

Final Project

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4/24/2020

```
setwd('~/Desktop/PLS397/')  
#Looking to find what drives car sales in the US,  
#and to see if we can predict car sales in the coming years after the current recession  
##-----##  
  
#read in csv data  
car_sales = read_csv("ALTSALES.csv")
```

```
## Parsed with column specification:  
## cols(  
##   DATE = col_date(format = ""),  
##   ALTSALES = col_double()  
## )
```

```
#clean up data  
car_sales <- mutate(car_sales, Sales = ALTSALES )  
car_sales <- subset(car_sales, select = -ALTSALES )  
car_sales <- mutate(car_sales, Date = DATE )  
car_sales <- subset(car_sales, select = -DATE )  
car_sales <- na.omit(car_sales)
```

```
library(plotly)
```

```
## Warning: package 'plotly' was built under R version 3.6.2
```

```
##  
## Attaching package: 'plotly'
```

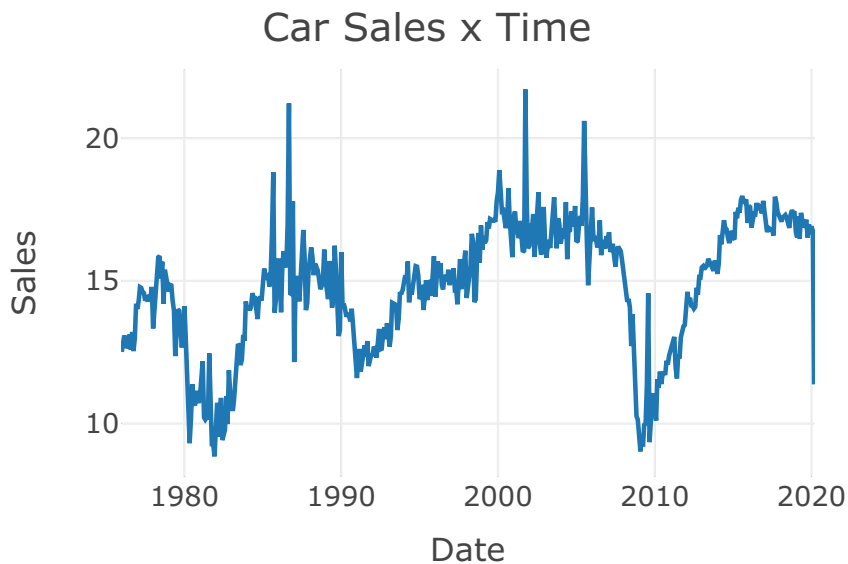
```
## The following object is masked from 'package:ggmap':  
##  
##   wind
```

```
## The following object is masked from 'package:ggplot2':  
##  
##   last_plot
```

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

```
## The following object is masked from 'package:graphics':  
##  
## layout
```

```
library(shiny)  
#inteaactive plot of car sales over time in the US  
#car_plot = plot_ly(car_sales, x = ~Date, y = ~Sales, type= 'scatter', mode='lines')  
  
car_plot <- plot_ly() %>%  
  add_trace(data = car_sales,  
    x = ~Date,  
    y = ~Sales,  
    colors = "BrBG",  
    type = "scatter",  
    mode = "line") %>%  
  layout(title = "Car Sales x Time",  
    xaxis = list(title = "Date"))  
  
htmlwidgets::saveWidget(car_plot, "CarSales.html")  
car_plot
```



```
getwd()
```

```
## [1] "/Users/carsondobozy/Desktop"
```

```
setwd("~/Desktop/PLS397")
```

```
#Unemployment Numbers CSV data
```

```
#chose unemployment because that seems to be one of the biggest deciding factors of car sales
```

```
#after doing research
```

```
Unemployment = read_csv("CCSA.csv")
```

```
## Parsed with column specification:
```

```
## cols(
```

```
##   DATE = col_date(format = ""),
```

```
##   CCSA = col_character()
```

```
## )
```

```
Unemployment <- mutate(Unemployment, Unemployed = CCSA )
```

```
Unemployment <- subset(Unemployment, select = -CCSA )
```

```
Unemployment <- mutate(Unemployment, Date = DATE )
```

```
Unemployment <- subset(Unemployment, select = -DATE )
```

```
Unemployment <- na.omit(Unemployment)
```

```
Unemployment$Unemployed = as.numeric(as.character(Unemployment$Unemployed))
```

```
## Warning: NAs introduced by coercion
```

```
#Make sure data is numeric
```

```
is.num <- sapply(Unemployment, is.numeric)
```

```
Unemployment[is.num] <- lapply(Unemployment[is.num], round, 8)
```

```
Unemployment
```

```
## # A tibble: 640 x 2
```

```
##   Unemployed Date
```

```
##           <dbl> <date>
```

```
## 1    1118750 1967-01-01
```

```
## 2    1162500 1967-02-01
```

```
## 3    1243250 1967-03-01
```

```
## 4    1281000 1967-04-01
```

```
## 5    1277500 1967-05-01
```

```
## 6    1246000 1967-06-01
```

```
## 7    1246200 1967-07-01
```

```
## 8    1209250 1967-08-01
```

```
## 9    1181400 1967-09-01
```

```
## 10   1172250 1967-10-01
```

```
## # ... with 630 more rows
```

```
#plot to show unemployment over time
```

```
Unemp_plot <- plot_ly() %>%
```

```
  add_trace(data = Unemployment,
```

```
    x = ~Date,
```

```

y = ~Unemployed,
colors = "red",
type = "scatter",
mode = "line") %>%
layout(title = "People on Unemployment x Time",
xaxis = list(title = "Date"))

```

Unemp_plot

Warning: Ignoring 1 observations



```

set.seed(420)
#train and test data for car sales
split1=caTools::sample.split(car_sales$Sales,SplitRatio = 0.8)
training_set1=subset(car_sales,split1==TRUE)
test_set1=subset(car_sales,split1==FALSE)

#Fitting regression model to the training set with unemployment levels
regressor1=lm(formula=car_sales$Sales[0:531]~Unemployment$Unemployed[109:639],
data=training_set1)

```

```
#Predicting the test set
```

```
y_pred1=predict(regressor1,newdata=test_set1)
```

```
## Warning: 'newdata' had 107 rows but variables found have 531 rows
```

```
#predicted car sales model (unemployment regression)
```

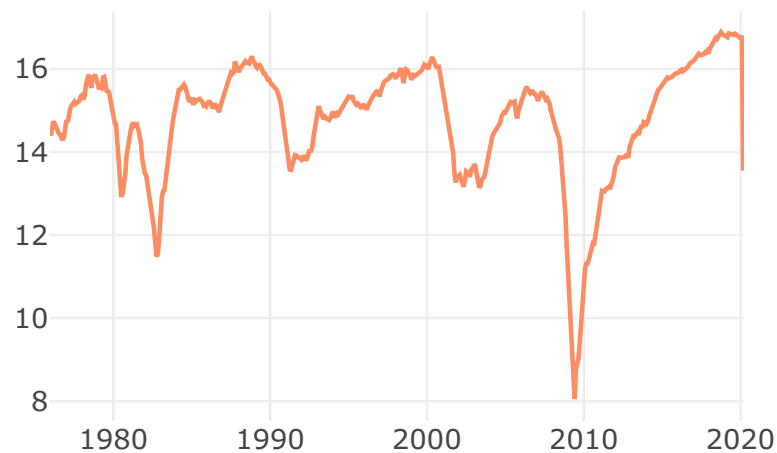
```
new_date1 = car_sales$Date[0:531]
```

```
car_pred1 = plot_ly(car_sales, x = new_date1, y = y_pred1, type= 'scatter', mode='lines', color='red')
```

```
car_pred1
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```



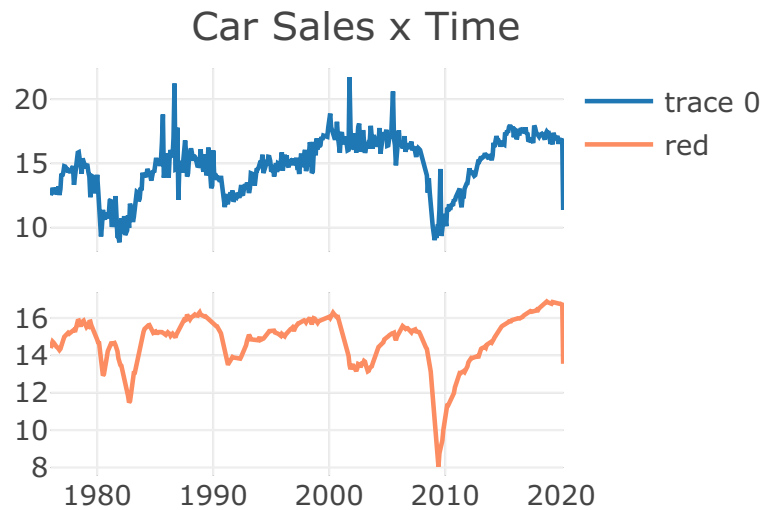
```
#subplot to show Original Data vs model
```

```
#here is our first predicted time series with just Unemp an predictor
```

```
subplot(car_plot, car_pred1, nrow = 2, margin = 0.05, shareX = TRUE)
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```



```
getwd()
```

```
## [1] "/Users/carsondobozy/Desktop"
```

```
setwd("~/Desktop/PLS397")
```

```
#Consumption levels CSV data
```

```
#Consumption is obviously related to car sales, and has good response to major issues that cause market  
#i.e 9/11 attacks, 2008 market crash, corona virus pandemic
```

```
Consumption = read_csv("PCEDG.csv")
```

```
## Parsed with column specification:
```

```
## cols(
```

```
##   DATE = col_date(format = ""),
```

```
##   PCEDG = col_double()
```

```
## )
```

```
Consumption <- mutate(Consumption, Personal_Consumption = PCEDG )
Consumption <- subset(Consumption, select = -PCEDG )
Consumption <- mutate(Consumption, Date = DATE )
Consumption <- subset(Consumption, select = -DATE )
Consumption <- na.omit(Consumption)
```

```
#make sure data is numeric
Consumption <- rbind(Consumption, c(1124.0, "2020-03-01"))
Consumption <- transform(Consumption, Personal_Consumption = as.numeric(Personal_Consumption))
head(Consumption)
```

```
##   Personal_Consumption      Date
## 1                42.3 1959-01-01
## 2                44.2 1959-02-01
## 3                44.4 1959-03-01
## 4                45.1 1959-04-01
## 5                45.4 1959-05-01
## 6                46.0 1959-06-01
```

```
set.seed(420)
#train and test data for car sales
split2=caTools::sample.split(car_sales$Sales,SplitRatio = 0.8)
training_set2=subset(car_sales,split2==TRUE)
test_set2=subset(car_sales,split2==FALSE)

#Fitting regression model to the training set Unemployment and Consumption
regressor2=lm(formula=car_sales$Sales[0:531]~Unemployment$Unemployed[109:639] + Consumption$Personal_Consumption,
              data=training_set2)

#Predicting the test set
y_pred2=predict(regressor2,newdata=test_set2)
```

```
## Warning: 'newdata' had 107 rows but variables found have 531 rows
```

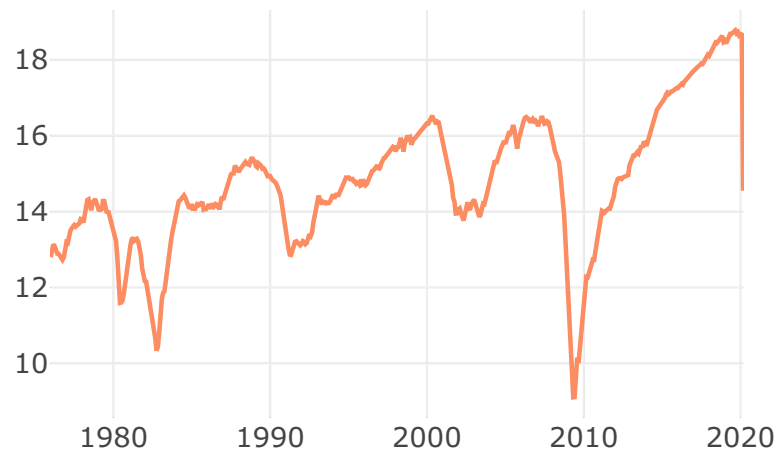
```
#prediction model 2 (accounts for more variation)

new_date2 = car_sales$Date[0:531]
car_pred2 = plot_ly(car_sales, x = new_date2, y = y_pred2, type= 'scatter', mode='lines', color='red')

car_pred2
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```



```
#subplot to show our two models vs actual data
```

```
#here we can see our model is becoming more accurate and more sensitive to volatility
```

```
subplot(car_plot, car_pred1, car_pred2, nrow = 3, margin = 0.05, shareX = TRUE)
```

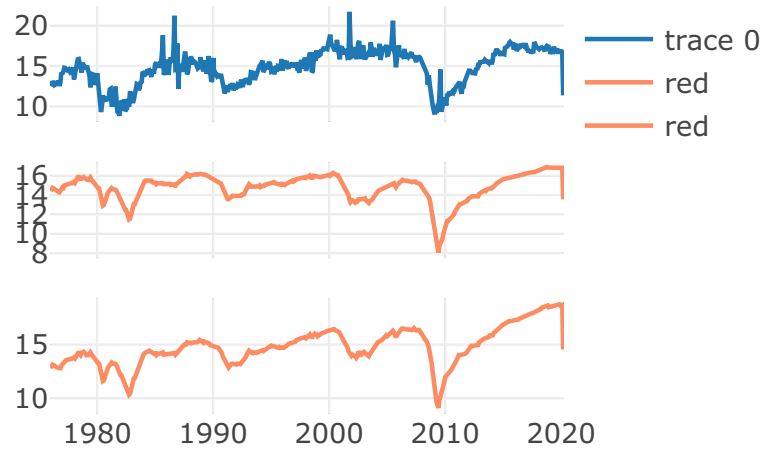
```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```


Car Sales x Time



```
getwd()
```

```
## [1] "/Users/carsondobozy/Desktop"
```

```
setwd("~/Desktop/PLS397")
#Gas prices csv data
#Gas prices will give our model a better sensitivity and feel for how car sales move over time
GasPrices = read_csv("APU000074714.csv")
```

```
## Parsed with column specification:
## cols(
##   DATE = col_date(format = ""),
##   APU000074714 = col_double()
## )
```

```
GasPrices <- mutate(GasPrices, Gas_Price = APU000074714 )
GasPrices <- subset(GasPrices, select = -APU000074714 )
GasPrices <- mutate(GasPrices, Date = DATE )
GasPrices <- subset(GasPrices, select = -DATE )
GasPrices <- na.omit(GasPrices)
```

```

#create dataframe with all variables
data = data.frame(Date = new_date1[0:531],
                  CarSales = car_sales$Sales[0:531],
                  Unemployed = Unemployment$Unemployed[109:639],
                  Consumption = Consumption$Personal_Consumption[205:735],
                  GasPrice = GasPrices$Gas_Price[0:531]
                  )

data

```

##	Date	CarSales	Unemployed	Consumption	GasPrice
## 1	1976-01-01	12.512	3035200	161.2	0.605
## 2	1976-02-01	13.044	2865750	164.2	0.600
## 3	1976-03-01	13.085	2843000	164.5	0.594
## 4	1976-04-01	12.915	2872250	167.6	0.592
## 5	1976-05-01	12.645	2941000	162.2	0.600
## 6	1976-06-01	12.727	2989500	167.9	0.616
## 7	1976-07-01	13.122	2995800	169.7	0.623
## 8	1976-08-01	12.594	3015250	168.7	0.628
## 9	1976-09-01	13.209	3070000	171.2	0.630
## 10	1976-10-01	12.537	3093000	170.9	0.629
## 11	1976-11-01	13.006	3055750	173.2	0.629
## 12	1976-12-01	14.197	2923500	182.2	0.626
## 13	1977-01-01	14.019	2827200	177.8	0.627
## 14	1977-02-01	14.335	2849000	184.1	0.637
## 15	1977-03-01	14.782	2702750	189.9	0.643
## 16	1977-04-01	14.753	2671200	188.9	0.651
## 17	1977-05-01	14.605	2631250	188.6	0.659
## 18	1977-06-01	14.571	2619250	190.2	0.665
## 19	1977-07-01	14.306	2583000	191.7	0.667
## 20	1977-08-01	14.488	2610500	194.2	0.667
## 21	1977-09-01	14.274	2589500	196.1	0.666
## 22	1977-10-01	14.511	2576200	197.1	0.665
## 23	1977-11-01	14.396	2568500	200.8	0.664
## 24	1977-12-01	14.789	2507000	204.2	0.665
## 25	1978-01-01	13.334	2493500	191.2	0.648
## 26	1978-02-01	13.969	2555500	198.5	0.647
## 27	1978-03-01	14.714	2499750	204.7	0.647
## 28	1978-04-01	15.757	2349600	213.5	0.649
## 29	1978-05-01	15.830	2231500	217.0	0.655
## 30	1978-06-01	15.868	2221750	218.1	0.663
## 31	1978-07-01	15.086	2313200	215.3	0.674
## 32	1978-08-01	15.676	2398000	221.8	0.682
## 33	1978-09-01	14.195	2269800	213.1	0.688
## 34	1978-10-01	15.391	2230500	220.3	0.690
## 35	1978-11-01	15.015	2223750	222.3	0.695
## 36	1978-12-01	14.839	2286600	224.2	0.705
## 37	1979-01-01	14.626	2382500	220.5	0.716
## 38	1979-02-01	14.856	2414250	224.0	0.730
## 39	1979-03-01	14.839	2385800	225.3	0.755
## 40	1979-04-01	14.304	2398500	222.7	0.802
## 41	1979-05-01	13.966	2259250	224.4	0.844
## 42	1979-06-01	12.363	2251600	219.3	0.901
## 43	1979-07-01	13.712	2358500	226.0	0.949

## 44	1979-08-01	13.999	2458250	231.3	0.988
## 45	1979-09-01	13.953	2428200	235.4	1.020
## 46	1979-10-01	12.733	2490000	228.3	1.028
## 47	1979-11-01	12.667	2602500	229.0	1.041
## 48	1979-12-01	13.198	2698800	229.9	1.065
## 49	1980-01-01	14.115	2781750	239.6	1.131
## 50	1980-02-01	12.967	2868500	232.9	1.207
## 51	1980-03-01	11.797	2881200	223.6	1.252
## 52	1980-04-01	10.198	3126500	212.4	1.264
## 53	1980-05-01	9.310	3544800	208.5	1.266
## 54	1980-06-01	10.181	3832500	214.9	1.269
## 55	1980-07-01	11.381	3845500	226.7	1.271
## 56	1980-08-01	10.860	3805200	224.0	1.267
## 57	1980-09-01	10.622	3693500	225.4	1.257
## 58	1980-10-01	11.146	3556250	236.3	1.250
## 59	1980-11-01	11.014	3300600	236.7	1.250
## 60	1980-12-01	10.718	3125500	235.7	1.258
## 61	1981-01-01	11.036	3038200	239.9	1.298
## 62	1981-02-01	12.116	2978000	247.3	1.382
## 63	1981-03-01	12.185	2899250	250.9	1.417
## 64	1981-04-01	10.212	2857000	241.7	1.412
## 65	1981-05-01	10.136	2904000	239.8	1.400
## 66	1981-06-01	10.205	2903250	241.4	1.391
## 67	1981-07-01	10.206	2883000	245.2	1.382
## 68	1981-08-01	12.457	2948400	260.4	1.376
## 69	1981-09-01	10.863	3013000	250.2	1.376
## 70	1981-10-01	9.209	3127000	237.3	1.371
## 71	1981-11-01	9.294	3337250	237.0	1.369
## 72	1981-12-01	8.849	3525250	236.3	1.365
## 73	1982-01-01	10.075	3533600	241.0	1.358
## 74	1982-02-01	10.725	3555500	249.3	1.334
## 75	1982-03-01	10.457	3655500	249.0	1.284
## 76	1982-04-01	9.541	3864500	244.9	1.225
## 77	1982-05-01	10.900	3991800	256.8	1.237
## 78	1982-06-01	9.420	4094250	246.0	1.309
## 79	1982-07-01	9.585	4101400	247.8	1.331
## 80	1982-08-01	9.779	4260250	248.6	1.323
## 81	1982-09-01	10.958	4452750	260.0	1.307
## 82	1982-10-01	9.981	4639600	254.1	1.295
## 83	1982-11-01	11.866	4601000	268.1	1.283
## 84	1982-12-01	11.073	4400000	270.8	1.260
## 85	1983-01-01	10.688	3919000	268.3	1.230
## 86	1983-02-01	10.441	3859250	266.8	1.187
## 87	1983-03-01	10.832	3767500	271.6	1.152
## 88	1983-04-01	11.507	3760200	281.7	1.215
## 89	1983-05-01	11.865	3624250	288.8	1.259
## 90	1983-06-01	12.785	3455500	298.2	1.277
## 91	1983-07-01	12.733	3189600	303.4	1.288
## 92	1983-08-01	12.048	3105750	301.2	1.285
## 93	1983-09-01	12.258	3007000	302.6	1.274
## 94	1983-10-01	13.103	2902800	313.7	1.255
## 95	1983-11-01	12.899	2787750	315.9	1.241
## 96	1983-12-01	14.278	2712200	328.3	1.231
## 97	1984-01-01	13.998	2549250	336.8	1.216

## 98	1984-02-01	14.130	2469500	328.7	1.209
## 99	1984-03-01	13.967	2424400	328.8	1.210
## 100	1984-04-01	14.094	2422250	336.0	1.227
## 101	1984-05-01	14.569	2385000	341.7	1.236
## 102	1984-06-01	14.394	2360400	346.1	1.229
## 103	1984-07-01	14.455	2353000	341.5	1.212
## 104	1984-08-01	14.006	2385750	339.7	1.196
## 105	1984-09-01	13.662	2434800	345.0	1.203
## 106	1984-10-01	14.342	2524000	343.0	1.209
## 107	1984-11-01	14.444	2584250	358.4	1.207
## 108	1984-12-01	14.306	2547000	360.1	1.193
## 109	1985-01-01	15.265	2552250	365.5	1.148
## 110	1985-02-01	15.432	2623500	364.9	1.131
## 111	1985-03-01	15.049	2564400	373.6	1.159
## 112	1985-04-01	15.224	2578750	365.7	1.205
## 113	1985-05-01	15.270	2560750	384.3	1.231
## 114	1985-06-01	14.800	2551800	369.7	1.241
## 115	1985-07-01	15.222	2542500	376.3	1.242
## 116	1985-08-01	16.633	2562600	390.3	1.229
## 117	1985-09-01	18.809	2580500	422.7	1.216
## 118	1985-10-01	13.887	2631750	379.2	1.204
## 119	1985-11-01	14.333	2625200	380.8	1.207
## 120	1985-12-01	15.387	2643750	391.2	1.208
## 121	1986-01-01	15.781	2604000	401.4	1.194
## 122	1986-02-01	15.126	2568500	389.4	1.120
## 123	1986-03-01	13.900	2593600	384.1	0.981
## 124	1986-04-01	15.579	2608750	404.0	0.888
## 125	1986-05-01	16.038	2671000	414.2	0.923
## 126	1986-06-01	15.637	2635000	403.7	0.955
## 127	1986-07-01	15.471	2608000	415.9	0.890
## 128	1986-08-01	17.010	2655600	434.4	0.843
## 129	1986-09-01	21.221	2707000	486.8	0.860
## 130	1986-10-01	14.516	2718750	434.9	0.831
## 131	1986-11-01	14.545	2630800	420.0	0.821
## 132	1986-12-01	17.782	2571250	468.5	0.823
## 133	1987-01-01	12.155	2512400	399.7	0.862
## 134	1987-02-01	14.830	2472000	427.0	0.905
## 135	1987-03-01	15.017	2429250	428.8	0.912
## 136	1987-04-01	15.167	2411000	437.6	0.934
## 137	1987-05-01	14.283	2324000	434.0	0.941
## 138	1987-06-01	15.341	2279000	445.7	0.958
## 139	1987-07-01	15.372	2196500	452.4	0.971
## 140	1987-08-01	16.786	2211600	468.9	0.995
## 141	1987-09-01	15.820	2196750	460.3	0.990
## 142	1987-10-01	13.975	2046800	443.1	0.976
## 143	1987-11-01	14.227	2082250	447.4	0.976
## 144	1987-12-01	15.354	2115500	459.4	0.961
## 145	1988-01-01	15.770	2188000	470.3	0.933
## 146	1988-02-01	16.172	2141500	468.7	0.913
## 147	1988-03-01	15.848	2112000	472.4	0.904
## 148	1988-04-01	15.201	2081200	467.8	0.930
## 149	1988-05-01	15.606	2067750	474.7	0.955
## 150	1988-06-01	15.525	2043000	477.3	0.955
## 151	1988-07-01	15.375	2065200	472.4	0.967

##	152	1988-08-01	15.078	2088000	470.1	0.987
##	153	1988-09-01	14.710	2075750	468.7	0.974
##	154	1988-10-01	14.815	2015600	477.9	0.957
##	155	1988-11-01	15.038	1978250	481.8	0.949
##	156	1988-12-01	16.098	2045200	498.9	0.930
##	157	1989-01-01	15.017	2061000	496.2	0.918
##	158	1989-02-01	14.668	2113750	481.3	0.926
##	159	1989-03-01	14.362	2131500	481.9	0.940
##	160	1989-04-01	15.698	2098800	500.4	1.065
##	161	1989-05-01	14.942	2093500	487.6	1.119
##	162	1989-06-01	14.065	2122750	492.0	1.114
##	163	1989-07-01	14.389	2179400	497.4	1.092
##	164	1989-08-01	16.234	2207250	518.7	1.057
##	165	1989-09-01	15.361	2208800	500.8	1.029
##	166	1989-10-01	13.270	2281000	493.9	1.027
##	167	1989-11-01	13.068	2285000	490.1	0.999
##	168	1989-12-01	13.273	2285000	491.6	0.980
##	169	1990-01-01	16.010	2354750	536.4	1.042
##	170	1990-02-01	14.066	2354000	505.9	1.037
##	171	1990-03-01	14.203	2363800	503.8	1.023
##	172	1990-04-01	14.009	2380250	505.7	1.044
##	173	1990-05-01	13.743	2390000	495.3	1.061
##	174	1990-06-01	13.867	2423800	494.3	1.088
##	175	1990-07-01	13.789	2471750	496.3	1.084
##	176	1990-08-01	13.582	2509250	489.3	1.190
##	177	1990-09-01	14.025	2595400	495.1	1.294
##	178	1990-10-01	13.483	2720750	486.1	1.378
##	179	1990-11-01	12.877	2888250	482.7	1.377
##	180	1990-12-01	12.702	2968200	474.0	1.354
##	181	1991-01-01	11.596	3088000	452.7	1.247
##	182	1991-02-01	12.175	3262750	467.0	1.143
##	183	1991-03-01	12.616	3419000	495.4	1.082
##	184	1991-04-01	11.825	3483250	474.4	1.104
##	185	1991-05-01	12.270	3486750	473.5	1.156
##	186	1991-06-01	12.505	3426800	477.8	1.160
##	187	1991-07-01	12.742	3307500	485.4	1.127
##	188	1991-08-01	12.352	3291800	479.8	1.140
##	189	1991-09-01	12.890	3296250	487.9	1.143
##	190	1991-10-01	12.015	3311000	474.1	1.122
##	191	1991-11-01	12.364	3310600	477.3	1.134
##	192	1991-12-01	12.420	3349250	480.9	1.123
##	193	1992-01-01	12.367	3353250	495.6	1.073
##	194	1992-02-01	12.698	3314600	501.3	1.054
##	195	1992-03-01	12.592	3312000	491.7	1.058
##	196	1992-04-01	12.310	3343750	490.0	1.079
##	197	1992-05-01	12.860	3344800	501.9	1.136
##	198	1992-06-01	13.317	3289750	511.0	1.179
##	199	1992-07-01	12.600	3217750	507.2	1.174
##	200	1992-08-01	12.620	3250200	511.9	1.158
##	201	1992-09-01	13.114	3204250	517.1	1.158
##	202	1992-10-01	13.368	3062400	522.7	1.154
##	203	1992-11-01	12.958	2949000	514.1	1.159
##	204	1992-12-01	13.514	2823750	532.4	1.136
##	205	1993-01-01	13.193	2713000	538.1	1.117

##	206	1993-02-01	12.698	2641000	524.2	1.108
##	207	1993-03-01	13.041	2687500	521.2	1.098
##	208	1993-04-01	14.235	2775500	543.0	1.112
##	209	1993-05-01	14.212	2778400	552.0	1.129
##	210	1993-06-01	14.188	2812000	548.6	1.130
##	211	1993-07-01	14.143	2782800	558.6	1.109
##	212	1993-08-01	13.276	2803250	551.5	1.097
##	213	1993-09-01	13.676	2826000	559.8	1.085
##	214	1993-10-01	14.603	2825000	568.9	1.127
##	215	1993-11-01	14.539	2800750	574.2	1.113
##	216	1993-12-01	14.679	2762250	578.3	1.070
##	217	1994-01-01	15.035	2709600	579.6	1.043
##	218	1994-02-01	15.194	2792500	593.3	1.051
##	219	1994-03-01	14.974	2754500	593.6	1.045
##	220	1994-04-01	15.680	2736600	607.0	1.064
##	221	1994-05-01	14.249	2752750	588.9	1.080
##	222	1994-06-01	14.763	2720000	600.3	1.106
##	223	1994-07-01	14.522	2659600	602.1	1.136
##	224	1994-08-01	14.989	2647500	612.0	1.182
##	225	1994-09-01	14.911	2629250	613.8	1.177
##	226	1994-10-01	15.517	2574000	629.6	1.152
##	227	1994-11-01	15.500	2532250	635.1	1.163
##	228	1994-12-01	15.196	2528800	630.7	1.143
##	229	1995-01-01	14.363	2512500	623.6	1.129
##	230	1995-02-01	14.457	2522500	613.0	1.120
##	231	1995-03-01	14.865	2531250	627.2	1.115
##	232	1995-04-01	13.980	2519400	613.2	1.140
##	233	1995-05-01	14.418	2573000	624.8	1.200
##	234	1995-06-01	15.019	2606750	642.8	1.226
##	235	1995-07-01	14.326	2622800	631.0	1.195
##	236	1995-08-01	15.006	2607250	645.3	1.164
##	237	1995-09-01	14.959	2626800	651.3	1.148
##	238	1995-10-01	14.470	2663250	638.1	1.127
##	239	1995-11-01	15.012	2672000	650.6	1.101
##	240	1995-12-01	15.862	2612600	668.0	1.101
##	241	1996-01-01	14.449	2648750	645.8	1.129
##	242	1996-02-01	15.215	2692750	663.2	1.124
##	243	1996-03-01	15.679	2685000	670.4	1.162
##	244	1996-04-01	15.112	2633500	679.5	1.251
##	245	1996-05-01	15.624	2590500	680.1	1.323
##	246	1996-06-01	14.864	2548000	669.4	1.299
##	247	1996-07-01	14.700	2490000	672.9	1.272
##	248	1996-08-01	15.128	2494400	681.7	1.240
##	249	1996-09-01	15.184	2473000	683.6	1.234
##	250	1996-10-01	14.972	2460250	688.8	1.227
##	251	1996-11-01	15.392	2428600	692.2	1.250
##	252	1996-12-01	14.849	2487750	687.8	1.260
##	253	1997-01-01	15.332	2487750	703.3	1.261
##	254	1997-02-01	14.916	2415000	702.0	1.255
##	255	1997-03-01	15.444	2347600	711.5	1.235
##	256	1997-04-01	14.694	2324250	697.5	1.231
##	257	1997-05-01	14.717	2302800	690.2	1.226
##	258	1997-06-01	14.180	2295500	702.1	1.229
##	259	1997-07-01	15.194	2269500	715.7	1.205

##	260	1997-08-01	15.765	2272400	732.6	1.253
##	261	1997-09-01	14.711	2234750	720.0	1.277
##	262	1997-10-01	15.036	2215500	724.7	1.242
##	263	1997-11-01	15.421	2215000	740.8	1.213
##	264	1997-12-01	16.059	2235250	746.1	1.177
##	265	1998-01-01	14.400	2275200	733.0	1.131
##	266	1998-02-01	14.839	2224250	739.4	1.082
##	267	1998-03-01	15.001	2221750	740.7	1.041
##	268	1998-04-01	15.521	2182500	758.1	1.052
##	269	1998-05-01	16.649	2134600	778.3	1.092
##	270	1998-06-01	16.378	2214250	771.3	1.094
##	271	1998-07-01	14.255	2333750	769.4	1.079
##	272	1998-08-01	14.358	2237600	784.9	1.052
##	273	1998-09-01	15.862	2153000	800.9	1.033
##	274	1998-10-01	16.679	2164400	819.4	1.042
##	275	1998-11-01	15.631	2203750	817.9	1.028
##	276	1998-12-01	16.943	2220250	838.2	0.986
##	277	1999-01-01	16.094	2287200	808.4	0.972
##	278	1999-02-01	16.566	2240500	824.1	0.955
##	279	1999-03-01	16.332	2227000	827.4	0.991
##	280	1999-04-01	16.422	2237500	841.3	1.177
##	281	1999-05-01	17.059	2214400	855.4	1.178
##	282	1999-06-01	16.839	2192250	867.7	1.148
##	283	1999-07-01	17.171	2193200	865.2	1.189
##	284	1999-08-01	17.121	2180250	871.9	1.255
##	285	1999-09-01	17.116	2162000	876.4	1.280
##	286	1999-10-01	17.139	2102800	868.0	1.274
##	287	1999-11-01	17.072	2085750	871.2	1.264
##	288	1999-12-01	17.793	2097250	889.8	1.298
##	289	2000-01-01	18.114	2109800	908.6	1.301
##	290	2000-02-01	18.879	2147500	930.7	1.369
##	291	2000-03-01	17.822	2079000	923.3	1.541
##	292	2000-04-01	17.442	2015400	900.6	1.506
##	293	2000-05-01	17.467	1989500	907.0	1.498
##	294	2000-06-01	17.078	2028250	898.2	1.617
##	295	2000-07-01	16.851	2085600	897.3	1.593
##	296	2000-08-01	17.090	2117250	906.4	1.510
##	297	2000-09-01	18.245	2119600	931.3	1.582
##	298	2000-10-01	17.117	2116250	920.6	1.559
##	299	2000-11-01	16.259	2211250	913.4	1.555
##	300	2000-12-01	15.831	2306400	913.5	1.489
##	301	2001-01-01	17.251	2395750	916.5	1.472
##	302	2001-02-01	17.433	2486500	938.9	1.484
##	303	2001-03-01	16.868	2585400	925.1	1.447
##	304	2001-04-01	16.531	2697250	908.3	1.564
##	305	2001-05-01	16.503	2819250	916.0	1.729
##	306	2001-06-01	17.104	2947400	934.1	1.640
##	307	2001-07-01	16.123	3030750	925.0	1.482
##	308	2001-08-01	16.016	3120000	942.5	1.427
##	309	2001-09-01	16.056	3262200	904.1	1.531
##	310	2001-10-01	21.709	3527500	1035.1	1.362
##	311	2001-11-01	17.725	3656500	997.0	1.263
##	312	2001-12-01	16.147	3589400	955.6	1.131
##	313	2002-01-01	16.220	3550500	970.7	1.139

##	314	2002-02-01	17.005	3554250	983.2	1.130
##	315	2002-03-01	16.788	3610800	974.9	1.241
##	316	2002-04-01	17.343	3689250	1001.5	1.407
##	317	2002-05-01	15.844	3712000	962.7	1.421
##	318	2002-06-01	16.626	3635200	968.0	1.404
##	319	2002-07-01	17.829	3504250	1001.6	1.412
##	320	2002-08-01	18.105	3516800	1019.7	1.423
##	321	2002-09-01	16.326	3555000	983.9	1.422
##	322	2002-10-01	15.923	3555750	969.9	1.449
##	323	2002-11-01	16.195	3482400	978.5	1.448
##	324	2002-12-01	17.593	3482750	1009.9	1.394
##	325	2003-01-01	16.426	3414500	982.6	1.473
##	326	2003-02-01	15.814	3437000	956.4	1.641
##	327	2003-03-01	16.173	3540800	984.6	1.748
##	328	2003-04-01	16.433	3629750	1003.9	1.659
##	329	2003-05-01	16.152	3719200	1005.7	1.542
##	330	2003-06-01	16.686	3701500	1013.9	1.514
##	331	2003-07-01	16.777	3616250	1024.9	1.524
##	332	2003-08-01	17.931	3596400	1059.3	1.628
##	333	2003-09-01	16.945	3575750	1041.1	1.728
##	334	2003-10-01	16.143	3486250	1036.2	1.603
##	335	2003-11-01	17.197	3373400	1053.5	1.535
##	336	2003-12-01	16.992	3270250	1051.5	1.494
##	337	2004-01-01	16.304	3148200	1048.1	1.592
##	338	2004-02-01	16.634	3114750	1065.2	1.672
##	339	2004-03-01	16.837	3046250	1079.4	1.766
##	340	2004-04-01	16.493	3000750	1062.8	1.833
##	341	2004-05-01	17.759	2975600	1091.5	2.009
##	342	2004-06-01	15.761	2950750	1043.6	2.041
##	343	2004-07-01	16.870	2917000	1076.9	1.939
##	344	2004-08-01	16.717	2891500	1079.0	1.898
##	345	2004-09-01	17.432	2862750	1099.3	1.891
##	346	2004-10-01	17.056	2778000	1098.6	2.029
##	347	2004-11-01	16.912	2734500	1099.9	2.010
##	348	2004-12-01	17.627	2719000	1122.6	1.882
##	349	2005-01-01	16.370	2723800	1096.4	1.823
##	350	2005-02-01	16.403	2686500	1113.2	1.918
##	351	2005-03-01	16.930	2659500	1120.2	2.065
##	352	2005-04-01	17.274	2604400	1142.8	2.283
##	353	2005-05-01	16.928	2586250	1116.4	2.216
##	354	2005-06-01	17.967	2600000	1154.6	2.176
##	355	2005-07-01	20.607	2595200	1202.2	2.316
##	356	2005-08-01	16.917	2580750	1139.5	2.506
##	357	2005-09-01	16.427	2716500	1113.8	2.927
##	358	2005-10-01	14.847	2803400	1099.6	2.785
##	359	2005-11-01	16.022	2701250	1116.4	2.343
##	360	2005-12-01	16.688	2639400	1128.2	2.186
##	361	2006-01-01	17.572	2557000	1167.9	2.315
##	362	2006-02-01	16.515	2507250	1143.5	2.310
##	363	2006-03-01	16.409	2455500	1151.0	2.401
##	364	2006-04-01	16.568	2401000	1151.0	2.757
##	365	2006-05-01	16.170	2383750	1147.2	2.947
##	366	2006-06-01	16.352	2408500	1149.5	2.917
##	367	2006-07-01	17.125	2449400	1168.7	2.999

##	368	2006-08-01	15.901	2466250	1146.0	2.985
##	369	2006-09-01	16.419	2446200	1166.9	2.589
##	370	2006-10-01	16.322	2446250	1168.3	2.272
##	371	2006-11-01	16.128	2476000	1164.4	2.241
##	372	2006-12-01	16.569	2481200	1175.5	2.334
##	373	2007-01-01	16.402	2524250	1183.5	2.274
##	374	2007-02-01	16.704	2569250	1175.1	2.285
##	375	2007-03-01	16.015	2519000	1178.5	2.592
##	376	2007-04-01	16.215	2496000	1181.2	2.860
##	377	2007-05-01	16.296	2447750	1197.7	3.130
##	378	2007-06-01	15.823	2482000	1178.2	3.052
##	379	2007-07-01	15.499	2542250	1180.7	2.961
##	380	2007-08-01	16.034	2553000	1192.4	2.782
##	381	2007-09-01	16.200	2537200	1202.6	2.789
##	382	2007-10-01	16.127	2561750	1209.0	2.793
##	383	2007-11-01	16.038	2616750	1197.7	3.069
##	384	2007-12-01	15.718	2712000	1180.0	3.020
##	385	2008-01-01	15.383	2798750	1168.4	3.047
##	386	2008-02-01	15.166	2844250	1148.4	3.033
##	387	2008-03-01	14.795	2912800	1143.7	3.258
##	388	2008-04-01	14.268	2964000	1139.1	3.441
##	389	2008-05-01	14.364	3013600	1143.7	3.764
##	390	2008-06-01	14.065	3057750	1130.4	4.065
##	391	2008-07-01	12.715	3176250	1100.0	4.090
##	392	2008-08-01	13.834	3378000	1114.3	3.786
##	393	2008-09-01	12.688	3521750	1073.2	3.698
##	394	2008-10-01	10.666	3731000	1026.6	3.173
##	395	2008-11-01	10.255	4096600	1002.4	2.151
##	396	2008-12-01	10.141	4522250	995.0	1.689
##	397	2009-01-01	9.573	4861200	1023.0	1.787
##	398	2009-02-01	9.023	5297000	1006.2	1.928
##	399	2009-03-01	9.552	5765750	984.2	1.949
##	400	2009-04-01	9.197	6184500	978.8	2.056
##	401	2009-05-01	9.996	6525600	998.9	2.265
##	402	2009-06-01	9.956	6534250	1006.4	2.631
##	403	2009-07-01	11.370	6139000	1020.8	2.543
##	404	2009-08-01	14.568	6047800	1089.1	2.627
##	405	2009-09-01	9.347	5984750	995.4	2.574
##	406	2009-10-01	10.371	5765600	1003.6	2.561
##	407	2009-11-01	10.817	5460500	1017.4	2.660
##	408	2009-12-01	11.060	5141750	1021.6	2.621
##	409	2010-01-01	10.669	4839000	1006.1	2.731
##	410	2010-02-01	10.108	4793750	1005.2	2.659
##	411	2010-03-01	11.553	4731750	1052.0	2.780
##	412	2010-04-01	11.249	4728000	1046.0	2.858
##	413	2010-05-01	11.821	4674800	1041.7	2.869
##	414	2010-06-01	11.385	4583250	1044.1	2.736
##	415	2010-07-01	11.715	4528600	1047.5	2.736
##	416	2010-08-01	11.802	4461250	1053.7	2.745
##	417	2010-09-01	11.703	4467750	1056.1	2.704
##	418	2010-10-01	12.199	4363400	1079.2	2.795
##	419	2010-11-01	12.070	4195500	1077.5	2.852
##	420	2010-12-01	12.383	4100000	1078.7	2.985
##	421	2011-01-01	12.547	3918400	1085.0	3.091

##	422	2011-02-01	12.815	3849250	1083.8	3.167
##	423	2011-03-01	12.984	3765500	1095.0	3.546
##	424	2011-04-01	13.037	3770800	1090.9	3.816
##	425	2011-05-01	11.980	3773750	1081.2	3.933
##	426	2011-06-01	11.581	3741750	1076.6	3.702
##	427	2011-07-01	12.419	3721600	1085.7	3.654
##	428	2011-08-01	12.277	3716000	1085.2	3.630
##	429	2011-09-01	13.026	3742750	1101.3	3.612
##	430	2011-10-01	13.391	3701600	1114.4	3.468
##	431	2011-11-01	13.406	3652500	1107.9	3.423
##	432	2011-12-01	13.455	3573400	1114.9	3.278
##	433	2012-01-01	14.058	3451250	1130.4	3.399
##	434	2012-02-01	14.617	3381750	1145.9	3.572
##	435	2012-03-01	14.237	3336800	1138.0	3.868
##	436	2012-04-01	14.408	3323000	1137.4	3.927
##	437	2012-05-01	14.135	3328000	1133.4	3.792
##	438	2012-06-01	14.118	3324400	1129.9	3.552
##	439	2012-07-01	14.027	3305750	1134.7	3.451
##	440	2012-08-01	14.092	3306250	1138.4	3.707
##	441	2012-09-01	14.759	3314400	1151.9	3.856
##	442	2012-10-01	14.514	3276250	1141.2	3.786
##	443	2012-11-01	15.130	3326250	1169.4	3.488
##	444	2012-12-01	15.121	3190200	1180.1	3.331
##	445	2013-01-01	15.474	3132750	1192.6	3.351
##	446	2013-02-01	15.516	3058750	1193.2	3.693
##	447	2013-03-01	15.412	3037800	1180.5	3.735
##	448	2013-04-01	15.451	3041500	1182.3	3.590
##	449	2013-05-01	15.537	3012250	1187.1	3.623
##	450	2013-06-01	15.774	2992800	1186.9	3.633
##	451	2013-07-01	15.674	3020250	1190.8	3.628
##	452	2013-08-01	15.486	2934400	1187.7	3.600
##	453	2013-09-01	15.506	2895750	1188.3	3.556
##	454	2013-10-01	15.354	2928500	1191.4	3.375
##	455	2013-11-01	15.714	2851200	1201.7	3.251
##	456	2013-12-01	15.463	2858500	1190.4	3.277
##	457	2014-01-01	15.249	2876750	1173.9	3.320
##	458	2014-02-01	15.617	2848750	1204.7	3.364
##	459	2014-03-01	16.606	2779200	1231.9	3.532
##	460	2014-04-01	16.280	2721000	1230.3	3.659
##	461	2014-05-01	16.737	2667400	1238.6	3.691
##	462	2014-06-01	17.125	2588750	1249.4	3.695
##	463	2014-07-01	16.851	2533500	1248.4	3.633
##	464	2014-08-01	16.808	2504800	1258.6	3.481
##	465	2014-09-01	16.527	2447750	1259.8	3.403
##	466	2014-10-01	16.326	2423250	1263.7	3.182
##	467	2014-11-01	16.544	2408800	1272.8	2.887
##	468	2014-12-01	16.757	2380000	1272.7	2.560
##	469	2015-01-01	16.497	2349800	1272.6	2.110
##	470	2015-02-01	16.455	2340250	1276.2	2.249
##	471	2015-03-01	17.416	2326500	1297.7	2.483
##	472	2015-04-01	17.197	2281500	1304.9	2.485
##	473	2015-05-01	17.562	2260400	1311.7	2.775
##	474	2015-06-01	17.390	2273750	1306.3	2.832
##	475	2015-07-01	17.837	2244750	1315.6	2.832

##	476	2015-08-01	17.973	2254000	1319.3	2.679
##	477	2015-09-01	17.792	2243000	1315.2	2.394
##	478	2015-10-01	17.748	2207600	1307.2	2.289
##	479	2015-11-01	17.858	2208500	1321.9	2.185
##	480	2015-12-01	17.031	2203750	1322.1	2.060
##	481	2016-01-01	17.631	2204600	1321.5	1.967
##	482	2016-02-01	17.585	2188000	1341.7	1.767
##	483	2016-03-01	16.868	2166250	1326.8	1.958
##	484	2016-04-01	17.295	2155200	1334.9	2.134
##	485	2016-05-01	17.351	2175750	1338.4	2.264
##	486	2016-06-01	17.337	2159000	1356.5	2.363
##	487	2016-07-01	17.729	2141200	1364.3	2.225
##	488	2016-08-01	17.523	2148000	1360.3	2.155
##	489	2016-09-01	17.585	2113500	1370.2	2.208
##	490	2016-10-01	17.493	2075200	1373.9	2.243
##	491	2016-11-01	17.374	2048250	1356.2	2.187
##	492	2016-12-01	17.806	2056400	1387.0	2.230
##	493	2017-01-01	17.300	2036250	1385.4	2.351
##	494	2017-02-01	17.386	2018000	1386.2	2.299
##	495	2017-03-01	16.710	1996500	1383.7	2.323
##	496	2017-04-01	16.863	1974200	1394.4	2.418
##	497	2017-05-01	16.851	1944000	1394.8	2.386
##	498	2017-06-01	16.796	1962500	1406.8	2.337
##	499	2017-07-01	16.771	1961000	1411.4	2.281
##	500	2017-08-01	16.590	1953500	1402.0	2.374
##	501	2017-09-01	17.951	1951000	1434.3	2.630
##	502	2017-10-01	17.768	1922750	1441.4	2.484
##	503	2017-11-01	17.416	1927500	1452.5	2.548
##	504	2017-12-01	17.235	1894600	1457.7	2.459
##	505	2018-01-01	17.130	1908250	1455.5	2.539
##	506	2018-02-01	17.080	1860250	1453.2	2.575
##	507	2018-03-01	17.220	1830400	1455.7	2.572
##	508	2018-04-01	17.312	1813250	1471.6	2.737
##	509	2018-05-01	17.309	1746750	1481.0	2.907
##	510	2018-06-01	17.215	1734000	1477.4	2.914
##	511	2018-07-01	16.890	1749500	1481.0	2.873
##	512	2018-08-01	16.857	1723750	1489.6	2.862
##	513	2018-09-01	17.316	1685400	1485.0	2.873
##	514	2018-10-01	17.478	1657500	1489.6	2.887
##	515	2018-11-01	17.379	1681250	1509.3	2.671
##	516	2018-12-01	17.377	1695200	1458.0	2.414
##	517	2019-01-01	16.711	1716750	1483.4	2.289
##	518	2019-02-01	16.519	1729250	1463.8	2.353
##	519	2019-03-01	17.260	1724000	1508.9	2.564
##	520	2019-04-01	16.483	1673000	1507.8	2.835
##	521	2019-05-01	17.385	1682750	1529.0	2.901
##	522	2019-06-01	17.178	1697000	1537.1	2.752
##	523	2019-07-01	16.876	1691750	1541.8	2.776
##	524	2019-08-01	16.974	1694200	1545.6	2.655
##	525	2019-09-01	17.148	1678000	1561.7	2.630
##	526	2019-10-01	16.520	1693750	1541.7	2.673
##	527	2019-11-01	16.985	1692200	1553.1	2.620
##	528	2019-12-01	16.647	1736000	1548.1	2.587
##	529	2020-01-01	16.914	1737750	1557.7	2.567

```
## 530 2020-02-01 16.737 1703800 1550.0 2.465
## 531 2020-03-01 11.372 3497750 1124.0 2.267
```

```
set.seed(420)
#train and test data for car sales
split3=caTools::sample.split(car_sales$Sales,SplitRatio = 0.8)
training_set3=subset(car_sales,split3==TRUE)
test_set3=subset(car_sales,split3==FALSE)

#Fitting regression model to the training set (Unemployment, Consumption, and GasPrices)
regressor3=lm(formula=car_sales$Sales[0:531]~Unemployment$Unemployed[109:639] + Consumption$Personal_Consumption[109:639],
              data=training_set3)

#Prediction values
y_pred3=predict(regressor3,newdata=test_set3)
```

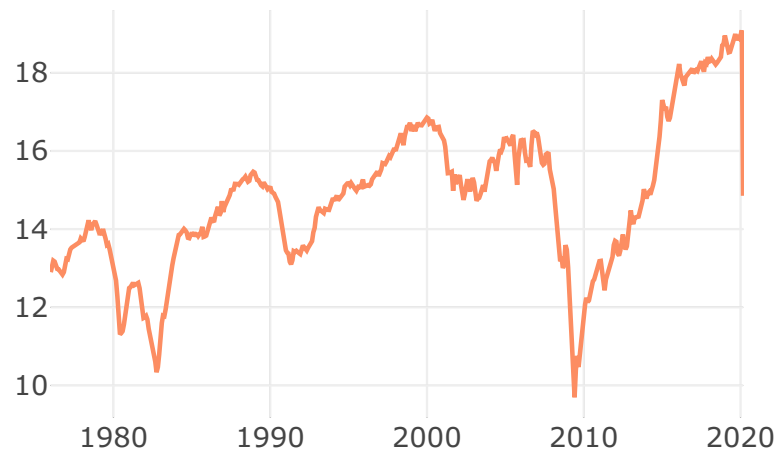
```
## Warning: 'newdata' had 107 rows but variables found have 531 rows
```

```
#plot new prediction (best fit)
new_date3 = car_sales$Date[0:531]
car_pred3 = plot_ly(car_sales, x = new_date3, y = y_pred3, type= 'scatter', mode='lines', color='red')

car_pred3
```

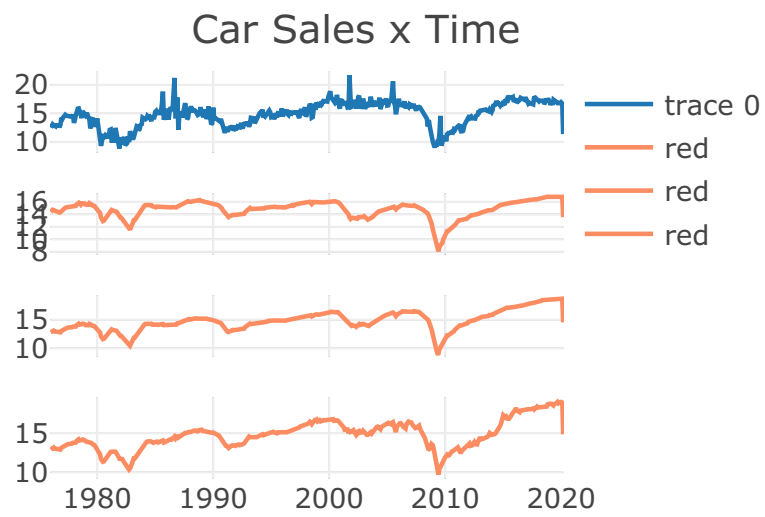
```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```

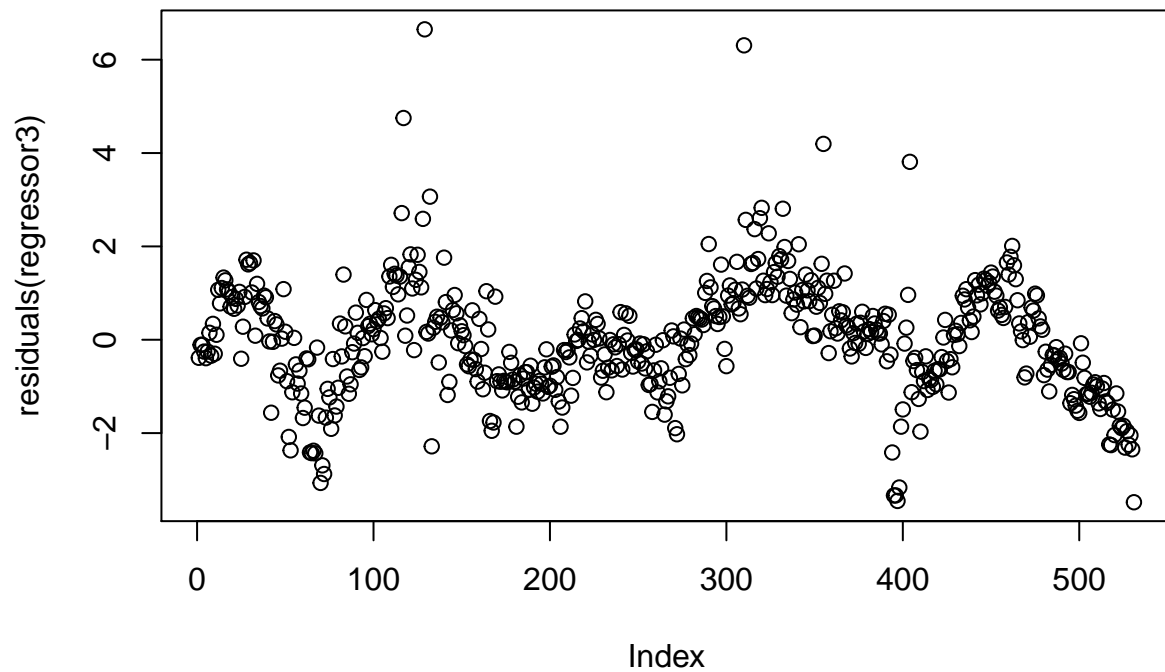


#subplot show advancement in our model (Blue is OG data, Orange are models to fit, bottom graph being m
`subplot(car_plot, car_pred1, car_pred2, car_pred3, nrow = 4, margin = 0.05, shareX = TRUE)`

```
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
## Warning in RColorBrewer::brewer.pal(N, "Set2"): minimal value for n is 3, returning requested palette
```



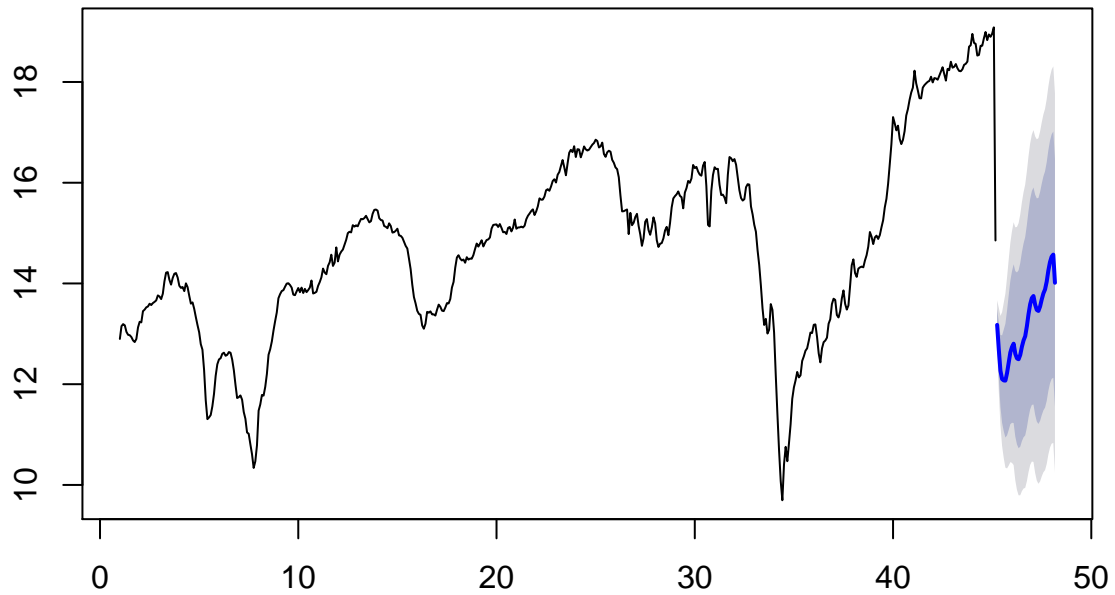
```
#residual plot  
plot(residuals(regressor3))
```



```
#plot forecast with our prediction model 3, 36 month term
data2 = data.frame(Date = new_date3,
                    Prediction = y_pred3)
ts.data = ts(data2, frequency=12)
fit <- auto.arima(ts.data[,2], D=1)
fore <- forecast(fit, h=36)

plot(fore)
```

Forecasts from ARIMA(4,0,0)(2,1,1)[12]

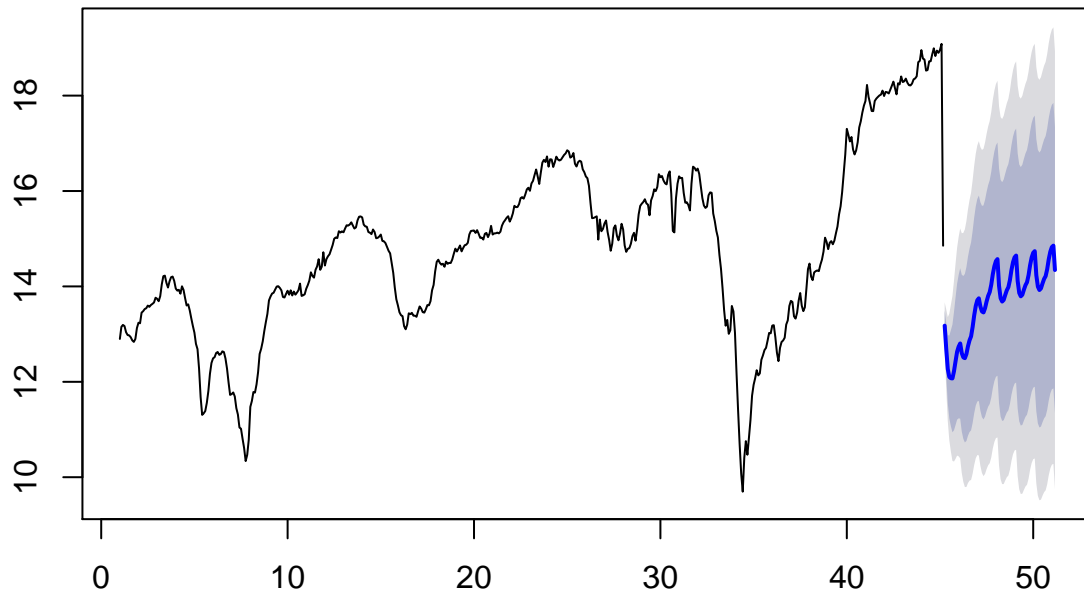


```
#plot forecast with our prediction model 3, 72 month term
data3 = data.frame(Date = new_date3,
                   Prediction = y_pred3)

ts.data1 = ts(data3, frequency=12)
fit1 <- auto.arima(ts.data1[,2], D=1)
fore1 <- forecast(fit, h=72)

plot(fore1)
```


Forecasts from ARIMA(4,0,0)(2,1,1)[12]



#Forecasted values (3yr)

fore

##	Point	Forecast	Lo 80	Hi 80	Lo 95	Hi 95
##	Apr 45	13.17735	12.85911	13.49559	12.690646	13.66406
##	May 45	12.69182	12.15186	13.23179	11.866015	13.51763
##	Jun 45	12.26681	11.55478	12.97885	11.177857	13.35577
##	Jul 45	12.10190	11.23457	12.96923	10.775434	13.42837
##	Aug 45	12.07533	11.06862	13.08204	10.535700	13.61496
##	Sep 45	12.07100	10.94157	13.20042	10.343692	13.79830
##	Oct 45	12.22256	10.98413	13.46098	10.328553	14.11656
##	Nov 45	12.42809	11.09205	13.76413	10.384788	14.47139
##	Dec 45	12.63111	11.20723	14.05499	10.453479	14.80875
##	Jan 46	12.73769	11.23435	14.24104	10.438523	15.03687
##	Feb 46	12.80448	11.22885	14.38011	10.394757	15.21420
##	Mar 46	12.60391	10.96222	14.24560	10.093158	15.11466
##	Apr 46	12.51248	10.80663	14.21834	9.903603	15.12137
##	May 46	12.49557	10.72939	14.26175	9.794424	15.19671
##	Jun 46	12.58190	10.75972	14.40409	9.795109	15.36870
##	Jul 46	12.74447	10.87010	14.61885	9.877860	15.61108
##	Aug 46	12.86950	10.94649	14.79251	9.928508	15.81049
##	Sep 46	12.95284	10.98452	14.92115	9.942562	15.96311
##	Oct 46	13.14922	11.13866	15.15978	10.074330	16.22411
##	Nov 46	13.38980	11.33978	15.43982	10.254565	16.52503
##	Dec 46	13.58866	11.50175	15.67557	10.397005	16.78031

```
## Jan 47      13.70955 11.58811 15.83100 10.465082 16.95402
## Feb 47      13.75095 11.59714 15.90476 10.456978 17.04492
## Mar 47      13.57966 11.39548 15.76384 10.239246 16.92008
## Apr 47      13.47476 11.26033 15.68920 10.088073 16.86145
## May 47      13.45449 11.21095 15.69802 10.023300 16.88567
## Jun 47      13.54347 11.27239 15.81455 10.070149 17.01679
## Jul 47      13.68372 11.38650 15.98094 10.170432 17.19701
## Aug 47      13.80274 11.48079 16.12469 10.251619 17.35386
## Sep 47      13.88155 11.53623 16.22687 10.294696 17.46841
## Oct 47      14.03602 11.66863 16.40340 10.415414 17.65662
## Nov 47      14.25636 11.86813 16.64458 10.603879 17.90883
## Dec 47      14.42385 12.01594 16.83176 10.741273 18.10643
## Jan 48      14.53136 12.10485 16.95787 10.820340 18.24238
## Feb 48      14.57249 12.12841 17.01657 10.834589 18.31038
## Mar 48      14.01340 11.55270 16.47409 10.250091 17.77670
```

#forecasted values (6yr)

fore1

```
##      Point Forecast      Lo 80      Hi 80      Lo 95      Hi 95
## Apr 45      13.17735 12.85911 13.49559 12.690646 13.66406
## May 45      12.69182 12.15186 13.23179 11.866015 13.51763
## Jun 45      12.26681 11.55478 12.97885 11.177857 13.35577
## Jul 45      12.10190 11.23457 12.96923 10.775434 13.42837
## Aug 45      12.07533 11.06862 13.08204 10.535700 13.61496
## Sep 45      12.07100 10.94157 13.20042 10.343692 13.79830
## Oct 45      12.22256 10.98413 13.46098 10.328553 14.11656
## Nov 45      12.42809 11.09205 13.76413 10.384788 14.47139
## Dec 45      12.63111 11.20723 14.05499 10.453479 14.80875
## Jan 46      12.73769 11.23435 14.24104 10.438523 15.03687
## Feb 46      12.80448 11.22885 14.38011 10.394757 15.21420
## Mar 46      12.60391 10.96222 14.24560 10.093158 15.11466
## Apr 46      12.51248 10.80663 14.21834  9.903603 15.12137
## May 46      12.49557 10.72939 14.26175  9.794424 15.19671
## Jun 46      12.58190 10.75972 14.40409  9.795109 15.36870
## Jul 46      12.74447 10.87010 14.61885  9.877860 15.61108
## Aug 46      12.86950 10.94649 14.79251  9.928508 15.81049
## Sep 46      12.95284 10.98452 14.92115  9.942562 15.96311
## Oct 46      13.14922 11.13866 15.15978 10.074330 16.22411
## Nov 46      13.38980 11.33978 15.43982 10.254565 16.52503
## Dec 46      13.58866 11.50175 15.67557 10.397005 16.78031
## Jan 47      13.70955 11.58811 15.83100 10.465082 16.95402
## Feb 47      13.75095 11.59714 15.90476 10.456978 17.04492
## Mar 47      13.57966 11.39548 15.76384 10.239246 16.92008
## Apr 47      13.47476 11.26033 15.68920 10.088073 16.86145
## May 47      13.45449 11.21095 15.69802 10.023300 16.88567
## Jun 47      13.54347 11.27239 15.81455 10.070149 17.01679
## Jul 47      13.68372 11.38650 15.98094 10.170432 17.19701
## Aug 47      13.80274 11.48079 16.12469 10.251619 17.35386
## Sep 47      13.88155 11.53623 16.22687 10.294696 17.46841
## Oct 47      14.03602 11.66863 16.40340 10.415414 17.65662
## Nov 47      14.25636 11.86813 16.64458 10.603879 17.90883
```

## Dec 47	14.42385	12.01594	16.83176	10.741273	18.10643
## Jan 48	14.53136	12.10485	16.95787	10.820340	18.24238
## Feb 48	14.57249	12.12841	17.01657	10.834589	18.31038
## Mar 48	14.01340	11.55270	16.47409	10.250091	17.77670
## Apr 48	13.75379	11.27263	16.23494	9.959190	17.54839
## May 48	13.68256	11.18010	16.18502	9.855379	17.50974
## Jun 48	13.71623	11.19305	16.23941	9.857361	17.57510
## Jul 48	13.82079	11.27738	16.36419	9.930989	17.71058
## Aug 48	13.91930	11.35637	16.48222	9.999639	17.83895
## Sep 48	13.98362	11.40205	16.56519	10.035448	17.93179
## Oct 48	14.13111	11.53179	16.73043	10.155798	18.10643
## Nov 48	14.34362	11.72744	16.95979	10.342514	18.34472
## Dec 48	14.50810	11.87592	17.14027	10.482536	18.53366
## Jan 49	14.60940	11.96207	17.25674	10.560659	18.65815
## Feb 49	14.64702	11.98533	17.30872	10.576310	18.71774
## Mar 49	14.11406	11.43875	16.78937	10.022528	18.20559
## Apr 49	13.86390	11.17181	16.55599	9.746704	17.98110
## May 49	13.79205	11.08245	16.50165	9.648076	17.93603
## Jun 49	13.82506	11.09840	16.55172	9.654989	17.99513
## Jul 49	13.92967	11.18632	16.67302	9.734083	18.12526
## Aug 49	14.02548	11.26599	16.78497	9.805210	18.24575
## Sep 49	14.08655	11.31163	16.86148	9.842672	18.33044
## Oct 49	14.23374	11.44410	17.02339	9.967353	18.50014
## Nov 49	14.44411	11.64046	17.24776	10.156302	18.73192
## Dec 49	14.60718	11.79023	17.42413	10.299031	18.91533
## Jan 50	14.70579	11.87622	17.53537	10.378333	19.03325
## Feb 50	14.73936	11.89781	17.58091	10.393579	19.08514
## Mar 50	14.23609	11.38317	17.08900	9.872931	18.59924
## Apr 50	13.99539	11.12849	16.86230	9.610843	18.37994
## May 50	13.92429	11.04279	16.80579	9.517411	18.33117
## Jun 50	13.95856	11.06281	16.85430	9.529895	18.38722
## Jul 50	14.06262	11.15293	16.97231	9.612637	18.51260
## Aug 50	14.15680	11.23362	17.07999	9.686173	18.62743
## Sep 50	14.21583	11.27971	17.15194	9.725424	18.70623
## Oct 50	14.36009	11.41164	17.30854	9.850818	18.86936
## Nov 50	14.56786	11.60766	17.52807	10.040617	19.09510
## Dec 50	14.72791	11.75653	17.69929	10.183576	19.27224
## Jan 51	14.82399	11.84200	17.80598	10.263425	19.38455
## Feb 51	14.85498	11.86291	17.84705	10.278998	19.43096
## Mar 51	14.34342	11.34178	17.34506	9.752806	18.93403