535.7205
## 48	2/6/2019	189.0945
## 49	2/10/2019	119.2590
## 50	3/19/2019	867.6150
## 51	2/3/2019	671.7900
## 52	2/10/2019	234.0975
## 53	3/22/2019	75.0540
## 54	1/25/2019	16.2015
## 55	3/7/2019	33.9360
## 56	2/28/2019	722.2320
## 57	3/27/2019	93.1140
## 58	2/7/2019	752.6400
## 59	1/20/2019	759.6750
## 60	3/12/2019	192.8430
## 61	2/15/2019	77.9310
## 62	2/24/2019	351.0990
## 63	2/3/2019	520.4115
## 64	3/6/2019	166.0050
## 65	2/14/2019	318.1080
## 66	3/13/2019	166.6350
## 67	2/10/2019	70.2870
## 68	1/7/2019	614.9430
## 69	1/24/2019	827.0850
## 70	2/2/2019	19.2465
## 71	1/6/2019	939.5400
## 72	2/11/2019	652.2600
## 73	3/5/2019	152.8380
## 74	3/9/2019	478.2330
## 75	1/22/2019	705.6315
## 76	1/13/2019	437.3250
## 77	1/9/2019	463.4280
## 78	1/12/2019	189.0945
## 79	3/5/2019	822.2550
## 80	1/22/2019	106.9950
## 81	1/21/2019	624.8970
## 82	1/26/2019	304.5420
## 83	1/23/2019	161.7000
## 84	2/23/2019	337.5120
## 85	3/9/2019	256.7775
## 86	3/5/2019	610.4910
## 87	3/25/2019	401.7300
## 88	3/27/2019	362.9430
## 89	1/2/2019	44.5935
## 90	2/27/2019	485.0370
## 91	1/23/2019	198.9960
## 92	1/26/2019	471.0300
## 93	1/10/2019	161.5530
## 94	3/12/2019	608.2020

## 95	2/6/2019	94.2375
## 96	3/8/2019	102.0180
## 97	3/29/2019	922.6350
## 98	2/9/2019	78.4350
## 99	3/23/2019	166.1625
## 100	3/5/2019	521.0100
## 101	3/26/2019	51.1455
## 102	3/1/2019	742.2975
## 103	2/1/2019	218.0115
## 104	3/28/2019	367.0380
## 105	3/19/2019	223.0725
## 106	1/12/2019	931.0350
## 107	1/5/2019	172.4940
## 108	3/22/2019	391.4190
## 109	3/24/2019	321.1110
## 110	3/3/2019	860.6850
## 111	2/5/2019	34.6290
## 112	2/5/2019	309.3615
## 113	2/15/2019	535.3740
## 114	1/19/2019	548.7615
## 115	2/1/2019	763.4655
## 116	3/2/2019	85.1130
## 117	3/5/2019	115.1850
## 118	1/16/2019	53.9280
## 119	2/2/2019	115.0800
## 120	1/20/2019	112.2240
## 121	2/14/2019	836.3040
## 122	1/12/2019	419.8320
## 123	3/9/2019	944.6220
## 124	3/13/2019	536.8440
## 125	3/9/2019	474.3480
## 126	3/10/2019	688.6215
## 127	1/27/2019	169.3125
## 128	1/8/2019	299.8485
## 129	1/8/2019	575.7360
## 130	2/8/2019	853.1460
## 131	1/25/2019	291.2070
## 132	3/6/2019	580.4190
## 133	2/10/2019	146.3280
## 134	2/17/2019	550.9350
## 135	3/8/2019	512.1900
## 136	2/18/2019	284.1930
## 137	1/18/2019	138.1275
## 138	2/18/2019	216.8460
## 139	2/16/2019	545.0550
## 140	3/16/2019	609.0000
## 141	1/23/2019	942.9000
## 142	1/25/2019	950.2500
## 143	2/5/2019	720.3000
## 144	2/22/2019	31.9305
## 145	1/21/2019	491.0850
## 146	3/8/2019	291.4380
## 147	2/10/2019	316.4700
## 148	3/19/2019	277.7880

## 149	3/6/2019	603.6240
## 150	3/27/2019	272.6640
## 151	3/23/2019	384.4680
## 152	3/11/2019	254.0160
## 153	1/29/2019	786.6180
## 154	2/7/2019	103.8240
## 155	1/28/2019	680.1480
## 156	2/20/2019	484.5225
## 157	1/4/2019	75.7785
## 158	3/7/2019	263.9700
## 159	3/30/2019	918.7290
## 160	3/27/2019	588.3570
## 161	1/19/2019	362.7120
## 162	2/25/2019	66.8745
## 163	3/13/2019	336.5565
## 164	1/30/2019	160.4400
## 165	2/20/2019	418.9500
## 166	2/25/2019	357.5880
## 167	1/16/2019	1003.5900
## 168	2/8/2019	1039.2900
## 169	1/19/2019	323.0640
## 170	2/1/2019	510.9720
## 171	1/3/2019	367.5525
## 172	1/26/2019	420.2625
## 173	3/3/2019	175.1400
## 174	1/19/2019	333.2070
## 175	1/18/2019	166.2360
## 176	3/21/2019	319.7880
## 177	3/3/2019	186.2280
## 178	2/13/2019	165.4485
## 179	3/23/2019	465.4440
## 180	1/28/2019	273.4200
## 181	2/9/2019	472.3110
## 182	1/23/2019	323.1480
## 183	3/23/2019	162.7500
## 184	1/25/2019	288.2040
## 185	3/4/2019	90.6990
## 186	3/5/2019	56.9520
## 187	3/3/2019	793.7160
## 188	2/8/2019	195.1740
## 189	2/10/2019	77.7735
## 190	1/28/2019	293.2020
## 191	2/11/2019	242.6760
## 192	1/15/2019	154.3920
## 193	3/16/2019	829.7100
## 194	1/26/2019	107.3100
## 195	3/19/2019	171.7275
## 196	1/13/2019	78.0045
## 197	3/26/2019	91.7700
## 198	3/23/2019	26.5545
## 199	3/12/2019	174.3000
## 200	2/17/2019	374.7975
## 201	1/29/2019	120.6450
## 202	3/15/2019	241.4580

##	203	1/14/2019	451.3635
##	204	2/6/2019	271.9500
##	205	2/15/2019	93.2925
##	206	1/3/2019	217.6335
##	207	1/4/2019	629.8425
##	208	3/18/2019	299.5650
##	209	3/28/2019	95.6655
##	210	3/2/2019	942.4485
##	211	1/25/2019	247.8735
##	212	1/16/2019	881.3070
##	213	3/20/2019	484.8900
##	214	1/4/2019	146.2230
##	215	3/11/2019	217.6335
##	216	3/22/2019	19.1940
##	217	3/24/2019	130.0425
##	218	2/21/2019	298.1160
##	219	2/12/2019	796.9080
##	220	3/10/2019	180.6210
##	221	1/31/2019	285.7050
##	222	3/6/2019	456.2880
##	223	2/17/2019	62.0025
##	224	2/21/2019	13.1670
##	225	3/20/2019	90.8250
##	226	1/11/2019	183.0360
##	227	1/26/2019	655.5465
##	228	1/31/2019	155.6520
##	229	2/26/2019	571.4100
##	230	3/11/2019	532.7280
##	231	1/26/2019	170.8770
##	232	3/12/2019	33.3585
##	233	2/11/2019	794.6505
##	234	2/21/2019	310.0440
##	235	3/9/2019	545.3700
##	236	1/20/2019	195.5940
##	237	1/28/2019	91.4025
##	238	3/5/2019	232.1550
##	239	3/2/2019	69.4050
##	240	1/11/2019	94.1745
##	241	1/11/2019	235.6830
##	242	3/11/2019	125.5170
##	243	2/28/2019	195.7200
##	244	1/5/2019	263.1300
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##	246	1/1/2019	399.7560
##	247	2/9/2019	256.4100
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##	249	1/7/2019	326.4240
##	250	1/14/2019	536.9910
##	251	2/2/2019	439.8975
##	252	3/17/2019	369.4950
##	253	3/2/2019	30.2190
##	254	3/16/2019	99.7500
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##	256	1/29/2019	137.0040

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##	260	2/7/2019	276.9480
##	261	3/19/2019	709.3170
##	262	3/7/2019	69.0900
##	263	3/13/2019	160.8600
##	264	2/9/2019	233.5200
##	265	2/26/2019	57.1725
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##	310	3/5/2019	172.0110

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##	316	2/14/2019	208.6770
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##	327	3/9/2019	523.8450
##	328	3/12/2019	395.8920
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##	330	3/25/2019	152.7120
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##	335	3/24/2019	77.1750
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##	342	3/5/2019	411.3795
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##	353	3/14/2019	402.2655
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##	357	3/8/2019	394.2750
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##	360	3/16/2019	78.7185
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##	411	1/2/2019	359.2050
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##	413	1/4/2019	110.0925
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## 479	3/16/2019	360.8850
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## 482	2/15/2019	344.4000
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## 488	3/23/2019	156.0300
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## 505	2/25/2019	92.8725
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## 529	2/7/2019	570.7800
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## 543	2/13/2019	84.7560
## 544	1/28/2019	118.2510
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## 547	1/12/2019	308.9100
## 548	1/7/2019	575.9775
## 549	1/26/2019	270.5850
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## 553	2/5/2019	550.3680
## 554	3/7/2019	139.9230
## 555	3/25/2019	142.0020
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## 570	3/2/2019	543.7530
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## 586	3/9/2019	217.1820
## 587	3/27/2019	164.8710
## 588	2/4/2019	226.0650
## 589	3/14/2019	625.9050
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## 594	2/5/2019	236.8800
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## 597	2/15/2019	164.4300
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## 605	1/8/2019	381.3915
## 606	2/8/2019	133.3500
## 607	2/10/2019	394.3275
## 608	3/28/2019	209.1180
## 609	1/23/2019	32.1405
## 610	1/17/2019	121.5690
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## 614	1/19/2019	84.9765
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## 619	1/23/2019	620.7390
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## 623	1/17/2019	695.2365
## 624	1/12/2019	874.1250
## 625	2/16/2019	95.9175
## 626	1/26/2019	165.6480
## 627	3/9/2019	127.8270
## 628	3/14/2019	867.0900
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## 632	3/5/2019	246.6765
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## 634	3/18/2019	314.0550

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## 638	3/19/2019	48.5100
## 639	3/8/2019	92.5575
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## 642	3/19/2019	743.8200
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## 649	1/16/2019	32.5290
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## 654	3/6/2019	352.6740
## 655	2/16/2019	252.7560
## 656	3/14/2019	49.4235
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## 658	1/18/2019	277.6725
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## 660	2/26/2019	58.2225
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## 662	1/16/2019	125.9790
## 663	3/24/2019	370.1250
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## 667	2/20/2019	181.8810
## 668	2/23/2019	75.4740
## 669	2/16/2019	300.5730
## 670	1/17/2019	85.3020
## 671	1/14/2019	588.4200
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## 674	2/15/2019	282.5760
## 675	3/1/2019	477.5400
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## 677	2/19/2019	470.9880
## 678	2/23/2019	308.5740
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## 680	1/11/2019	305.5500
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## 682	1/14/2019	36.5505
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## 684	2/27/2019	45.1080
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## 686	1/8/2019	103.1100
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##	718	1/19/2019	37.6110
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##	722	1/18/2019	856.4535
##	723	3/18/2019	138.9780
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##	725	2/4/2019	98.0280
##	726	2/6/2019	239.4000
##	727	1/8/2019	175.0455
##	728	3/5/2019	732.2700
##	729	3/16/2019	408.4920
##	730	3/9/2019	383.5230
##	731	3/1/2019	93.7440
##	732	2/28/2019	176.4000
##	733	2/8/2019	20.6850
##	734	1/24/2019	557.7180
##	735	3/1/2019	56.4060
##	736	3/10/2019	860.4750
##	737	3/23/2019	596.8200
##	738	1/29/2019	616.9800
##	739	1/12/2019	769.1040
##	740	3/20/2019	887.9220
##	741	3/23/2019	408.7335
##	742	1/14/2019	89.0715

## 743	2/12/2019	150.4230
## 744	2/20/2019	79.1490
## 745	1/2/2019	266.0280
## 746	2/2/2019	40.3410
## 747	1/8/2019	684.9150
## 748	1/30/2019	55.2825
## 749	3/26/2019	116.1405
## 750	1/15/2019	597.0405
## 751	3/14/2019	93.7440
## 752	2/3/2019	143.2200
## 753	2/22/2019	182.9100
## 754	1/24/2019	384.7200
## 755	1/25/2019	267.3405
## 756	3/9/2019	817.2360
## 757	2/17/2019	300.2160
## 758	1/11/2019	608.0760
## 759	2/27/2019	197.9250
## 760	3/25/2019	232.6380
## 761	2/11/2019	810.6000
## 762	1/31/2019	757.3650
## 763	1/20/2019	536.5920
## 764	3/26/2019	56.1225
## 765	1/20/2019	233.1000
## 766	3/5/2019	801.8640
## 767	1/5/2019	239.5890
## 768	2/13/2019	86.2470
## 769	3/16/2019	401.6880
## 770	1/15/2019	72.0090
## 771	2/26/2019	401.2680
## 772	2/27/2019	631.1445
## 773	2/17/2019	499.7265
## 774	2/6/2019	55.0410
## 775	1/17/2019	137.8650
## 776	1/22/2019	151.5150
## 777	3/5/2019	480.0285
## 778	1/3/2019	98.0490
## 779	3/20/2019	132.5625
## 780	1/31/2019	830.3715
## 781	2/19/2019	183.1200
## 782	2/11/2019	397.9920
## 783	2/5/2019	32.1510
## 784	3/3/2019	369.6840
## 785	2/24/2019	53.3400
## 786	2/4/2019	548.1630
## 787	2/19/2019	603.8760
## 788	1/23/2019	57.6975
## 789	1/14/2019	190.4805
## 790	1/17/2019	432.9885
## 791	3/3/2019	48.7305
## 792	2/15/2019	287.9100
## 793	1/15/2019	1022.3850
## 794	2/27/2019	680.6100
## 795	2/26/2019	97.8810
## 796	3/15/2019	57.0780

## 797	1/24/2019	63.9135
## 798	2/22/2019	257.1450
## 799	3/15/2019	97.4190
## 800	2/11/2019	455.1225
## 801	1/12/2019	144.9630
## 802	3/3/2019	253.6800
## 803	3/23/2019	495.3165
## 804	3/4/2019	462.6720
## 805	2/23/2019	714.3255
## 806	3/17/2019	325.3740
## 807	1/16/2019	195.6780
## 808	1/8/2019	210.9660
## 809	1/14/2019	18.6375
## 810	1/31/2019	652.8900
## 811	3/15/2019	90.3000
## 812	2/24/2019	422.7300
## 813	2/8/2019	341.0925
## 814	3/22/2019	99.9075
## 815	1/24/2019	408.4080
## 816	3/14/2019	446.9640
## 817	1/23/2019	333.9840
## 818	1/19/2019	284.5920
## 819	1/27/2019	403.8720
## 820	2/3/2019	247.5900
## 821	3/25/2019	222.1380
## 822	2/24/2019	100.1280
## 823	2/7/2019	10.6785
## 824	3/4/2019	216.4365
## 825	2/14/2019	441.5880
## 826	1/29/2019	92.4420
## 827	1/28/2019	681.4395
## 828	3/26/2019	130.0320
## 829	3/24/2019	681.9750
## 830	1/1/2019	779.3100
## 831	1/24/2019	88.7040
## 832	2/25/2019	262.7940
## 833	1/9/2019	99.5400
## 834	2/14/2019	95.8650
## 835	3/12/2019	299.3655
## 836	3/26/2019	54.9990
## 837	1/9/2019	202.3350
## 838	1/2/2019	281.1690
## 839	1/15/2019	586.6350
## 840	1/1/2019	184.0860
## 841	2/15/2019	163.6110
## 842	2/28/2019	63.3150
## 843	3/2/2019	82.8870
## 844	2/13/2019	31.2270
## 845	1/26/2019	22.3860
## 846	1/30/2019	295.4070
## 847	1/27/2019	76.9230
## 848	1/30/2019	23.4990
## 849	1/8/2019	688.7160
## 850	1/19/2019	624.3300

##	851	1/25/2019	77.8050
##	852	2/19/2019	206.8080
##	853	1/14/2019	390.9465
##	854	2/25/2019	554.2950
##	855	1/23/2019	503.7375
##	856	2/16/2019	345.0195
##	857	1/1/2019	177.4080
##	858	3/7/2019	118.9020
##	859	2/15/2019	362.8170
##	860	1/23/2019	450.1035
##	861	2/20/2019	90.5835
##	862	1/8/2019	26.7960
##	863	3/17/2019	106.5960
##	864	1/12/2019	375.3645
##	865	1/8/2019	250.7085
##	866	1/26/2019	106.5015
##	867	3/15/2019	760.4520
##	868	1/17/2019	131.9220
##	869	1/8/2019	76.5765
##	870	1/6/2019	271.2780
##	871	2/16/2019	182.4270
##	872	3/13/2019	59.3250
##	873	1/28/2019	225.0150
##	874	1/18/2019	561.0780
##	875	3/19/2019	97.8180
##	876	3/15/2019	548.1840
##	877	2/12/2019	54.9675
##	878	2/25/2019	41.7375
##	879	3/21/2019	756.1680
##	880	1/19/2019	101.6400
##	881	1/8/2019	348.7050
##	882	3/30/2019	85.5120
##	883	2/20/2019	335.8950
##	884	3/30/2019	216.8460
##	885	3/19/2019	175.0140
##	886	1/13/2019	335.0130
##	887	2/5/2019	92.2950
##	888	3/23/2019	771.4350
##	889	3/13/2019	102.3960
##	890	3/17/2019	807.6600
##	891	2/21/2019	439.2150
##	892	2/7/2019	486.4440
##	893	3/2/2019	485.5725
##	894	3/6/2019	148.9950
##	895	2/6/2019	317.8350
##	896	1/28/2019	832.9440
##	897	1/18/2019	446.4390
##	898	2/5/2019	297.8010
##	899	3/2/2019	629.1600
##	900	2/9/2019	331.1280
##	901	1/14/2019	423.7380
##	902	2/9/2019	193.0740
##	903	3/26/2019	145.5825
##	904	1/28/2019	84.7455

##	905	2/14/2019	122.4720
##	906	3/24/2019	329.1960
##	907	2/9/2019	888.4050
##	908	3/24/2019	435.1200
##	909	3/27/2019	167.0340
##	910	1/27/2019	514.6050
##	911	3/27/2019	91.8225
##	912	1/19/2019	235.7460
##	913	2/7/2019	782.2080
##	914	1/31/2019	431.2560
##	915	2/25/2019	313.7400
##	916	2/2/2019	223.5870
##	917	3/14/2019	44.9925
##	918	3/11/2019	397.6140
##	919	2/22/2019	217.2555
##	920	3/2/2019	82.7190
##	921	3/10/2019	338.2155
##	922	2/8/2019	103.1310
##	923	2/22/2019	26.7330
##	924	1/10/2019	611.0790
##	925	3/14/2019	221.8860
##	926	1/10/2019	57.8760
##	927	2/15/2019	92.7255
##	928	1/13/2019	374.4090
##	929	2/15/2019	833.9625
##	930	3/2/2019	53.1510
##	931	3/24/2019	629.4960
##	932	2/2/2019	175.0350
##	933	2/27/2019	781.6200
##	934	1/20/2019	470.9880
##	935	1/3/2019	397.8450
##	936	1/24/2019	270.0180
##	937	1/5/2019	579.8415
##	938	3/30/2019	469.7700
##	939	2/17/2019	290.0835
##	940	3/21/2019	360.9270
##	941	3/2/2019	279.3840
##	942	3/27/2019	943.2990
##	943	1/19/2019	479.6400
##	944	2/19/2019	266.6475
##	945	3/28/2019	74.0880
##	946	1/5/2019	690.0180
##	947	3/26/2019	176.9250
##	948	2/3/2019	56.4690
##	949	2/6/2019	188.0025
##	950	2/24/2019	222.0120
##	951	2/21/2019	125.7165
##	952	1/9/2019	68.9850
##	953	2/25/2019	263.9700
##	954	1/13/2019	88.3680
##	955	2/9/2019	415.2330
##	956	1/6/2019	312.8895
##	957	1/10/2019	477.1305
##	958	2/7/2019	289.9260

```
## 959 1/9/2019 165.9000
## 960 2/19/2019 932.3370
## 961 3/18/2019 96.5790
## 962 2/5/2019 43.8690
## 963 3/19/2019 16.2750
## 964 3/30/2019 304.9830
## 965 1/26/2019 69.9930
## 966 3/2/2019 80.3670
## 967 3/4/2019 314.6850
## 968 1/13/2019 255.1815
## 969 3/25/2019 49.7700
## 970 3/11/2019 181.0725
## 971 1/1/2019 888.6150
## 972 2/10/2019 271.2885
## 973 1/26/2019 640.0380
## 974 2/11/2019 252.2520
## 975 2/7/2019 180.8730
## 976 3/6/2019 104.8320
## 977 3/4/2019 313.5720
## 978 2/26/2019 167.5800
## 979 3/10/2019 26.7225
## 980 2/4/2019 71.1585
## 981 1/19/2019 250.2780
## 982 1/23/2019 244.2300
## 983 3/14/2019 921.1860
## 984 1/23/2019 734.7060
## 985 1/9/2019 708.3195
## 986 2/7/2019 334.4775
## 987 2/18/2019 30.9960
## 988 1/3/2019 520.8000
## 989 3/29/2019 864.5700
## 990 1/28/2019 633.1080
## 991 3/22/2019 296.9400
## 992 1/24/2019 804.3000
## 993 3/10/2019 121.8630
## 994 2/22/2019 183.6450
## 995 2/18/2019 63.9975
## 996 1/29/2019 42.3675
## 997 3/2/2019 1022.4900
## 998 2/9/2019 33.4320
## 999 2/22/2019 69.1110
## 1000 2/18/2019 649.2990
```

```
# Checking the top and bottom of the data
#
head(logs)
```

```
##      Date    Sales
## 1 1/5/2019 548.9715
## 2 3/8/2019 80.2200
## 3 3/3/2019 340.5255
## 4 1/27/2019 489.0480
## 5 2/8/2019 634.3785
## 6 3/25/2019 627.6165
```

```
tail(logs)
```

```
##           Date      Sales
## 995 2/18/2019  63.9975
## 996 1/29/2019  42.3675
## 997 3/2/2019 1022.4900
## 998 2/9/2019  33.4320
## 999 2/22/2019  69.1110
## 1000 2/18/2019 649.2990
```

```
# checking the data types
```

```
#
```

```
glimpse(logs)
```

```
## Rows: 1,000
```

```
## Columns: 2
```

```
## $ Date <chr> "1/5/2019", "3/8/2019", "3/3/2019", "1/27/2019", "2/8/2019", "3/~
```

```
## $ Sales <dbl> 548.9715, 80.2200, 340.5255, 489.0480, 634.3785, 627.6165, 433.6~
```

data cleaning

```
# checking for duplicates
```

```
#
```

```
anyDuplicated(logs)
```

```
## [1] 0
```

```
# there are no duplicates in this data set
```

```
# checking for missing values
```

```
#
```

```
colSums(is.na(logs))
```

```
##   Date Sales
```

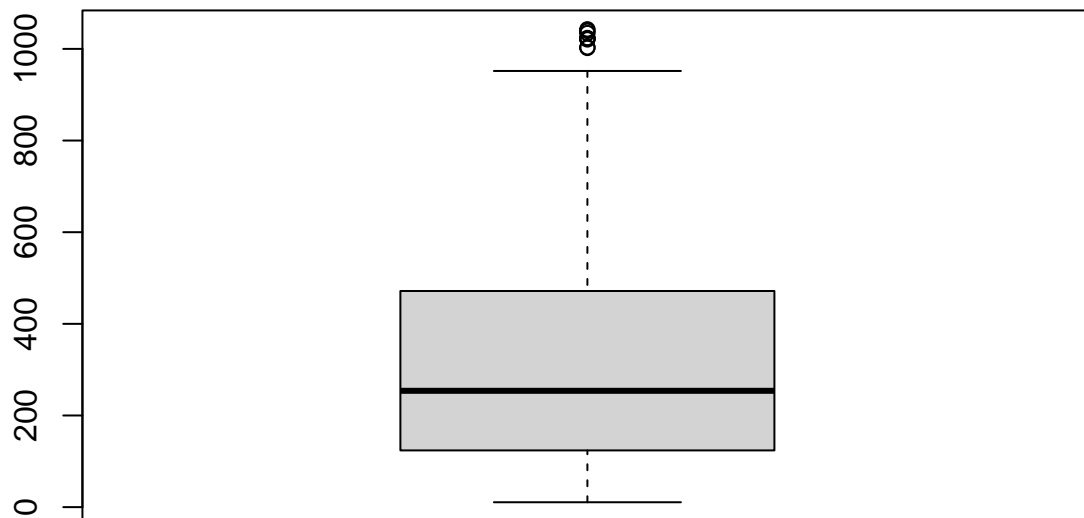
```
##    0      0
```

```
# there are no missing values in this data set.
```

```
# Checking for outliers using boxplots
```

```
#
```

```
boxplot(logs$Sales)
```



```
# the outliers will not be removed as they are important in this study.
```

```
# changing Date column to date object
#
logs <- read.csv('http://bit.ly/CarreFourSalesDataset')
logs
```

##	Date	Sales
## 1	1/5/2019	548.9715
## 2	3/8/2019	80.2200
## 3	3/3/2019	340.5255
## 4	1/27/2019	489.0480
## 5	2/8/2019	634.3785
## 6	3/25/2019	627.6165
## 7	2/25/2019	433.6920
## 8	2/24/2019	772.3800
## 9	1/10/2019	76.1460
## 10	2/20/2019	172.7460
## 11	2/6/2019	60.8160
## 12	3/9/2019	107.1420
## 13	2/12/2019	246.4875
## 14	2/7/2019	453.4950
## 15	3/29/2019	749.4900
## 16	1/15/2019	590.4360
## 17	3/11/2019	506.6355

## 18	1/1/2019	457.4430
## 19	1/21/2019	172.2105
## 20	3/11/2019	84.6300
## 21	2/25/2019	451.7100
## 22	3/5/2019	277.1370
## 23	3/15/2019	69.7200
## 24	2/17/2019	181.4400
## 25	3/2/2019	279.1845
## 26	3/22/2019	441.7560
## 27	2/8/2019	35.1960
## 28	3/10/2019	184.1070
## 29	1/25/2019	463.8900
## 30	3/15/2019	235.2105
## 31	2/25/2019	494.1825
## 32	1/28/2019	737.7615
## 33	1/10/2019	703.7520
## 34	3/15/2019	202.8180
## 35	2/6/2019	417.5640
## 36	1/7/2019	71.5260
## 37	3/10/2019	328.7550
## 38	1/15/2019	575.3160
## 39	3/23/2019	461.3280
## 40	3/3/2019	253.0080
## 41	1/17/2019	91.0560
## 42	2/2/2019	117.8310
## 43	2/8/2019	435.4560
## 44	3/4/2019	829.0800
## 45	3/16/2019	32.2770
## 46	3/9/2019	394.6320
## 47	2/27/2019	535.7205
## 48	2/6/2019	189.0945
## 49	2/10/2019	119.2590
## 50	3/19/2019	867.6150
## 51	2/3/2019	671.7900
## 52	2/10/2019	234.0975
## 53	3/22/2019	75.0540
## 54	1/25/2019	16.2015
## 55	3/7/2019	33.9360
## 56	2/28/2019	722.2320
## 57	3/27/2019	93.1140
## 58	2/7/2019	752.6400
## 59	1/20/2019	759.6750
## 60	3/12/2019	192.8430
## 61	2/15/2019	77.9310
## 62	2/24/2019	351.0990
## 63	2/3/2019	520.4115
## 64	3/6/2019	166.0050
## 65	2/14/2019	318.1080
## 66	3/13/2019	166.6350
## 67	2/10/2019	70.2870
## 68	1/7/2019	614.9430
## 69	1/24/2019	827.0850
## 70	2/2/2019	19.2465
## 71	1/6/2019	939.5400

## 72	2/11/2019	652.2600
## 73	3/5/2019	152.8380
## 74	3/9/2019	478.2330
## 75	1/22/2019	705.6315
## 76	1/13/2019	437.3250
## 77	1/9/2019	463.4280
## 78	1/12/2019	189.0945
## 79	3/5/2019	822.2550
## 80	1/22/2019	106.9950
## 81	1/21/2019	624.8970
## 82	1/26/2019	304.5420
## 83	1/23/2019	161.7000
## 84	2/23/2019	337.5120
## 85	3/9/2019	256.7775
## 86	3/5/2019	610.4910
## 87	3/25/2019	401.7300
## 88	3/27/2019	362.9430
## 89	1/2/2019	44.5935
## 90	2/27/2019	485.0370
## 91	1/23/2019	198.9960
## 92	1/26/2019	471.0300
## 93	1/10/2019	161.5530
## 94	3/12/2019	608.2020
## 95	2/6/2019	94.2375
## 96	3/8/2019	102.0180
## 97	3/29/2019	922.6350
## 98	2/9/2019	78.4350
## 99	3/23/2019	166.1625
## 100	3/5/2019	521.0100
## 101	3/26/2019	51.1455
## 102	3/1/2019	742.2975
## 103	2/1/2019	218.0115
## 104	3/28/2019	367.0380
## 105	3/19/2019	223.0725
## 106	1/12/2019	931.0350
## 107	1/5/2019	172.4940
## 108	3/22/2019	391.4190
## 109	3/24/2019	321.1110
## 110	3/3/2019	860.6850
## 111	2/5/2019	34.6290
## 112	2/5/2019	309.3615
## 113	2/15/2019	535.3740
## 114	1/19/2019	548.7615
## 115	2/1/2019	763.4655
## 116	3/2/2019	85.1130
## 117	3/5/2019	115.1850
## 118	1/16/2019	53.9280
## 119	2/2/2019	115.0800
## 120	1/20/2019	112.2240
## 121	2/14/2019	836.3040
## 122	1/12/2019	419.8320
## 123	3/9/2019	944.6220
## 124	3/13/2019	536.8440
## 125	3/9/2019	474.3480

## 126	3/10/2019	688.6215
## 127	1/27/2019	169.3125
## 128	1/8/2019	299.8485
## 129	1/8/2019	575.7360
## 130	2/8/2019	853.1460
## 131	1/25/2019	291.2070
## 132	3/6/2019	580.4190
## 133	2/10/2019	146.3280
## 134	2/17/2019	550.9350
## 135	3/8/2019	512.1900
## 136	2/18/2019	284.1930
## 137	1/18/2019	138.1275
## 138	2/18/2019	216.8460
## 139	2/16/2019	545.0550
## 140	3/16/2019	609.0000
## 141	1/23/2019	942.9000
## 142	1/25/2019	950.2500
## 143	2/5/2019	720.3000
## 144	2/22/2019	31.9305
## 145	1/21/2019	491.0850
## 146	3/8/2019	291.4380
## 147	2/10/2019	316.4700
## 148	3/19/2019	277.7880
## 149	3/6/2019	603.6240
## 150	3/27/2019	272.6640
## 151	3/23/2019	384.4680
## 152	3/11/2019	254.0160
## 153	1/29/2019	786.6180
## 154	2/7/2019	103.8240
## 155	1/28/2019	680.1480
## 156	2/20/2019	484.5225
## 157	1/4/2019	75.7785
## 158	3/7/2019	263.9700
## 159	3/30/2019	918.7290
## 160	3/27/2019	588.3570
## 161	1/19/2019	362.7120
## 162	2/25/2019	66.8745
## 163	3/13/2019	336.5565
## 164	1/30/2019	160.4400
## 165	2/20/2019	418.9500
## 166	2/25/2019	357.5880
## 167	1/16/2019	1003.5900
## 168	2/8/2019	1039.2900
## 169	1/19/2019	323.0640
## 170	2/1/2019	510.9720
## 171	1/3/2019	367.5525
## 172	1/26/2019	420.2625
## 173	3/3/2019	175.1400
## 174	1/19/2019	333.2070
## 175	1/18/2019	166.2360
## 176	3/21/2019	319.7880
## 177	3/3/2019	186.2280
## 178	2/13/2019	165.4485
## 179	3/23/2019	465.4440

## 180	1/28/2019	273.4200
## 181	2/9/2019	472.3110
## 182	1/23/2019	323.1480
## 183	3/23/2019	162.7500
## 184	1/25/2019	288.2040
## 185	3/4/2019	90.6990
## 186	3/5/2019	56.9520
## 187	3/3/2019	793.7160
## 188	2/8/2019	195.1740
## 189	2/10/2019	77.7735
## 190	1/28/2019	293.2020
## 191	2/11/2019	242.6760
## 192	1/15/2019	154.3920
## 193	3/16/2019	829.7100
## 194	1/26/2019	107.3100
## 195	3/19/2019	171.7275
## 196	1/13/2019	78.0045
## 197	3/26/2019	91.7700
## 198	3/23/2019	26.5545
## 199	3/12/2019	174.3000
## 200	2/17/2019	374.7975
## 201	1/29/2019	120.6450
## 202	3/15/2019	241.4580
## 203	1/14/2019	451.3635
## 204	2/6/2019	271.9500
## 205	2/15/2019	93.2925
## 206	1/3/2019	217.6335
## 207	1/4/2019	629.8425
## 208	3/18/2019	299.5650
## 209	3/28/2019	95.6655
## 210	3/2/2019	942.4485
## 211	1/25/2019	247.8735
## 212	1/16/2019	881.3070
## 213	3/20/2019	484.8900
## 214	1/4/2019	146.2230
## 215	3/11/2019	217.6335
## 216	3/22/2019	19.1940
## 217	3/24/2019	130.0425
## 218	2/21/2019	298.1160
## 219	2/12/2019	796.9080
## 220	3/10/2019	180.6210
## 221	1/31/2019	285.7050
## 222	3/6/2019	456.2880
## 223	2/17/2019	62.0025
## 224	2/21/2019	13.1670
## 225	3/20/2019	90.8250
## 226	1/11/2019	183.0360
## 227	1/26/2019	655.5465
## 228	1/31/2019	155.6520
## 229	2/26/2019	571.4100
## 230	3/11/2019	532.7280
## 231	1/26/2019	170.8770
## 232	3/12/2019	33.3585
## 233	2/11/2019	794.6505

##	234	2/21/2019	310.0440
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##	237	1/28/2019	91.4025
##	238	3/5/2019	232.1550
##	239	3/2/2019	69.4050
##	240	1/11/2019	94.1745
##	241	1/11/2019	235.6830
##	242	3/11/2019	125.5170
##	243	2/28/2019	195.7200
##	244	1/5/2019	263.1300
##	245	2/2/2019	788.5080
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##	247	2/9/2019	256.4100
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##	249	1/7/2019	326.4240
##	250	1/14/2019	536.9910
##	251	2/2/2019	439.8975
##	252	3/17/2019	369.4950
##	253	3/2/2019	30.2190
##	254	3/16/2019	99.7500
##	255	1/6/2019	494.7600
##	256	1/29/2019	137.0040
##	257	1/31/2019	69.6675
##	258	2/5/2019	163.2330
##	259	2/13/2019	135.4500
##	260	2/7/2019	276.9480
##	261	3/19/2019	709.3170
##	262	3/7/2019	69.0900
##	263	3/13/2019	160.8600
##	264	2/9/2019	233.5200
##	265	2/26/2019	57.1725
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##	269	1/5/2019	297.1080
##	270	1/4/2019	373.1700
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##	272	1/3/2019	44.3520
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##	276	1/7/2019	352.5795
##	277	1/7/2019	229.1100
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##	308	2/17/2019	745.8360
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##	314	3/7/2019	146.9475
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## 357	3/8/2019	394.2750
## 358	1/9/2019	1002.1200
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## 360	3/16/2019	78.7185
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## 363	3/7/2019	209.5590
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##	413	1/4/2019	110.0925
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## 459	1/27/2019	488.9850
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## 465	3/28/2019	269.5350
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## 467	2/8/2019	273.0525
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## 470	2/15/2019	103.7820
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## 478	3/7/2019	353.0940
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## 517	3/29/2019	288.0150
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## 529	2/7/2019	570.7800
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##	608	3/28/2019	209.1180
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## 625	2/16/2019	95.9175
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## 634	3/18/2019	314.0550
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## 636	1/15/2019	697.9350
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## 639	3/8/2019	92.5575
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## 674	2/15/2019	282.5760
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## 677	2/19/2019	470.9880
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## 684	2/27/2019	45.1080
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## 686	1/8/2019	103.1100
## 687	1/8/2019	136.1430
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## 725	2/4/2019	98.0280
## 726	2/6/2019	239.4000
## 727	1/8/2019	175.0455
## 728	3/5/2019	732.2700
## 729	3/16/2019	408.4920
## 730	3/9/2019	383.5230
## 731	3/1/2019	93.7440
## 732	2/28/2019	176.4000
## 733	2/8/2019	20.6850
## 734	1/24/2019	557.7180
## 735	3/1/2019	56.4060
## 736	3/10/2019	860.4750
## 737	3/23/2019	596.8200
## 738	1/29/2019	616.9800
## 739	1/12/2019	769.1040
## 740	3/20/2019	887.9220
## 741	3/23/2019	408.7335
## 742	1/14/2019	89.0715
## 743	2/12/2019	150.4230
## 744	2/20/2019	79.1490
## 745	1/2/2019	266.0280
## 746	2/2/2019	40.3410
## 747	1/8/2019	684.9150
## 748	1/30/2019	55.2825
## 749	3/26/2019	116.1405
## 750	1/15/2019	597.0405
## 751	3/14/2019	93.7440
## 752	2/3/2019	143.2200
## 753	2/22/2019	182.9100
## 754	1/24/2019	384.7200
## 755	1/25/2019	267.3405
## 756	3/9/2019	817.2360
## 757	2/17/2019	300.2160
## 758	1/11/2019	608.0760
## 759	2/27/2019	197.9250
## 760	3/25/2019	232.6380
## 761	2/11/2019	810.6000
## 762	1/31/2019	757.3650
## 763	1/20/2019	536.5920
## 764	3/26/2019	56.1225
## 765	1/20/2019	233.1000
## 766	3/5/2019	801.8640
## 767	1/5/2019	239.5890
## 768	2/13/2019	86.2470
## 769	3/16/2019	401.6880
## 770	1/15/2019	72.0090
## 771	2/26/2019	401.2680
## 772	2/27/2019	631.1445
## 773	2/17/2019	499.7265

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## 776	1/22/2019	151.5150
## 777	3/5/2019	480.0285
## 778	1/3/2019	98.0490
## 779	3/20/2019	132.5625
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## 782	2/11/2019	397.9920
## 783	2/5/2019	32.1510
## 784	3/3/2019	369.6840
## 785	2/24/2019	53.3400
## 786	2/4/2019	548.1630
## 787	2/19/2019	603.8760
## 788	1/23/2019	57.6975
## 789	1/14/2019	190.4805
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## 795	2/26/2019	97.8810
## 796	3/15/2019	57.0780
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## 800	2/11/2019	455.1225
## 801	1/12/2019	144.9630
## 802	3/3/2019	253.6800
## 803	3/23/2019	495.3165
## 804	3/4/2019	462.6720
## 805	2/23/2019	714.3255
## 806	3/17/2019	325.3740
## 807	1/16/2019	195.6780
## 808	1/8/2019	210.9660
## 809	1/14/2019	18.6375
## 810	1/31/2019	652.8900
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## 812	2/24/2019	422.7300
## 813	2/8/2019	341.0925
## 814	3/22/2019	99.9075
## 815	1/24/2019	408.4080
## 816	3/14/2019	446.9640
## 817	1/23/2019	333.9840
## 818	1/19/2019	284.5920
## 819	1/27/2019	403.8720
## 820	2/3/2019	247.5900
## 821	3/25/2019	222.1380
## 822	2/24/2019	100.1280
## 823	2/7/2019	10.6785
## 824	3/4/2019	216.4365
## 825	2/14/2019	441.5880
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## 827	1/28/2019	681.4395

## 828	3/26/2019	130.0320
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## 832	2/25/2019	262.7940
## 833	1/9/2019	99.5400
## 834	2/14/2019	95.8650
## 835	3/12/2019	299.3655
## 836	3/26/2019	54.9990
## 837	1/9/2019	202.3350
## 838	1/2/2019	281.1690
## 839	1/15/2019	586.6350
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## 842	2/28/2019	63.3150
## 843	3/2/2019	82.8870
## 844	2/13/2019	31.2270
## 845	1/26/2019	22.3860
## 846	1/30/2019	295.4070
## 847	1/27/2019	76.9230
## 848	1/30/2019	23.4990
## 849	1/8/2019	688.7160
## 850	1/19/2019	624.3300
## 851	1/25/2019	77.8050
## 852	2/19/2019	206.8080
## 853	1/14/2019	390.9465
## 854	2/25/2019	554.2950
## 855	1/23/2019	503.7375
## 856	2/16/2019	345.0195
## 857	1/1/2019	177.4080
## 858	3/7/2019	118.9020
## 859	2/15/2019	362.8170
## 860	1/23/2019	450.1035
## 861	2/20/2019	90.5835
## 862	1/8/2019	26.7960
## 863	3/17/2019	106.5960
## 864	1/12/2019	375.3645
## 865	1/8/2019	250.7085
## 866	1/26/2019	106.5015
## 867	3/15/2019	760.4520
## 868	1/17/2019	131.9220
## 869	1/8/2019	76.5765
## 870	1/6/2019	271.2780
## 871	2/16/2019	182.4270
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## 876	3/15/2019	548.1840
## 877	2/12/2019	54.9675
## 878	2/25/2019	41.7375
## 879	3/21/2019	756.1680
## 880	1/19/2019	101.6400
## 881	1/8/2019	348.7050

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##	884	3/30/2019	216.8460
##	885	3/19/2019	175.0140
##	886	1/13/2019	335.0130
##	887	2/5/2019	92.2950
##	888	3/23/2019	771.4350
##	889	3/13/2019	102.3960
##	890	3/17/2019	807.6600
##	891	2/21/2019	439.2150
##	892	2/7/2019	486.4440
##	893	3/2/2019	485.5725
##	894	3/6/2019	148.9950
##	895	2/6/2019	317.8350
##	896	1/28/2019	832.9440
##	897	1/18/2019	446.4390
##	898	2/5/2019	297.8010
##	899	3/2/2019	629.1600
##	900	2/9/2019	331.1280
##	901	1/14/2019	423.7380
##	902	2/9/2019	193.0740
##	903	3/26/2019	145.5825
##	904	1/28/2019	84.7455
##	905	2/14/2019	122.4720
##	906	3/24/2019	329.1960
##	907	2/9/2019	888.4050
##	908	3/24/2019	435.1200
##	909	3/27/2019	167.0340
##	910	1/27/2019	514.6050
##	911	3/27/2019	91.8225
##	912	1/19/2019	235.7460
##	913	2/7/2019	782.2080
##	914	1/31/2019	431.2560
##	915	2/25/2019	313.7400
##	916	2/2/2019	223.5870
##	917	3/14/2019	44.9925
##	918	3/11/2019	397.6140
##	919	2/22/2019	217.2555
##	920	3/2/2019	82.7190
##	921	3/10/2019	338.2155
##	922	2/8/2019	103.1310
##	923	2/22/2019	26.7330
##	924	1/10/2019	611.0790
##	925	3/14/2019	221.8860
##	926	1/10/2019	57.8760
##	927	2/15/2019	92.7255
##	928	1/13/2019	374.4090
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##	930	3/2/2019	53.1510
##	931	3/24/2019	629.4960
##	932	2/2/2019	175.0350
##	933	2/27/2019	781.6200
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##	935	1/3/2019	397.8450

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##	937	1/5/2019	579.8415
##	938	3/30/2019	469.7700
##	939	2/17/2019	290.0835
##	940	3/21/2019	360.9270
##	941	3/2/2019	279.3840
##	942	3/27/2019	943.2990
##	943	1/19/2019	479.6400
##	944	2/19/2019	266.6475
##	945	3/28/2019	74.0880
##	946	1/5/2019	690.0180
##	947	3/26/2019	176.9250
##	948	2/3/2019	56.4690
##	949	2/6/2019	188.0025
##	950	2/24/2019	222.0120
##	951	2/21/2019	125.7165
##	952	1/9/2019	68.9850
##	953	2/25/2019	263.9700
##	954	1/13/2019	88.3680
##	955	2/9/2019	415.2330
##	956	1/6/2019	312.8895
##	957	1/10/2019	477.1305
##	958	2/7/2019	289.9260
##	959	1/9/2019	165.9000
##	960	2/19/2019	932.3370
##	961	3/18/2019	96.5790
##	962	2/5/2019	43.8690
##	963	3/19/2019	16.2750
##	964	3/30/2019	304.9830
##	965	1/26/2019	69.9930
##	966	3/2/2019	80.3670
##	967	3/4/2019	314.6850
##	968	1/13/2019	255.1815
##	969	3/25/2019	49.7700
##	970	3/11/2019	181.0725
##	971	1/1/2019	888.6150
##	972	2/10/2019	271.2885
##	973	1/26/2019	640.0380
##	974	2/11/2019	252.2520
##	975	2/7/2019	180.8730
##	976	3/6/2019	104.8320
##	977	3/4/2019	313.5720
##	978	2/26/2019	167.5800
##	979	3/10/2019	26.7225
##	980	2/4/2019	71.1585
##	981	1/19/2019	250.2780
##	982	1/23/2019	244.2300
##	983	3/14/2019	921.1860
##	984	1/23/2019	734.7060
##	985	1/9/2019	708.3195
##	986	2/7/2019	334.4775
##	987	2/18/2019	30.9960
##	988	1/3/2019	520.8000
##	989	3/29/2019	864.5700


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## 990 1/28/2019 633.1080
## 991 3/22/2019 296.9400
## 992 1/24/2019 804.3000
## 993 3/10/2019 121.8630
## 994 2/22/2019 183.6450
## 995 2/18/2019 63.9975
## 996 1/29/2019 42.3675
## 997 3/2/2019 1022.4900
## 998 2/9/2019 33.4320
## 999 2/22/2019 69.1110
## 1000 2/18/2019 649.2990
```

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logs
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## 3	2019-03-03	340.5255
## 4	2019-01-27	489.0480
## 5	2019-02-08	634.3785
## 6	2019-03-25	627.6165
## 7	2019-02-25	433.6920
## 8	2019-02-24	772.3800
## 9	2019-01-10	76.1460
## 10	2019-02-20	172.7460
## 11	2019-02-06	60.8160
## 12	2019-03-09	107.1420
## 13	2019-02-12	246.4875
## 14	2019-02-07	453.4950
## 15	2019-03-29	749.4900
## 16	2019-01-15	590.4360
## 17	2019-03-11	506.6355
## 18	2019-01-01	457.4430
## 19	2019-01-21	172.2105
## 20	2019-03-11	84.6300
## 21	2019-02-25	451.7100
## 22	2019-03-05	277.1370
## 23	2019-03-15	69.7200
## 24	2019-02-17	181.4400
## 25	2019-03-02	279.1845
## 26	2019-03-22	441.7560
## 27	2019-02-08	35.1960
## 28	2019-03-10	184.1070
## 29	2019-01-25	463.8900
## 30	2019-03-15	235.2105
## 31	2019-02-25	494.1825
## 32	2019-01-28	737.7615
## 33	2019-01-10	703.7520
## 34	2019-03-15	202.8180
## 35	2019-02-06	417.5640
## 36	2019-01-07	71.5260
## 37	2019-03-10	328.7550
## 38	2019-01-15	575.3160

## 39	2019-03-23	461.3280
## 40	2019-03-03	253.0080
## 41	2019-01-17	91.0560
## 42	2019-02-02	117.8310
## 43	2019-02-08	435.4560
## 44	2019-03-04	829.0800
## 45	2019-03-16	32.2770
## 46	2019-03-09	394.6320
## 47	2019-02-27	535.7205
## 48	2019-02-06	189.0945
## 49	2019-02-10	119.2590
## 50	2019-03-19	867.6150
## 51	2019-02-03	671.7900
## 52	2019-02-10	234.0975
## 53	2019-03-22	75.0540
## 54	2019-01-25	16.2015
## 55	2019-03-07	33.9360
## 56	2019-02-28	722.2320
## 57	2019-03-27	93.1140
## 58	2019-02-07	752.6400
## 59	2019-01-20	759.6750
## 60	2019-03-12	192.8430
## 61	2019-02-15	77.9310
## 62	2019-02-24	351.0990
## 63	2019-02-03	520.4115
## 64	2019-03-06	166.0050
## 65	2019-02-14	318.1080
## 66	2019-03-13	166.6350
## 67	2019-02-10	70.2870
## 68	2019-01-07	614.9430
## 69	2019-01-24	827.0850
## 70	2019-02-02	19.2465
## 71	2019-01-06	939.5400
## 72	2019-02-11	652.2600
## 73	2019-03-05	152.8380
## 74	2019-03-09	478.2330
## 75	2019-01-22	705.6315
## 76	2019-01-13	437.3250
## 77	2019-01-09	463.4280
## 78	2019-01-12	189.0945
## 79	2019-03-05	822.2550
## 80	2019-01-22	106.9950
## 81	2019-01-21	624.8970
## 82	2019-01-26	304.5420
## 83	2019-01-23	161.7000
## 84	2019-02-23	337.5120
## 85	2019-03-09	256.7775
## 86	2019-03-05	610.4910
## 87	2019-03-25	401.7300
## 88	2019-03-27	362.9430
## 89	2019-01-02	44.5935
## 90	2019-02-27	485.0370
## 91	2019-01-23	198.9960
## 92	2019-01-26	471.0300

## 93	2019-01-10	161.5530
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## 96	2019-03-08	102.0180
## 97	2019-03-29	922.6350
## 98	2019-02-09	78.4350
## 99	2019-03-23	166.1625
## 100	2019-03-05	521.0100
## 101	2019-03-26	51.1455
## 102	2019-03-01	742.2975
## 103	2019-02-01	218.0115
## 104	2019-03-28	367.0380
## 105	2019-03-19	223.0725
## 106	2019-01-12	931.0350
## 107	2019-01-05	172.4940
## 108	2019-03-22	391.4190
## 109	2019-03-24	321.1110
## 110	2019-03-03	860.6850
## 111	2019-02-05	34.6290
## 112	2019-02-05	309.3615
## 113	2019-02-15	535.3740
## 114	2019-01-19	548.7615
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## 116	2019-03-02	85.1130
## 117	2019-03-05	115.1850
## 118	2019-01-16	53.9280
## 119	2019-02-02	115.0800
## 120	2019-01-20	112.2240
## 121	2019-02-14	836.3040
## 122	2019-01-12	419.8320
## 123	2019-03-09	944.6220
## 124	2019-03-13	536.8440
## 125	2019-03-09	474.3480
## 126	2019-03-10	688.6215
## 127	2019-01-27	169.3125
## 128	2019-01-08	299.8485
## 129	2019-01-08	575.7360
## 130	2019-02-08	853.1460
## 131	2019-01-25	291.2070
## 132	2019-03-06	580.4190
## 133	2019-02-10	146.3280
## 134	2019-02-17	550.9350
## 135	2019-03-08	512.1900
## 136	2019-02-18	284.1930
## 137	2019-01-18	138.1275
## 138	2019-02-18	216.8460
## 139	2019-02-16	545.0550
## 140	2019-03-16	609.0000
## 141	2019-01-23	942.9000
## 142	2019-01-25	950.2500
## 143	2019-02-05	720.3000
## 144	2019-02-22	31.9305
## 145	2019-01-21	491.0850
## 146	2019-03-08	291.4380

##	147	2019-02-10	316.4700
##	148	2019-03-19	277.7880
##	149	2019-03-06	603.6240
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##	151	2019-03-23	384.4680
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##	153	2019-01-29	786.6180
##	154	2019-02-07	103.8240
##	155	2019-01-28	680.1480
##	156	2019-02-20	484.5225
##	157	2019-01-04	75.7785
##	158	2019-03-07	263.9700
##	159	2019-03-30	918.7290
##	160	2019-03-27	588.3570
##	161	2019-01-19	362.7120
##	162	2019-02-25	66.8745
##	163	2019-03-13	336.5565
##	164	2019-01-30	160.4400
##	165	2019-02-20	418.9500
##	166	2019-02-25	357.5880
##	167	2019-01-16	1003.5900
##	168	2019-02-08	1039.2900
##	169	2019-01-19	323.0640
##	170	2019-02-01	510.9720
##	171	2019-01-03	367.5525
##	172	2019-01-26	420.2625
##	173	2019-03-03	175.1400
##	174	2019-01-19	333.2070
##	175	2019-01-18	166.2360
##	176	2019-03-21	319.7880
##	177	2019-03-03	186.2280
##	178	2019-02-13	165.4485
##	179	2019-03-23	465.4440
##	180	2019-01-28	273.4200
##	181	2019-02-09	472.3110
##	182	2019-01-23	323.1480
##	183	2019-03-23	162.7500
##	184	2019-01-25	288.2040
##	185	2019-03-04	90.6990
##	186	2019-03-05	56.9520
##	187	2019-03-03	793.7160
##	188	2019-02-08	195.1740
##	189	2019-02-10	77.7735
##	190	2019-01-28	293.2020
##	191	2019-02-11	242.6760
##	192	2019-01-15	154.3920
##	193	2019-03-16	829.7100
##	194	2019-01-26	107.3100
##	195	2019-03-19	171.7275
##	196	2019-01-13	78.0045
##	197	2019-03-26	91.7700
##	198	2019-03-23	26.5545
##	199	2019-03-12	174.3000
##	200	2019-02-17	374.7975

##	201	2019-01-29	120.6450
##	202	2019-03-15	241.4580
##	203	2019-01-14	451.3635
##	204	2019-02-06	271.9500
##	205	2019-02-15	93.2925
##	206	2019-01-03	217.6335
##	207	2019-01-04	629.8425
##	208	2019-03-18	299.5650
##	209	2019-03-28	95.6655
##	210	2019-03-02	942.4485
##	211	2019-01-25	247.8735
##	212	2019-01-16	881.3070
##	213	2019-03-20	484.8900
##	214	2019-01-04	146.2230
##	215	2019-03-11	217.6335
##	216	2019-03-22	19.1940
##	217	2019-03-24	130.0425
##	218	2019-02-21	298.1160
##	219	2019-02-12	796.9080
##	220	2019-03-10	180.6210
##	221	2019-01-31	285.7050
##	222	2019-03-06	456.2880
##	223	2019-02-17	62.0025
##	224	2019-02-21	13.1670
##	225	2019-03-20	90.8250
##	226	2019-01-11	183.0360
##	227	2019-01-26	655.5465
##	228	2019-01-31	155.6520
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##	230	2019-03-11	532.7280
##	231	2019-01-26	170.8770
##	232	2019-03-12	33.3585
##	233	2019-02-11	794.6505
##	234	2019-02-21	310.0440
##	235	2019-03-09	545.3700
##	236	2019-01-20	195.5940
##	237	2019-01-28	91.4025
##	238	2019-03-05	232.1550
##	239	2019-03-02	69.4050
##	240	2019-01-11	94.1745
##	241	2019-01-11	235.6830
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##	244	2019-01-05	263.1300
##	245	2019-02-02	788.5080
##	246	2019-01-01	399.7560
##	247	2019-02-09	256.4100
##	248	2019-01-23	94.1850
##	249	2019-01-07	326.4240
##	250	2019-01-14	536.9910
##	251	2019-02-02	439.8975
##	252	2019-03-17	369.4950
##	253	2019-03-02	30.2190
##	254	2019-03-16	99.7500

##	255	2019-01-06	494.7600
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##	257	2019-01-31	69.6675
##	258	2019-02-05	163.2330
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##	261	2019-03-19	709.3170
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##	265	2019-02-26	57.1725
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##	269	2019-01-05	297.1080
##	270	2019-01-04	373.1700
##	271	2019-03-06	354.0075
##	272	2019-01-03	44.3520
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##	276	2019-01-07	352.5795
##	277	2019-01-07	229.1100
##	278	2019-02-02	400.7640
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##	280	2019-03-20	462.2100
##	281	2019-02-15	587.6640
##	282	2019-03-06	38.8500
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##	284	2019-03-04	628.9290
##	285	2019-03-12	200.2140
##	286	2019-02-20	350.0700
##	287	2019-03-24	78.6030
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##	290	2019-02-03	697.3680
##	291	2019-01-24	423.1500
##	292	2019-03-14	204.6975
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##	294	2019-01-21	76.3560
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##	301	2019-01-02	209.6220
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##	303	2019-02-25	51.0405
##	304	2019-03-18	214.9980
##	305	2019-02-23	125.6640
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##	312	2019-02-05	145.5930
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##	314	2019-03-07	146.9475
##	315	2019-02-10	820.3650
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##	326	2019-03-12	410.5080
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##	330	2019-03-25	152.7120
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##	332	2019-02-17	103.6350
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##	350	2019-02-27	141.7500
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##	353	2019-03-14	402.2655
##	354	2019-03-02	255.1500
##	355	2019-03-04	31.7520
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##	357	2019-03-08	394.2750
##	358	2019-01-09	1002.1200
##	359	2019-03-01	86.6250
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##	377	2019-01-05	334.3410
##	378	2019-02-22	701.8515
##	379	2019-02-06	407.3160
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##	382	2019-03-19	55.8810
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##	385	2019-01-06	214.9350
##	386	2019-01-31	79.6110
##	387	2019-03-11	294.6510
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##	391	2019-02-15	253.5120
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##	405	2019-02-16	718.7565
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##	408	2019-01-04	288.5820
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##	410	2019-01-28	125.0550
##	411	2019-01-02	359.2050
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##	413	2019-01-04	110.0925
##	414	2019-03-10	81.3960
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##	437	2019-01-20	348.3060
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##	439	2019-03-08	71.5680
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##	467	2019-02-08	273.0525
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##	505	2019-02-25	92.8725
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##	517	2019-03-29	288.0150
##	518	2019-01-22	206.7975
##	519	2019-03-01	72.9330
##	520	2019-01-17	377.5800
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##	584	2019-01-14	75.9360
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##	600	2019-03-24	147.6720
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##	603	2019-03-14	814.3800
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##	724	2019-01-11	270.2595
##	725	2019-02-04	98.0280
##	726	2019-02-06	239.4000
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##	748	2019-01-30	55.2825
##	749	2019-03-26	116.1405
##	750	2019-01-15	597.0405
##	751	2019-03-14	93.7440
##	752	2019-02-03	143.2200
##	753	2019-02-22	182.9100
##	754	2019-01-24	384.7200
##	755	2019-01-25	267.3405
##	756	2019-03-09	817.2360
##	757	2019-02-17	300.2160
##	758	2019-01-11	608.0760
##	759	2019-02-27	197.9250
##	760	2019-03-25	232.6380
##	761	2019-02-11	810.6000
##	762	2019-01-31	757.3650
##	763	2019-01-20	536.5920
##	764	2019-03-26	56.1225
##	765	2019-01-20	233.1000
##	766	2019-03-05	801.8640
##	767	2019-01-05	239.5890
##	768	2019-02-13	86.2470
##	769	2019-03-16	401.6880
##	770	2019-01-15	72.0090
##	771	2019-02-26	401.2680
##	772	2019-02-27	631.1445
##	773	2019-02-17	499.7265
##	774	2019-02-06	55.0410
##	775	2019-01-17	137.8650
##	776	2019-01-22	151.5150
##	777	2019-03-05	480.0285
##	778	2019-01-03	98.0490
##	779	2019-03-20	132.5625
##	780	2019-01-31	830.3715
##	781	2019-02-19	183.1200
##	782	2019-02-11	397.9920
##	783	2019-02-05	32.1510
##	784	2019-03-03	369.6840
##	785	2019-02-24	53.3400
##	786	2019-02-04	548.1630
##	787	2019-02-19	603.8760
##	788	2019-01-23	57.6975
##	789	2019-01-14	190.4805
##	790	2019-01-17	432.9885
##	791	2019-03-03	48.7305
##	792	2019-02-15	287.9100
##	793	2019-01-15	1022.3850
##	794	2019-02-27	680.6100

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##	796	2019-03-15	57.0780
##	797	2019-01-24	63.9135
##	798	2019-02-22	257.1450
##	799	2019-03-15	97.4190
##	800	2019-02-11	455.1225
##	801	2019-01-12	144.9630
##	802	2019-03-03	253.6800
##	803	2019-03-23	495.3165
##	804	2019-03-04	462.6720
##	805	2019-02-23	714.3255
##	806	2019-03-17	325.3740
##	807	2019-01-16	195.6780
##	808	2019-01-08	210.9660
##	809	2019-01-14	18.6375
##	810	2019-01-31	652.8900
##	811	2019-03-15	90.3000
##	812	2019-02-24	422.7300
##	813	2019-02-08	341.0925
##	814	2019-03-22	99.9075
##	815	2019-01-24	408.4080
##	816	2019-03-14	446.9640
##	817	2019-01-23	333.9840
##	818	2019-01-19	284.5920
##	819	2019-01-27	403.8720
##	820	2019-02-03	247.5900
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##	822	2019-02-24	100.1280
##	823	2019-02-07	10.6785
##	824	2019-03-04	216.4365
##	825	2019-02-14	441.5880
##	826	2019-01-29	92.4420
##	827	2019-01-28	681.4395
##	828	2019-03-26	130.0320
##	829	2019-03-24	681.9750
##	830	2019-01-01	779.3100
##	831	2019-01-24	88.7040
##	832	2019-02-25	262.7940
##	833	2019-01-09	99.5400
##	834	2019-02-14	95.8650
##	835	2019-03-12	299.3655
##	836	2019-03-26	54.9990
##	837	2019-01-09	202.3350
##	838	2019-01-02	281.1690
##	839	2019-01-15	586.6350
##	840	2019-01-01	184.0860
##	841	2019-02-15	163.6110
##	842	2019-02-28	63.3150
##	843	2019-03-02	82.8870
##	844	2019-02-13	31.2270
##	845	2019-01-26	22.3860
##	846	2019-01-30	295.4070
##	847	2019-01-27	76.9230
##	848	2019-01-30	23.4990

##	849	2019-01-08	688.7160
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##	851	2019-01-25	77.8050
##	852	2019-02-19	206.8080
##	853	2019-01-14	390.9465
##	854	2019-02-25	554.2950
##	855	2019-01-23	503.7375
##	856	2019-02-16	345.0195
##	857	2019-01-01	177.4080
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##	859	2019-02-15	362.8170
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##	861	2019-02-20	90.5835
##	862	2019-01-08	26.7960
##	863	2019-03-17	106.5960
##	864	2019-01-12	375.3645
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##	866	2019-01-26	106.5015
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##	868	2019-01-17	131.9220
##	869	2019-01-08	76.5765
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##	871	2019-02-16	182.4270
##	872	2019-03-13	59.3250
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##	874	2019-01-18	561.0780
##	875	2019-03-19	97.8180
##	876	2019-03-15	548.1840
##	877	2019-02-12	54.9675
##	878	2019-02-25	41.7375
##	879	2019-03-21	756.1680
##	880	2019-01-19	101.6400
##	881	2019-01-08	348.7050
##	882	2019-03-30	85.5120
##	883	2019-02-20	335.8950
##	884	2019-03-30	216.8460
##	885	2019-03-19	175.0140
##	886	2019-01-13	335.0130
##	887	2019-02-05	92.2950
##	888	2019-03-23	771.4350
##	889	2019-03-13	102.3960
##	890	2019-03-17	807.6600
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##	892	2019-02-07	486.4440
##	893	2019-03-02	485.5725
##	894	2019-03-06	148.9950
##	895	2019-02-06	317.8350
##	896	2019-01-28	832.9440
##	897	2019-01-18	446.4390
##	898	2019-02-05	297.8010
##	899	2019-03-02	629.1600
##	900	2019-02-09	331.1280
##	901	2019-01-14	423.7380
##	902	2019-02-09	193.0740

##	903	2019-03-26	145.5825
##	904	2019-01-28	84.7455
##	905	2019-02-14	122.4720
##	906	2019-03-24	329.1960
##	907	2019-02-09	888.4050
##	908	2019-03-24	435.1200
##	909	2019-03-27	167.0340
##	910	2019-01-27	514.6050
##	911	2019-03-27	91.8225
##	912	2019-01-19	235.7460
##	913	2019-02-07	782.2080
##	914	2019-01-31	431.2560
##	915	2019-02-25	313.7400
##	916	2019-02-02	223.5870
##	917	2019-03-14	44.9925
##	918	2019-03-11	397.6140
##	919	2019-02-22	217.2555
##	920	2019-03-02	82.7190
##	921	2019-03-10	338.2155
##	922	2019-02-08	103.1310
##	923	2019-02-22	26.7330
##	924	2019-01-10	611.0790
##	925	2019-03-14	221.8860
##	926	2019-01-10	57.8760
##	927	2019-02-15	92.7255
##	928	2019-01-13	374.4090
##	929	2019-02-15	833.9625
##	930	2019-03-02	53.1510
##	931	2019-03-24	629.4960
##	932	2019-02-02	175.0350
##	933	2019-02-27	781.6200
##	934	2019-01-20	470.9880
##	935	2019-01-03	397.8450
##	936	2019-01-24	270.0180
##	937	2019-01-05	579.8415
##	938	2019-03-30	469.7700
##	939	2019-02-17	290.0835
##	940	2019-03-21	360.9270
##	941	2019-03-02	279.3840
##	942	2019-03-27	943.2990
##	943	2019-01-19	479.6400
##	944	2019-02-19	266.6475
##	945	2019-03-28	74.0880
##	946	2019-01-05	690.0180
##	947	2019-03-26	176.9250
##	948	2019-02-03	56.4690
##	949	2019-02-06	188.0025
##	950	2019-02-24	222.0120
##	951	2019-02-21	125.7165
##	952	2019-01-09	68.9850
##	953	2019-02-25	263.9700
##	954	2019-01-13	88.3680
##	955	2019-02-09	415.2330
##	956	2019-01-06	312.8895

```
## 957 2019-01-10 477.1305
## 958 2019-02-07 289.9260
## 959 2019-01-09 165.9000
## 960 2019-02-19 932.3370
## 961 2019-03-18 96.5790
## 962 2019-02-05 43.8690
## 963 2019-03-19 16.2750
## 964 2019-03-30 304.9830
## 965 2019-01-26 69.9930
## 966 2019-03-02 80.3670
## 967 2019-03-04 314.6850
## 968 2019-01-13 255.1815
## 969 2019-03-25 49.7700
## 970 2019-03-11 181.0725
## 971 2019-01-01 888.6150
## 972 2019-02-10 271.2885
## 973 2019-01-26 640.0380
## 974 2019-02-11 252.2520
## 975 2019-02-07 180.8730
## 976 2019-03-06 104.8320
## 977 2019-03-04 313.5720
## 978 2019-02-26 167.5800
## 979 2019-03-10 26.7225
## 980 2019-02-04 71.1585
## 981 2019-01-19 250.2780
## 982 2019-01-23 244.2300
## 983 2019-03-14 921.1860
## 984 2019-01-23 734.7060
## 985 2019-01-09 708.3195
## 986 2019-02-07 334.4775
## 987 2019-02-18 30.9960
## 988 2019-01-03 520.8000
## 989 2019-03-29 864.5700
## 990 2019-01-28 633.1080
## 991 2019-03-22 296.9400
## 992 2019-01-24 804.3000
## 993 2019-03-10 121.8630
## 994 2019-02-22 183.6450
## 995 2019-02-18 63.9975
## 996 2019-01-29 42.3675
## 997 2019-03-02 1022.4900
## 998 2019-02-09 33.4320
## 999 2019-02-22 69.1110
## 1000 2019-02-18 649.2990
```

```
# sorting them in order for easier analysis
#
logs$Date <- sort(logs$Date)
logs
```

```
##      Date      Sales
## 1 2019-01-01 548.9715
## 2 2019-01-01 80.2200
## 3 2019-01-01 340.5255
```

## 4	2019-01-01	489.0480
## 5	2019-01-01	634.3785
## 6	2019-01-01	627.6165
## 7	2019-01-01	433.6920
## 8	2019-01-01	772.3800
## 9	2019-01-01	76.1460
## 10	2019-01-01	172.7460
## 11	2019-01-01	60.8160
## 12	2019-01-01	107.1420
## 13	2019-01-02	246.4875
## 14	2019-01-02	453.4950
## 15	2019-01-02	749.4900
## 16	2019-01-02	590.4360
## 17	2019-01-02	506.6355
## 18	2019-01-02	457.4430
## 19	2019-01-02	172.2105
## 20	2019-01-02	84.6300
## 21	2019-01-03	451.7100
## 22	2019-01-03	277.1370
## 23	2019-01-03	69.7200
## 24	2019-01-03	181.4400
## 25	2019-01-03	279.1845
## 26	2019-01-03	441.7560
## 27	2019-01-03	35.1960
## 28	2019-01-03	184.1070
## 29	2019-01-04	463.8900
## 30	2019-01-04	235.2105
## 31	2019-01-04	494.1825
## 32	2019-01-04	737.7615
## 33	2019-01-04	703.7520
## 34	2019-01-04	202.8180
## 35	2019-01-05	417.5640
## 36	2019-01-05	71.5260
## 37	2019-01-05	328.7550
## 38	2019-01-05	575.3160
## 39	2019-01-05	461.3280
## 40	2019-01-05	253.0080
## 41	2019-01-05	91.0560
## 42	2019-01-05	117.8310
## 43	2019-01-05	435.4560
## 44	2019-01-05	829.0800
## 45	2019-01-05	32.2770
## 46	2019-01-05	394.6320
## 47	2019-01-06	535.7205
## 48	2019-01-06	189.0945
## 49	2019-01-06	119.2590
## 50	2019-01-06	867.6150
## 51	2019-01-06	671.7900
## 52	2019-01-06	234.0975
## 53	2019-01-06	75.0540
## 54	2019-01-06	16.2015
## 55	2019-01-06	33.9360
## 56	2019-01-07	722.2320
## 57	2019-01-07	93.1140

## 58	2019-01-07	752.6400
## 59	2019-01-07	759.6750
## 60	2019-01-07	192.8430
## 61	2019-01-07	77.9310
## 62	2019-01-07	351.0990
## 63	2019-01-07	520.4115
## 64	2019-01-07	166.0050
## 65	2019-01-08	318.1080
## 66	2019-01-08	166.6350
## 67	2019-01-08	70.2870
## 68	2019-01-08	614.9430
## 69	2019-01-08	827.0850
## 70	2019-01-08	19.2465
## 71	2019-01-08	939.5400
## 72	2019-01-08	652.2600
## 73	2019-01-08	152.8380
## 74	2019-01-08	478.2330
## 75	2019-01-08	705.6315
## 76	2019-01-08	437.3250
## 77	2019-01-08	463.4280
## 78	2019-01-08	189.0945
## 79	2019-01-08	822.2550
## 80	2019-01-08	106.9950
## 81	2019-01-08	624.8970
## 82	2019-01-08	304.5420
## 83	2019-01-09	161.7000
## 84	2019-01-09	337.5120
## 85	2019-01-09	256.7775
## 86	2019-01-09	610.4910
## 87	2019-01-09	401.7300
## 88	2019-01-09	362.9430
## 89	2019-01-09	44.5935
## 90	2019-01-09	485.0370
## 91	2019-01-10	198.9960
## 92	2019-01-10	471.0300
## 93	2019-01-10	161.5530
## 94	2019-01-10	608.2020
## 95	2019-01-10	94.2375
## 96	2019-01-10	102.0180
## 97	2019-01-10	922.6350
## 98	2019-01-10	78.4350
## 99	2019-01-10	166.1625
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## 102	2019-01-11	742.2975
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## 104	2019-01-11	367.0380
## 105	2019-01-11	223.0725
## 106	2019-01-11	931.0350
## 107	2019-01-11	172.4940
## 108	2019-01-12	391.4190
## 109	2019-01-12	321.1110
## 110	2019-01-12	860.6850
## 111	2019-01-12	34.6290

##	112	2019-01-12	309.3615
##	113	2019-01-12	535.3740
##	114	2019-01-12	548.7615
##	115	2019-01-12	763.4655
##	116	2019-01-12	85.1130
##	117	2019-01-12	115.1850
##	118	2019-01-12	53.9280
##	119	2019-01-13	115.0800
##	120	2019-01-13	112.2240
##	121	2019-01-13	836.3040
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##	123	2019-01-13	944.6220
##	124	2019-01-13	536.8440
##	125	2019-01-13	474.3480
##	126	2019-01-13	688.6215
##	127	2019-01-13	169.3125
##	128	2019-01-13	299.8485
##	129	2019-01-14	575.7360
##	130	2019-01-14	853.1460
##	131	2019-01-14	291.2070
##	132	2019-01-14	580.4190
##	133	2019-01-14	146.3280
##	134	2019-01-14	550.9350
##	135	2019-01-14	512.1900
##	136	2019-01-14	284.1930
##	137	2019-01-14	138.1275
##	138	2019-01-14	216.8460
##	139	2019-01-14	545.0550
##	140	2019-01-14	609.0000
##	141	2019-01-14	942.9000
##	142	2019-01-15	950.2500
##	143	2019-01-15	720.3000
##	144	2019-01-15	31.9305
##	145	2019-01-15	491.0850
##	146	2019-01-15	291.4380
##	147	2019-01-15	316.4700
##	148	2019-01-15	277.7880
##	149	2019-01-15	603.6240
##	150	2019-01-15	272.6640
##	151	2019-01-15	384.4680
##	152	2019-01-15	254.0160
##	153	2019-01-15	786.6180
##	154	2019-01-15	103.8240
##	155	2019-01-16	680.1480
##	156	2019-01-16	484.5225
##	157	2019-01-16	75.7785
##	158	2019-01-16	263.9700
##	159	2019-01-16	918.7290
##	160	2019-01-16	588.3570
##	161	2019-01-16	362.7120
##	162	2019-01-16	66.8745
##	163	2019-01-16	336.5565
##	164	2019-01-16	160.4400
##	165	2019-01-17	418.9500

##	166	2019-01-17	357.5880
##	167	2019-01-17	1003.5900
##	168	2019-01-17	1039.2900
##	169	2019-01-17	323.0640
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##	171	2019-01-17	367.5525
##	172	2019-01-17	420.2625
##	173	2019-01-17	175.1400
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##	175	2019-01-17	166.2360
##	176	2019-01-18	319.7880
##	177	2019-01-18	186.2280
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##	179	2019-01-18	465.4440
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##	196	2019-01-19	78.0045
##	197	2019-01-19	91.7700
##	198	2019-01-19	26.5545
##	199	2019-01-19	174.3000
##	200	2019-01-19	374.7975
##	201	2019-01-20	120.6450
##	202	2019-01-20	241.4580
##	203	2019-01-20	451.3635
##	204	2019-01-20	271.9500
##	205	2019-01-20	93.2925
##	206	2019-01-20	217.6335
##	207	2019-01-20	629.8425
##	208	2019-01-20	299.5650
##	209	2019-01-20	95.6655
##	210	2019-01-20	942.4485
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##	214	2019-01-21	146.2230
##	215	2019-01-21	217.6335
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##	218	2019-01-21	298.1160
##	219	2019-01-22	796.9080

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##	222	2019-01-22	456.2880
##	223	2019-01-22	62.0025
##	224	2019-01-22	13.1670
##	225	2019-01-22	90.8250
##	226	2019-01-23	183.0360
##	227	2019-01-23	655.5465
##	228	2019-01-23	155.6520
##	229	2019-01-23	571.4100
##	230	2019-01-23	532.7280
##	231	2019-01-23	170.8770
##	232	2019-01-23	33.3585
##	233	2019-01-23	794.6505
##	234	2019-01-23	310.0440
##	235	2019-01-23	545.3700
##	236	2019-01-23	195.5940
##	237	2019-01-23	91.4025
##	238	2019-01-23	232.1550
##	239	2019-01-23	69.4050
##	240	2019-01-23	94.1745
##	241	2019-01-23	235.6830
##	242	2019-01-23	125.5170
##	243	2019-01-24	195.7200
##	244	2019-01-24	263.1300
##	245	2019-01-24	788.5080
##	246	2019-01-24	399.7560
##	247	2019-01-24	256.4100
##	248	2019-01-24	94.1850
##	249	2019-01-24	326.4240
##	250	2019-01-24	536.9910
##	251	2019-01-24	439.8975
##	252	2019-01-24	369.4950
##	253	2019-01-24	30.2190
##	254	2019-01-24	99.7500
##	255	2019-01-24	494.7600
##	256	2019-01-25	137.0040
##	257	2019-01-25	69.6675
##	258	2019-01-25	163.2330
##	259	2019-01-25	135.4500
##	260	2019-01-25	276.9480
##	261	2019-01-25	709.3170
##	262	2019-01-25	69.0900
##	263	2019-01-25	160.8600
##	264	2019-01-25	233.5200
##	265	2019-01-25	57.1725
##	266	2019-01-25	723.2400
##	267	2019-01-25	148.9740
##	268	2019-01-25	783.3000
##	269	2019-01-25	297.1080
##	270	2019-01-25	373.1700
##	271	2019-01-25	354.0075
##	272	2019-01-25	44.3520
##	273	2019-01-26	203.5530

##	274	2019-01-26	25.2630
##	275	2019-01-26	628.1730
##	276	2019-01-26	352.5795
##	277	2019-01-26	229.1100
##	278	2019-01-26	400.7640
##	279	2019-01-26	745.3950
##	280	2019-01-26	462.2100
##	281	2019-01-26	587.6640
##	282	2019-01-26	38.8500
##	283	2019-01-26	16.1070
##	284	2019-01-26	628.9290
##	285	2019-01-26	200.2140
##	286	2019-01-26	350.0700
##	287	2019-01-26	78.6030
##	288	2019-01-26	224.4375
##	289	2019-01-26	356.5485
##	290	2019-01-27	697.3680
##	291	2019-01-27	423.1500
##	292	2019-01-27	204.6975
##	293	2019-01-27	65.6040
##	294	2019-01-27	76.3560
##	295	2019-01-27	190.1550
##	296	2019-01-27	272.5800
##	297	2019-01-27	121.1280
##	298	2019-01-27	493.7940
##	299	2019-01-27	252.0420
##	300	2019-01-27	93.0405
##	301	2019-01-27	209.6220
##	302	2019-01-27	40.9605
##	303	2019-01-27	51.0405
##	304	2019-01-28	214.9980
##	305	2019-01-28	125.6640
##	306	2019-01-28	530.6700
##	307	2019-01-28	295.6905
##	308	2019-01-28	745.8360
##	309	2019-01-28	83.4120
##	310	2019-01-28	172.0110
##	311	2019-01-28	503.5590
##	312	2019-01-28	145.5930
##	313	2019-01-28	74.7075
##	314	2019-01-28	146.9475
##	315	2019-01-28	820.3650
##	316	2019-01-28	208.6770
##	317	2019-01-28	66.4020
##	318	2019-01-29	392.6475
##	319	2019-01-29	218.0745
##	320	2019-01-29	185.0940
##	321	2019-01-29	216.6885
##	322	2019-01-29	41.3910
##	323	2019-01-29	96.1380
##	324	2019-01-29	324.2925
##	325	2019-01-29	135.5760
##	326	2019-01-29	410.5080
##	327	2019-01-29	523.8450

##	328	2019-01-29	395.8920
##	329	2019-01-29	214.7460
##	330	2019-01-30	152.7120
##	331	2019-01-30	208.0890
##	332	2019-01-30	103.6350
##	333	2019-01-30	404.3550
##	334	2019-01-30	49.3080
##	335	2019-01-30	77.1750
##	336	2019-01-30	149.3625
##	337	2019-01-30	721.9800
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##	339	2019-01-31	150.0975
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##	341	2019-01-31	151.4835
##	342	2019-01-31	411.3795
##	343	2019-01-31	565.2150
##	344	2019-01-31	509.4075
##	345	2019-01-31	140.6475
##	346	2019-01-31	736.4385
##	347	2019-01-31	75.5475
##	348	2019-01-31	749.7000
##	349	2019-01-31	191.2470
##	350	2019-01-31	141.7500
##	351	2019-01-31	1042.6500
##	352	2019-01-31	379.9215
##	353	2019-02-01	402.2655
##	354	2019-02-01	255.1500
##	355	2019-02-01	31.7520
##	356	2019-02-01	374.3880
##	357	2019-02-01	394.2750
##	358	2019-02-01	1002.1200
##	359	2019-02-02	86.6250
##	360	2019-02-02	78.7185
##	361	2019-02-02	680.0640
##	362	2019-02-02	793.5480
##	363	2019-02-02	209.5590
##	364	2019-02-02	461.2860
##	365	2019-02-02	173.2080
##	366	2019-02-02	343.0560
##	367	2019-02-02	484.9740
##	368	2019-02-02	276.9480
##	369	2019-02-02	150.7800
##	370	2019-02-02	203.1750
##	371	2019-02-02	193.0110
##	372	2019-02-02	128.0160
##	373	2019-02-03	441.6930
##	374	2019-02-03	265.1040
##	375	2019-02-03	352.2225
##	376	2019-02-03	507.6750
##	377	2019-02-03	334.3410
##	378	2019-02-03	701.8515
##	379	2019-02-03	407.3160
##	380	2019-02-03	99.3300
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##	385	2019-02-03	214.9350
##	386	2019-02-03	79.6110
##	387	2019-02-04	294.6510
##	388	2019-02-04	339.3600
##	389	2019-02-04	510.9615
##	390	2019-02-04	133.9170
##	391	2019-02-04	253.5120
##	392	2019-02-04	398.4750
##	393	2019-02-04	80.6610
##	394	2019-02-04	548.7300
##	395	2019-02-04	83.7270
##	396	2019-02-04	406.8750
##	397	2019-02-04	284.9175
##	398	2019-02-05	128.4255
##	399	2019-02-05	258.6780
##	400	2019-02-05	181.8180
##	401	2019-02-05	248.4090
##	402	2019-02-05	194.1240
##	403	2019-02-05	14.6790
##	404	2019-02-05	208.6875
##	405	2019-02-05	718.7565
##	406	2019-02-05	282.4920
##	407	2019-02-05	72.3975
##	408	2019-02-05	288.5820
##	409	2019-02-05	237.4260
##	410	2019-02-06	125.0550
##	411	2019-02-06	359.2050
##	412	2019-02-06	45.9270
##	413	2019-02-06	110.0925
##	414	2019-02-06	81.3960
##	415	2019-02-06	427.8120
##	416	2019-02-06	100.9155
##	417	2019-02-06	190.5960
##	418	2019-02-06	85.5855
##	419	2019-02-06	120.1620
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##	421	2019-02-06	121.5900
##	422	2019-02-06	264.7575
##	423	2019-02-07	1020.7050
##	424	2019-02-07	213.5280
##	425	2019-02-07	17.0940
##	426	2019-02-07	383.7645
##	427	2019-02-07	390.7995
##	428	2019-02-07	65.7405
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##	430	2019-02-07	951.8250
##	431	2019-02-07	145.0680
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##	433	2019-02-07	147.7980
##	434	2019-02-07	702.2190
##	435	2019-02-07	49.8120

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##	439	2019-02-07	71.5680
##	440	2019-02-07	343.2240
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##	442	2019-02-07	742.8120
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##	447	2019-02-08	290.4300
##	448	2019-02-08	144.0810
##	449	2019-02-08	28.4235
##	450	2019-02-08	41.0760
##	451	2019-02-08	470.6730
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##	454	2019-02-08	26.2500
##	455	2019-02-09	87.2340
##	456	2019-02-09	155.1900
##	457	2019-02-09	731.4300
##	458	2019-02-09	833.5950
##	459	2019-02-09	488.9850
##	460	2019-02-09	37.6845
##	461	2019-02-09	212.7300
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##	463	2019-02-09	310.5900
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##	465	2019-02-09	269.5350
##	466	2019-02-09	572.7750
##	467	2019-02-09	273.0525
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##	470	2019-02-10	103.7820
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##	472	2019-02-10	168.2100
##	473	2019-02-10	452.8650
##	474	2019-02-10	609.5880
##	475	2019-02-10	338.3100
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##	477	2019-02-10	174.6150
##	478	2019-02-10	353.0940
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##	482	2019-02-11	344.4000
##	483	2019-02-11	194.9850
##	484	2019-02-11	633.9900
##	485	2019-02-11	388.2900
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##	487	2019-02-12	431.4450
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##	490	2019-02-12	734.0760
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##	494	2019-02-12	127.2600
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##	497	2019-02-13	132.7620
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##	499	2019-02-13	103.0365
##	500	2019-02-13	432.7680
##	501	2019-02-13	77.6685
##	502	2019-02-13	33.4950
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##	505	2019-02-14	92.8725
##	506	2019-02-14	203.1120
##	507	2019-02-14	152.7750
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##	513	2019-02-15	398.9580
##	514	2019-02-15	731.6925
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##	516	2019-02-15	54.0435
##	517	2019-02-15	288.0150
##	518	2019-02-15	206.7975
##	519	2019-02-15	72.9330
##	520	2019-02-15	377.5800
##	521	2019-02-15	143.9865
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##	523	2019-02-15	235.8720
##	524	2019-02-15	132.0270
##	525	2019-02-15	514.7730
##	526	2019-02-15	479.9025
##	527	2019-02-15	164.6820
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##	529	2019-02-15	570.7800
##	530	2019-02-16	926.9505
##	531	2019-02-16	160.2090
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##	533	2019-02-16	240.9750
##	534	2019-02-16	154.1295
##	535	2019-02-16	148.6800
##	536	2019-02-16	122.5245
##	537	2019-02-16	77.6580
##	538	2019-02-17	102.8370
##	539	2019-02-17	306.8100
##	540	2019-02-17	551.1240
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##	543	2019-02-17	84.7560

##	544	2019-02-17	118.2510
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##	547	2019-02-17	308.9100
##	548	2019-02-17	575.9775
##	549	2019-02-17	270.5850
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##	551	2019-02-18	180.4005
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##	554	2019-02-18	139.9230
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##	570	2019-02-20	543.7530
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##	572	2019-02-20	280.0350
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##	575	2019-02-20	451.0275
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##	577	2019-02-21	253.2600
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##	582	2019-02-21	326.2560
##	583	2019-02-22	195.2580
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##	585	2019-02-22	198.6390
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##	591	2019-02-22	293.1390
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##	594	2019-02-23	236.8800
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##	601	2019-02-23	87.2340
##	602	2019-02-24	68.2395
##	603	2019-02-24	814.3800
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##	605	2019-02-24	381.3915
##	606	2019-02-24	133.3500
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##	614	2019-02-25	84.9765
##	615	2019-02-25	708.2250
##	616	2019-02-25	365.9040
##	617	2019-02-25	457.3800
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##	619	2019-02-25	620.7390
##	620	2019-02-25	273.7980
##	621	2019-02-25	225.7920
##	622	2019-02-25	96.1905
##	623	2019-02-25	695.2365
##	624	2019-02-25	874.1250
##	625	2019-02-25	95.9175
##	626	2019-02-25	165.6480
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##	628	2019-02-26	867.0900
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##	636	2019-02-27	697.9350
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##	675	2019-03-02	477.5400
##	676	2019-03-02	175.9170
##	677	2019-03-02	470.9880
##	678	2019-03-02	308.5740
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##	683	2019-03-02	310.7160
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##	694	2019-03-03	539.3430
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##	697	2019-03-03	113.5680
##	698	2019-03-04	261.1980
##	699	2019-03-04	657.5310
##	700	2019-03-04	1023.7500
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##	705	2019-03-04	835.2855

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##	707	2019-03-04	180.6000
##	708	2019-03-04	72.4290
##	709	2019-03-04	131.2080
##	710	2019-03-05	80.9550
##	711	2019-03-05	507.9060
##	712	2019-03-05	317.2260
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##	714	2019-03-05	130.8825
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##	720	2019-03-05	110.1240
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##	722	2019-03-05	856.4535
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##	724	2019-03-05	270.2595
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##	726	2019-03-05	239.4000
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##	730	2019-03-06	383.5230
##	731	2019-03-06	93.7440
##	732	2019-03-06	176.4000
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##	746	2019-03-07	40.3410
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##	754	2019-03-08	384.7200
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##	760	2019-03-09	232.6380
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##	762	2019-03-09	757.3650
##	763	2019-03-09	536.5920
##	764	2019-03-09	56.1225
##	765	2019-03-09	233.1000
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##	767	2019-03-09	239.5890
##	768	2019-03-09	86.2470
##	769	2019-03-09	401.6880
##	770	2019-03-09	72.0090
##	771	2019-03-09	401.2680
##	772	2019-03-09	631.1445
##	773	2019-03-09	499.7265
##	774	2019-03-10	55.0410
##	775	2019-03-10	137.8650
##	776	2019-03-10	151.5150
##	777	2019-03-10	480.0285
##	778	2019-03-10	98.0490
##	779	2019-03-10	132.5625
##	780	2019-03-10	830.3715
##	781	2019-03-10	183.1200
##	782	2019-03-10	397.9920
##	783	2019-03-10	32.1510
##	784	2019-03-10	369.6840
##	785	2019-03-10	53.3400
##	786	2019-03-11	548.1630
##	787	2019-03-11	603.8760
##	788	2019-03-11	57.6975
##	789	2019-03-11	190.4805
##	790	2019-03-11	432.9885
##	791	2019-03-11	48.7305
##	792	2019-03-11	287.9100
##	793	2019-03-11	1022.3850
##	794	2019-03-11	680.6100
##	795	2019-03-11	97.8810
##	796	2019-03-11	57.0780
##	797	2019-03-12	63.9135
##	798	2019-03-12	257.1450
##	799	2019-03-12	97.4190
##	800	2019-03-12	455.1225
##	801	2019-03-12	144.9630
##	802	2019-03-12	253.6800
##	803	2019-03-12	495.3165
##	804	2019-03-12	462.6720
##	805	2019-03-12	714.3255
##	806	2019-03-12	325.3740
##	807	2019-03-12	195.6780
##	808	2019-03-12	210.9660
##	809	2019-03-13	18.6375
##	810	2019-03-13	652.8900
##	811	2019-03-13	90.3000
##	812	2019-03-13	422.7300
##	813	2019-03-13	341.0925

##	814	2019-03-13	99.9075
##	815	2019-03-13	408.4080
##	816	2019-03-13	446.9640
##	817	2019-03-13	333.9840
##	818	2019-03-13	284.5920
##	819	2019-03-14	403.8720
##	820	2019-03-14	247.5900
##	821	2019-03-14	222.1380
##	822	2019-03-14	100.1280
##	823	2019-03-14	10.6785
##	824	2019-03-14	216.4365
##	825	2019-03-14	441.5880
##	826	2019-03-14	92.4420
##	827	2019-03-14	681.4395
##	828	2019-03-14	130.0320
##	829	2019-03-14	681.9750
##	830	2019-03-14	779.3100
##	831	2019-03-14	88.7040
##	832	2019-03-14	262.7940
##	833	2019-03-14	99.5400
##	834	2019-03-14	95.8650
##	835	2019-03-14	299.3655
##	836	2019-03-14	54.9990
##	837	2019-03-15	202.3350
##	838	2019-03-15	281.1690
##	839	2019-03-15	586.6350
##	840	2019-03-15	184.0860
##	841	2019-03-15	163.6110
##	842	2019-03-15	63.3150
##	843	2019-03-15	82.8870
##	844	2019-03-15	31.2270
##	845	2019-03-15	22.3860
##	846	2019-03-15	295.4070
##	847	2019-03-15	76.9230
##	848	2019-03-15	23.4990
##	849	2019-03-16	688.7160
##	850	2019-03-16	624.3300
##	851	2019-03-16	77.8050
##	852	2019-03-16	206.8080
##	853	2019-03-16	390.9465
##	854	2019-03-16	554.2950
##	855	2019-03-16	503.7375
##	856	2019-03-16	345.0195
##	857	2019-03-16	177.4080
##	858	2019-03-17	118.9020
##	859	2019-03-17	362.8170
##	860	2019-03-17	450.1035
##	861	2019-03-17	90.5835
##	862	2019-03-17	26.7960
##	863	2019-03-17	106.5960
##	864	2019-03-18	375.3645
##	865	2019-03-18	250.7085
##	866	2019-03-18	106.5015
##	867	2019-03-18	760.4520

##	868	2019-03-18	131.9220
##	869	2019-03-18	76.5765
##	870	2019-03-18	271.2780
##	871	2019-03-19	182.4270
##	872	2019-03-19	59.3250
##	873	2019-03-19	225.0150
##	874	2019-03-19	561.0780
##	875	2019-03-19	97.8180
##	876	2019-03-19	548.1840
##	877	2019-03-19	54.9675
##	878	2019-03-19	41.7375
##	879	2019-03-19	756.1680
##	880	2019-03-19	101.6400
##	881	2019-03-19	348.7050
##	882	2019-03-19	85.5120
##	883	2019-03-19	335.8950
##	884	2019-03-19	216.8460
##	885	2019-03-19	175.0140
##	886	2019-03-19	335.0130
##	887	2019-03-20	92.2950
##	888	2019-03-20	771.4350
##	889	2019-03-20	102.3960
##	890	2019-03-20	807.6600
##	891	2019-03-20	439.2150
##	892	2019-03-20	486.4440
##	893	2019-03-20	485.5725
##	894	2019-03-20	148.9950
##	895	2019-03-20	317.8350
##	896	2019-03-20	832.9440
##	897	2019-03-20	446.4390
##	898	2019-03-20	297.8010
##	899	2019-03-20	629.1600
##	900	2019-03-20	331.1280
##	901	2019-03-20	423.7380
##	902	2019-03-21	193.0740
##	903	2019-03-21	145.5825
##	904	2019-03-21	84.7455
##	905	2019-03-21	122.4720
##	906	2019-03-21	329.1960
##	907	2019-03-21	888.4050
##	908	2019-03-22	435.1200
##	909	2019-03-22	167.0340
##	910	2019-03-22	514.6050
##	911	2019-03-22	91.8225
##	912	2019-03-22	235.7460
##	913	2019-03-22	782.2080
##	914	2019-03-22	431.2560
##	915	2019-03-22	313.7400
##	916	2019-03-22	223.5870
##	917	2019-03-22	44.9925
##	918	2019-03-23	397.6140
##	919	2019-03-23	217.2555
##	920	2019-03-23	82.7190
##	921	2019-03-23	338.2155

##	922	2019-03-23	103.1310
##	923	2019-03-23	26.7330
##	924	2019-03-23	611.0790
##	925	2019-03-23	221.8860
##	926	2019-03-23	57.8760
##	927	2019-03-23	92.7255
##	928	2019-03-23	374.4090
##	929	2019-03-24	833.9625
##	930	2019-03-24	53.1510
##	931	2019-03-24	629.4960
##	932	2019-03-24	175.0350
##	933	2019-03-24	781.6200
##	934	2019-03-24	470.9880
##	935	2019-03-24	397.8450
##	936	2019-03-24	270.0180
##	937	2019-03-24	579.8415
##	938	2019-03-24	469.7700
##	939	2019-03-24	290.0835
##	940	2019-03-25	360.9270
##	941	2019-03-25	279.3840
##	942	2019-03-25	943.2990
##	943	2019-03-25	479.6400
##	944	2019-03-25	266.6475
##	945	2019-03-25	74.0880
##	946	2019-03-25	690.0180
##	947	2019-03-25	176.9250
##	948	2019-03-25	56.4690
##	949	2019-03-26	188.0025
##	950	2019-03-26	222.0120
##	951	2019-03-26	125.7165
##	952	2019-03-26	68.9850
##	953	2019-03-26	263.9700
##	954	2019-03-26	88.3680
##	955	2019-03-26	415.2330
##	956	2019-03-26	312.8895
##	957	2019-03-26	477.1305
##	958	2019-03-26	289.9260
##	959	2019-03-26	165.9000
##	960	2019-03-26	932.3370
##	961	2019-03-26	96.5790
##	962	2019-03-27	43.8690
##	963	2019-03-27	16.2750
##	964	2019-03-27	304.9830
##	965	2019-03-27	69.9930
##	966	2019-03-27	80.3670
##	967	2019-03-27	314.6850
##	968	2019-03-27	255.1815
##	969	2019-03-27	49.7700
##	970	2019-03-27	181.0725
##	971	2019-03-27	888.6150
##	972	2019-03-28	271.2885
##	973	2019-03-28	640.0380
##	974	2019-03-28	252.2520
##	975	2019-03-28	180.8730

```
## 976 2019-03-28 104.8320
## 977 2019-03-28 313.5720
## 978 2019-03-28 167.5800
## 979 2019-03-28 26.7225
## 980 2019-03-28 71.1585
## 981 2019-03-28 250.2780
## 982 2019-03-29 244.2300
## 983 2019-03-29 921.1860
## 984 2019-03-29 734.7060
## 985 2019-03-29 708.3195
## 986 2019-03-29 334.4775
## 987 2019-03-29 30.9960
## 988 2019-03-29 520.8000
## 989 2019-03-29 864.5700
## 990 2019-03-30 633.1080
## 991 2019-03-30 296.9400
## 992 2019-03-30 804.3000
## 993 2019-03-30 121.8630
## 994 2019-03-30 183.6450
## 995 2019-03-30 63.9975
## 996 2019-03-30 42.3675
## 997 2019-03-30 1022.4900
## 998 2019-03-30 33.4320
## 999 2019-03-30 69.1110
## 1000 2019-03-30 649.2990
```

Exploratory Analysis.

```
# measures of central tenderncey
#
summary(logs)
```

```
##      Date      Sales
## Min.   :2019-01-01  Min.   : 10.68
## 1st Qu.:2019-01-24  1st Qu.: 124.42
## Median :2019-02-13  Median : 253.85
## Mean   :2019-02-14  Mean    : 322.97
## 3rd Qu.:2019-03-08  3rd Qu.: 471.35
## Max.   :2019-03-30  Max.    :1042.65
```

```
# measures of spread
#
var(logs$Sales)
```

```
## [1] 60459.6
```

```
sd(logs$Sales)
```

```
## [1] 245.8853
```

```
skewness(logs$Sales)
```

```
## [1] 0.8912304
```

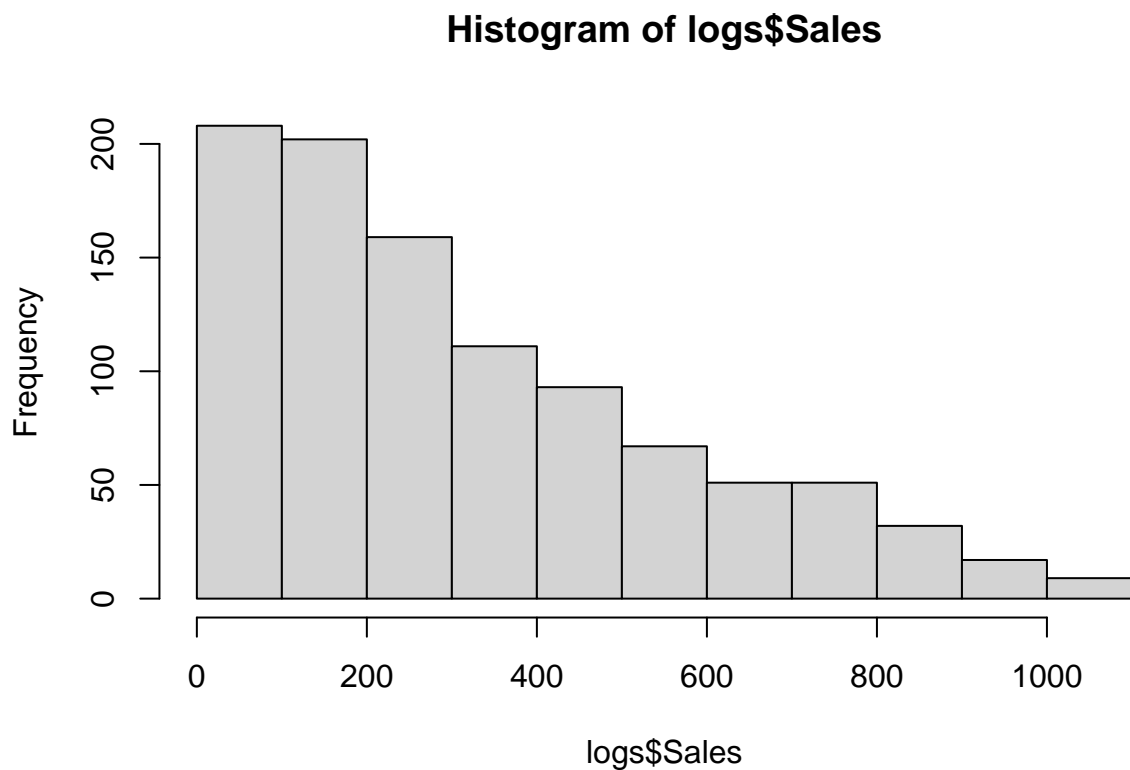
```
kurtosis(logs$Sales)
```

```
## [1] 2.91253
```

```
# visualization of frequency
```

```
#
```

```
hist(logs$Sales)
```



```
## implementing the solution.
```

```
# change data to tibbletime
```

```
#
```

```
logs <- read.csv('http://bit.ly/CarreFourSalesDataset')
```

```
logs$Date <- as.Date(logs$Date, format = '%m/%d/%Y')
```

```
logs$Date <- sort(logs$Date)
```

```
logs <- as_tbl_time(logs, index = Date)
```

```
head(logs)
```

```
## # A time tibble: 6 x 2
## # Index: Date
##   Date      Sales
##   <date>    <dbl>
## 1 2019-01-01 549.
## 2 2019-01-01  80.2
## 3 2019-01-01 341.
## 4 2019-01-01 489.
## 5 2019-01-01 634.
## 6 2019-01-01 628.
```

```
# Detecting anomalies
#
#library(tibbletime)
#library(anomalize)
#library(tidyverse)
#Anomalies <- logs %>%
  # group_by(Date) %>%
    #summarise(Sales = sum(Sales)) %>%
    #time_decompose(Sales) %>%
    #anomalize(remainder) %>%
    #time_recompose()
```

```
# vizualising the anomalies
#
#Anomalies %>% plot_anomalies(ncol = 3, alpha_dots = 0.5)
```