analyticsedge

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Introduction

Assignment 1 Answers

An Analytical Detective

There are two main types of crimes: violent crimes, and property crimes. In this problem, we'll focus on one specific type of property crime, called "motor vehicle theft" (sometimes referred to as grand theft auto). This is the act of stealing, or attempting to steal, a car. In this problem, we'll use some basic data analysis in R to understand the motor vehicle thefts in Chicago.

Please download the file mvtWeek1.csv for this problem (do not open this file in any spreadsheet software before completing this problem because it might change the format of the Date field).

Start:
Read the dataset mvtWeek1.csv into R, using the read.csv function, and call the data frame "mvt".

```
mvt <- read.csv("mvtWeek1.csv")
```

1.1: How many rows of data (observations) are in this dataset?
Answer: 191641

```
nrow(mvt)
```

```
[1] 191641
```

1.2: How many variables are in this dataset?
Answer: 11

```
ncol(mvt)
```

```
[1] 11
```

1.3: Using the "max" function, what is the maximum value of the variable "ID"?
Answer: 9181151

```
max(mvt$ID)
```

```
[1] 9181151
```

1.4: What is the minimum value of the variable "Beat"?
Answer: 111

```
min(mvt$Beat)
```

```
[1] 111
```

1.5: How many observations have value TRUE in the Arrest variable (this is the number of crimes for which an arrest was made)?
Answer: 15536

```
sum(mvt$Arrest)
```

```
[1] 15536
```

1.6: How many observations have a LocationDescription value of ALLEY?
Answer: 2308

```
sum(mvt$LocationDescription == "ALLEY")
```

```
[1] 2308
```

2.1: In what format are the entries in the variable Date?
Answer: Month/Day/Year Hour:Minute

```
mvt$Date[1]
```

```
[1] "12/31/12 23:15"
```

2.2: What is the month and year of the median date in our dataset? Enter your answer as "Month Year", without the quotes.
Answer: May 2006

```
DateConvert = as.Date(strptime(mvt$Date, "%m/%d/%y %H:%M"))
#summary(DateConvert)
median(DateConvert)
```

```
[1] "2006-05-21"
```

2.3: In which month did the fewest motor vehicle thefts occur?
Answer: February

```
mvt$Month = months(DateConvert)
mvt$Weekday = weekdays(DateConvert)
mvt$Date = DateConvert
table(mvt$Month)
```

```
  April    August  December  February   January      July      June     March
  15280     16572     16426     13511     16047     16801     16002     15758
    May  November   October September
  16035     16063     17086     16060
```

2.4: On which weekday did the most motor vehicle thefts occur?
Answer: Friday

```
table(mvt$Weekday)
```

```
 Friday    Monday  Saturday    Sunday  Thursday   Tuesday Wednesday
  29284     27397     27118     26316     27319     26791     27416
```

2.5: Which month has the largest number of motor vehicle thefts for which an arrest was made?
Answer: January

```
table(mvt$Month, mvt$Arrest)
```

```
          FALSE  TRUE
April     14028  1252
August    15243  1329
December  15029  1397
```

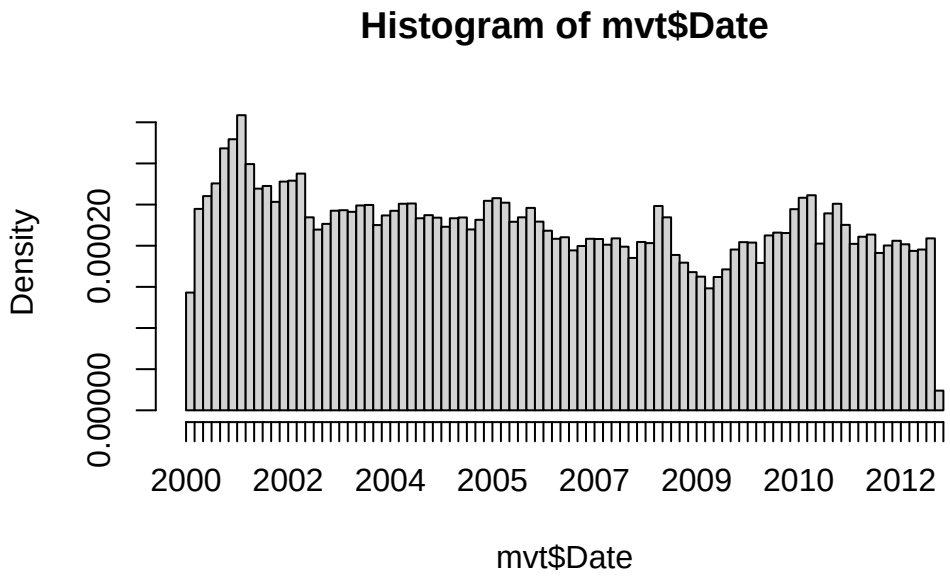
```
February  12273  1238
January   14612  1435
July      15477  1324
June      14772  1230
March     14460  1298
May       14848  1187
November  14807  1256
October   15744  1342
September 14812  1248
```

3.1.1: In general, does it look like crime increases or decreases from 2002 - 2012?
Answer: Decreases

3.1.2: In general, does it look like crime increases or decreases from 2005 - 2008?
Answer: Decreases

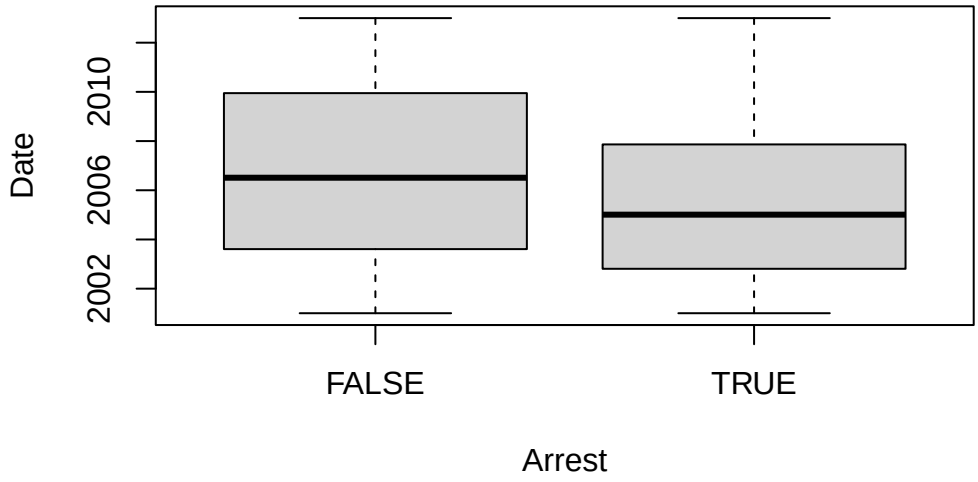
3.1.3: In general, does it look like crime increases or decreases from 2009 - 2011?
Answer: Increases

```
hist(mvt$Date, breaks=100)
```



3.2: Does it look like there were more crimes for which arrests were made in the first half of the time period or the second half of the time period?
Answer: First half

```
boxplot(Date ~ Arrest, data = mvt)
```



3.3: For what proportion of motor vehicle thefts in 2001 was an arrest made?
Answer: 0.1041173

```
table(mvt$Year, mvt$Arrest)
```

```
      FALSE  TRUE
  2001 18517  2152
  2002 16638  2115
  2003 14859  1798
  2004 15169  1693
  2005 14956  1528
  2006 14796  1302
  2007 13068  1212
  2008 13425  1020
  2009 11327   840
  2010 14796   701
  2011 15012   625
  2012 13542   550
```

```
2152/(18517+2152)
```

```
[1] 0.1041173
```

3.4: For what proportion of motor vehicle thefts in 2007 was an arrest made?
Answer: 0.08487395

```
table(mvt$Year, mvt$Arrest)
```

```
      FALSE  TRUE
  2001 18517  2152
  2002 16638  2115
  2003 14859  1798
  2004 15169  1693
  2005 14956  1528
  2006 14796  1302
  2007 13068  1212
  2008 13425  1020
  2009 11327   840
  2010 14796   701
  2011 15012   625
  2012 13542   550
```

```
1212/(13068+1212)
```

```
[1] 0.08487395
```

3.5: For what proportion of motor vehicle thefts in 2012 was an arrest made?
Answer: 0.03902924

```
table(mvt$Year, mvt$Arrest)
```

```
      FALSE  TRUE
  2001 18517  2152
  2002 16638  2115
  2003 14859  1798
  2004 15169  1693
  2005 14956  1528
  2006 14796  1302
  2007 13068  1212
  2008 13425  1020
  2009 11327   840
  2010 14796   701
```

```
2011 15012   625
2012 13542   550
```

```
550/(13542+550)
```

```
[1] 0.03902924
```

4.1: Which locations are the top five locations for motor vehicle thefts, excluding the "Other" category?
Answer: STREET, PARKING LOT/GARAGE(NON.RESID.), ALLEY, GAS STATION, DRIVEWAY - RESIDENTIAL

```
sort(table(mvt$LocationDescription), decreasing = TRUE)
```

```
                                STREET
                                156564
PARKING LOT/GARAGE(NON.RESID.)
                                14852
                                OTHER
                                 4573
                                ALLEY
                                 2308
                           GAS STATION
                                 2111
                DRIVEWAY - RESIDENTIAL
                                 1675
 RESIDENTIAL YARD (FRONT/BACK)
                                 1536
                            RESIDENCE
                                 1302
                    RESIDENCE-GARAGE
                                 1176
                     VACANT LOT/LAND
                                  985
            VEHICLE NON-COMMERCIAL
                                  817
                            SIDEWALK
                                  462
          CHA PARKING LOT/GROUNDS
                                  405
```

AIRPORT/AIRCRAFT
363
POLICE FACILITY/VEH PARKING LOT
266
PARK PROPERTY
255
SCHOOL, PUBLIC, GROUNDS
206
APARTMENT
184
SPORTS ARENA/STADIUM
166
CTA GARAGE / OTHER PROPERTY
148
COMMERCIAL / BUSINESS OFFICE
126
HOTEL/MOTEL
124
SCHOOL, PUBLIC, BUILDING
114
HOSPITAL BUILDING/GROUNDS
101
GROCERY FOOD STORE
80
CHURCH/SYNAGOGUE/PLACE OF WORSHIP
56
RESTAURANT
49
GOVERNMENT BUILDING/PROPERTY
48
COLLEGE/UNIVERSITY GROUNDS
47
CAR WASH
44
CONSTRUCTION SITE
35
SMALL RETAIL STORE
33
OTHER RAILROAD PROP / TRAIN DEPOT
28
AIRPORT EXTERIOR - NON-SECURE AREA
24
SCHOOL, PRIVATE, GROUNDS

	23
VEHICLE-COMMERCIAL	
	23
DEPARTMENT STORE	
	22
HIGHWAY/EXPRESSWAY	
	22
NURSING HOME/RETIREMENT HOME	
	21
TAXICAB	
	21
MOVIE HOUSE/THEATER	
	18
RESIDENCE PORCH/HALLWAY	
	18
BAR OR TAVERN	
	17
WAREHOUSE	
	17
FACTORY/MANUFACTURING BUILDING	
	16
SCHOOL, PRIVATE, BUILDING	
	14
TAVERN/LIQUOR STORE	
	14
AIRPORT PARKING LOT	
	11
AIRPORT VENDING ESTABLISHMENT	
	10
ATHLETIC CLUB	
	9
DRUG STORE	
	8
OTHER COMMERCIAL TRANSPORTATION	
	8
BANK	
	7
CONVENIENCE STORE	
	7
FOREST PRESERVE	
	6
AIRPORT TERMINAL UPPER LEVEL - NON-SECURE AREA	
	5

CHA APARTMENT
5
DAY CARE CENTER
5
FIRE STATION
5
ABANDONED BUILDING
4
AIRPORT BUILDING NON-TERMINAL - NON-SECURE AREA
4
BARBERSHOP
4
LAKEFRONT/WATERFRONT/RIVERBANK
4
LIBRARY
4
SAVINGS AND LOAN
4
BOWLING ALLEY
3
CLEANING STORE
3
MEDICAL/DENTAL OFFICE
3
BRIDGE
2
COLLEGE/UNIVERSITY RESIDENCE HALL
2
CURRENCY EXCHANGE
2
AIRPORT BUILDING NON-TERMINAL - SECURE AREA
1
AIRPORT EXTERIOR - SECURE AREA
1
ANIMAL HOSPITAL
1
APPLIANCE STORE
1
CTA TRAIN
1
JAIL / LOCK-UP FACILITY
1
NEWSSTAND

Create a subset of your data, only taking observations for which the theft happened in one of these five locations, and call this new data set "Top5".

```
Top5 <- subset(mvt, mvt$LocationDescription == "STREET"
       | mvt$LocationDescription == "PARKING LOT/GARAGE(NON.RESID.)"
       | mvt$LocationDescription == "ALLEY"
       | mvt$LocationDescription == "GAS STATION"
       | mvt$LocationDescription == "DRIVEWAY - RESIDENTIAL")
```

4.2: How many observations are in Top5?
Answer: 177510

```
nrow(Top5)
```

```
[1] 177510
```

4.3: One of the locations has a much higher arrest rate than the other locations. Which is it?
Answer: Gas Station (Check percentages)

```
Top5$LocationDescription = factor(Top5$LocationDescription)
table(Top5$LocationDescription, Top5$Arrest)
```

```
                                FALSE   TRUE
ALLEY                            2059    249
DRIVEWAY - RESIDENTIAL           1543    132
GAS STATION                      1672    439
PARKING LOT/GARAGE(NON.RESID.)  13249   1603
STREET                         144969  11595
```

4.4: On which day of the week do the most motor vehicle thefts at gas stations happen?
Answer: Saturday

```
table(Top5$LocationDescription == "GAS STATION", Top5$Weekday)
```

```
       Friday Monday Saturday Sunday Thursday Tuesday Wednesday
FALSE  26746  25008    24917  24220    24956   24527     25025
TRUE     332    280      338    336      282     270       273
```

4.5: On which day of the week do the fewest motor vehicle thefts in residential driveways happen?
Answer: Saturday

```
table(Top5$LocationDescription == "DRIVEWAY - RESIDENTIAL", Top5$Weekday)
```

```
       Friday Monday Saturday Sunday Thursday Tuesday Wednesday
FALSE  26821  25033    25053  24335    24975   24554     25064
TRUE     257    255      202    221      263     243       234
```

Stock Dynamics

A stock market is where buyers and sellers trade shares of a company, and is one of the most popular ways for individuals and companies to invest money. The size of the world stock market is now estimated to be in the trillions. The largest stock market in the world is the New York Stock Exchange (NYSE), located in New York City. About 2,800 companies are listed on the NYSE. In this problem, we'll look at the monthly stock prices of five of these companies: IBM, General Electric (GE), Procter and Gamble, Coca Cola, and Boeing. The data used in this problem comes from Infochimps.

Please download the following files: IBMStock.csv, GEStock.csv, ProcterGambleStock.csv, CocaColaStock.csv, BoeingStock.csv (do not open these files in any spreadsheet software before completing this problem because it might change the format of the Date field).

Start:
1. Read the datasets into R, using the read.csv function, and call the data frames "IBM", "GE", "ProcterGamble", "CocaCola", and "Boeing", respectively.

```
IBM <- read.csv("IBMStock.csv")
GE <- read.csv("GEStock.csv")
ProcterGamble <- read.csv("ProcterGambleStock.csv")
CocaCola <- read.csv("CocaColaStock.csv")
Boeing <- read.csv("BoeingStock.csv")
```

2. Before working with these data sets, we need to convert the dates into a format that R can understand. Take a look at the structure of one of the datasets using the str function. Right

now, the date variable is stored as a factor. We can convert this to a "Date" object in R by using the following five commands (one for each data set):

```
IBM$Date = as.Date(IBM$Date, "%m/%d/%y")
GE$Date = as.Date(GE$Date, "%m/%d/%y")
CocaCola$Date = as.Date(CocaCola$Date, "%m/%d/%y")
ProcterGamble$Date = as.Date(ProcterGamble$Date, "%m/%d/%y")
Boeing$Date = as.Date(Boeing$Date, "%m/%d/%y")
```

1.1: Our five datasets all have the same number of observations. How many observations are there in each data set?
Answer: 480

```
nrow(IBM)
```

```
[1] 480
```

```
# According to the assignment, use: str(IBM)
# We only need to use the command for one of the datasets, since they all have the same nu
```

1.2: What is the earliest year in our datasets?
Answer: 1970

```
min(IBM$Date)
```

```
[1] "1970-01-01"
```

```
# According to the assignment, use: summary(IBM$Date)
# Again, we only need to use the command for one of the datsets, since the observations st
```

1.3: What is the latest year in our datasets?
Answer: 2009

```
max(IBM$Date)
```

```
[1] "2009-12-01"
```

```
# According to the assignment, use: summary(IBM$Date)
# Again, we only need to use the command for one of the datsets, since the observations en
```

1.4: What is the mean stock price of IBM over this time period?
Answer: 144.375

```
mean(IBM$StockPrice)
```

```
[1] 144.375
```

```
# According to the assignment, use: summary(IBM$StockPrice)
```

1.5: What is the minimum stock price of General Electric (GE) over this time period?
Answer: 9.293636

```
min(GE$StockPrice)
```

```
[1] 9.293636
```

```
# According to the assignment, use: summary(GE$StockPrice)
```

1.6: What is the maximum stock price of Coca-Cola over this time period?
Answer: 146.5843

```
max(CocaCola$StockPrice)
```

```
[1] 146.5843
```

```
# According to the assignment, use: summary(CocaCola$StockPrice)
```

1.7: What is the median stock price of Boeing over this time period?
Answer:

```
median(Boeing$StockPrice)
```

```
[1] 44.8834
```

```
# According to the assignment, use: summary(Boeing$StockPrice)
```

1.8: What is the standard deviation of the stock price of Procter & Gamble over this time period?
Answer: 18.19414

```
sd(ProcterGamble$StockPrice)
```

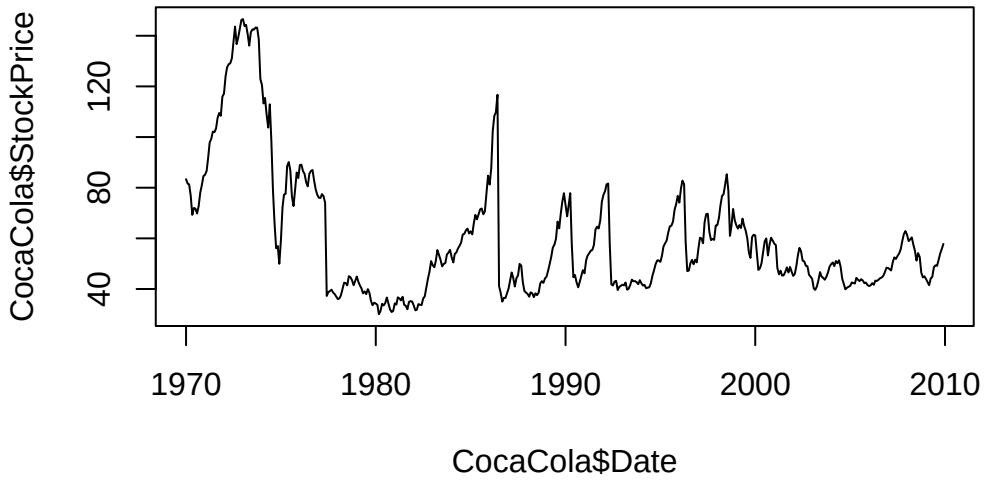
```
[1] 18.19414
```

Side note: According to the assignment, questions 1.2 - 1.7 should've been solved using the summary function. However, I used commands that would give more accurate answer. Along with the commands I used, I also wrote how the assignment could be solved using the summary function.

2.1.1: Around what year did Coca-Cola has its highest stock price in this time period?
Answer: 1973

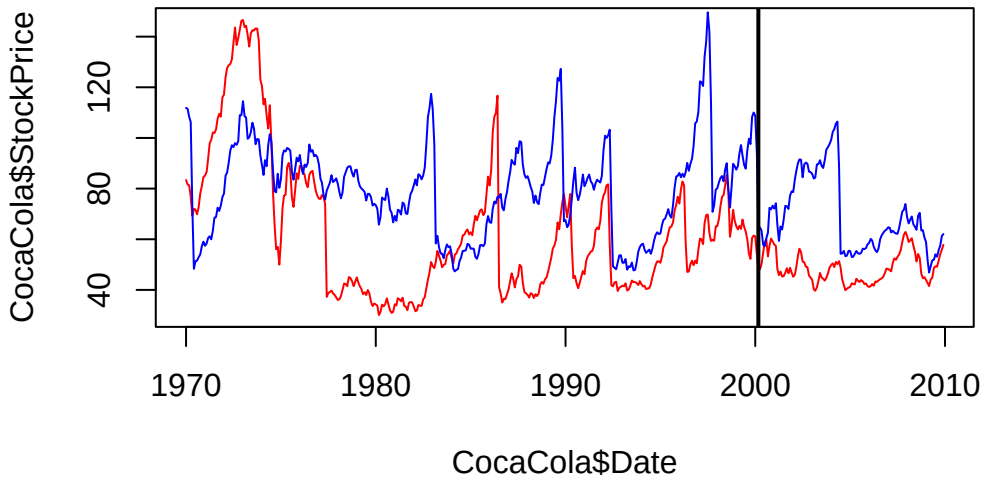
2.1.2: Around what year did Coca-Cola has its lowest stock price in this time period?
Answer: 1980

```
plot(CocaCola$Date, CocaCola$StockPrice, "l")
```



2.2: In March of 2000, the technology bubble burst, and a stock market crash occurred. According to this plot, which company's stock dropped more?
Answer: Procter and Gamble

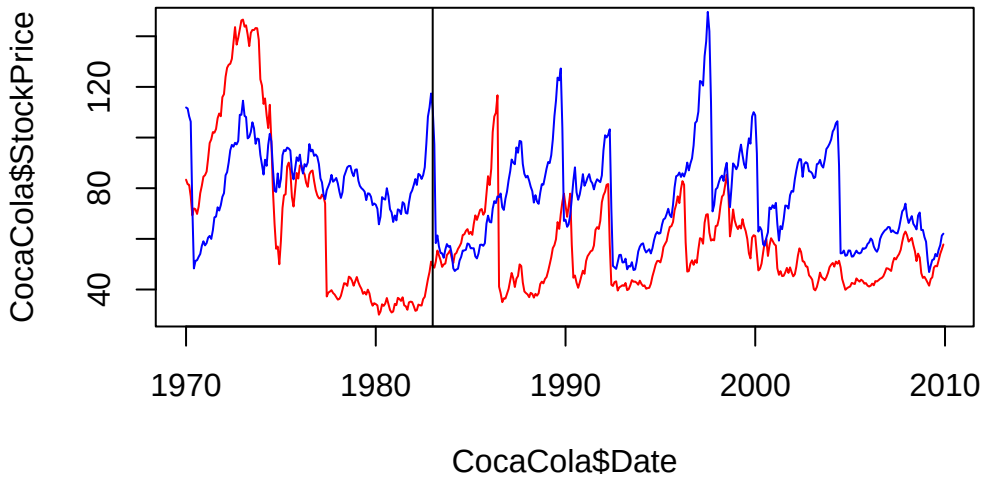
```
plot(CocaCola$Date, CocaCola$StockPrice, "l", col = "red")
lines(ProcterGamble$Date, ProcterGamble$StockPrice, col = "blue")
abline(v=as.Date(c("2000-03-01")), lwd=2)
```



2.3.1: Around 1983, the stock for one of these companies (Coca-Cola or Procter and Gamble) was going up, while the other was going down. Which one was going up?
Answer: CocaCola

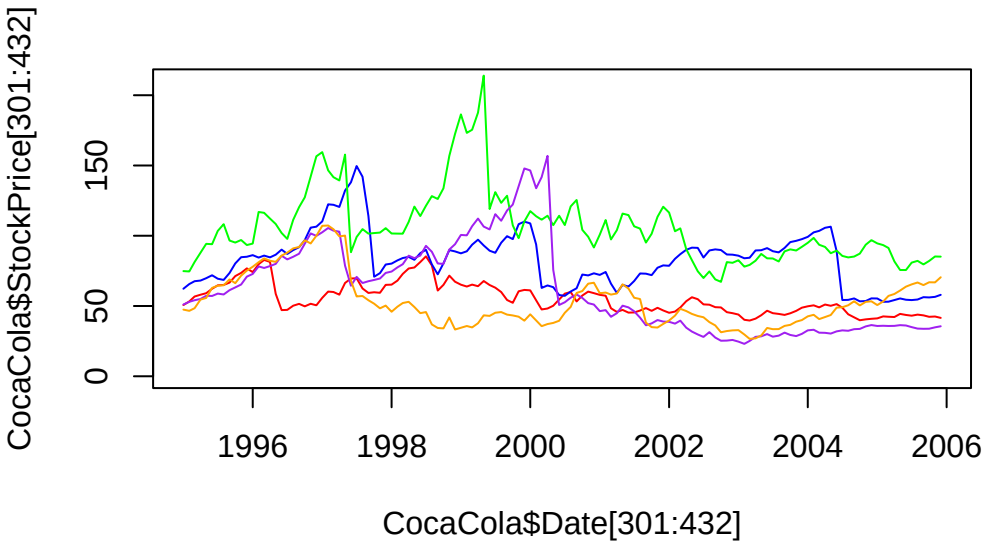
2.3.1: In the time period shown in the plot, which stock generally has lower values?
Answer: CocaCola

```
plot(CocaCola$Date, CocaCola$StockPrice, "l", col = "red")
lines(ProcterGamble$Date, ProcterGamble$StockPrice, col = "blue")
abline(v=as.Date(c("1983-01-01")))
```



Plot to answer the following questions:

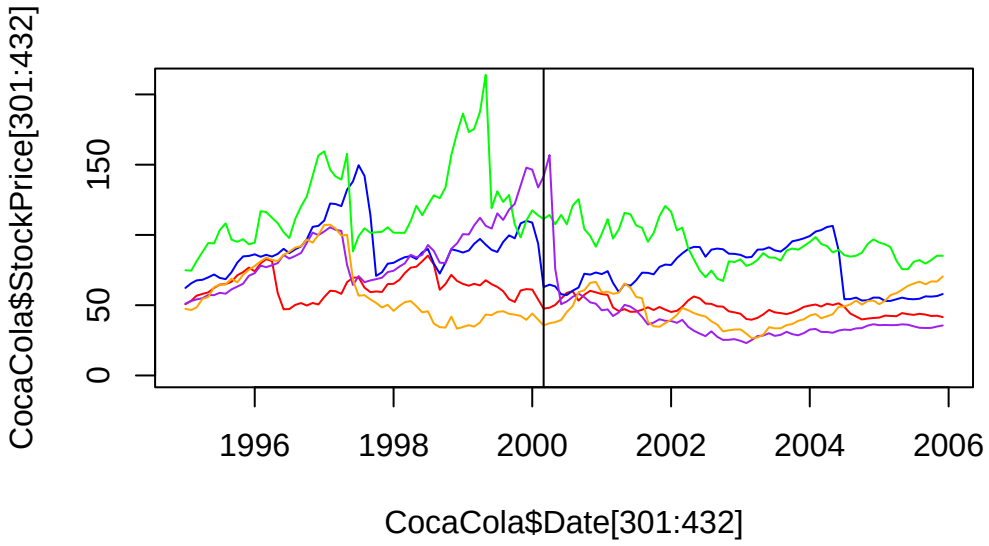
```
plot(CocaCola$Date[301:432], CocaCola$StockPrice[301:432], type="l", col="red", ylim=c(0,2
lines(ProcterGamble$Date[301:432], ProcterGamble$StockPrice[301:432], col = "blue")
lines(IBM$Date[301:432], IBM$StockPrice[301:432], col = "green")
lines(GE$Date[301:432], GE$StockPrice[301:432], col = "purple")
lines(Boeing$Date[301:432], Boeing$StockPrice[301:432], col = "orange")
```



3.1: Which stock fell the most right after the technology bubble burst in March 2000?

Answer: General Electric (GE)

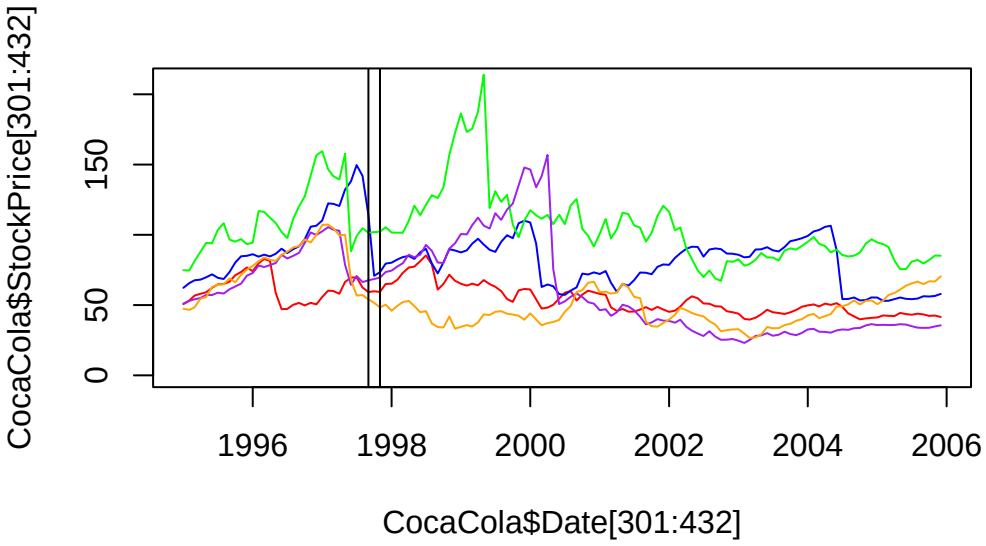
```
plot(CocaCola$Date[301:432], CocaCola$StockPrice[301:432], type="l", col="red", ylim=c(0,2
lines(ProcterGamble$Date[301:432], ProcterGamble$StockPrice[301:432], col = "blue")
lines(IBM$Date[301:432], IBM$StockPrice[301:432], col = "green")
lines(GE$Date[301:432], GE$StockPrice[301:432], col = "purple")
lines(Boeing$Date[301:432], Boeing$StockPrice[301:432], col = "orange")
abline(v = as.Date(c("2000-03-01")))
```



3.2: Which stock reaches the highest value in the time period 1995-2005?
Answer: IBM

3.3: Comparing September 1997 to November 1997, which companies saw a decreasing trend in their stock price?
Answer: Procer and Gamble, Boeing

```
plot(CocaCola$Date[301:432], CocaCola$StockPrice[301:432], type="l", col="red", ylim=c(0,2
lines(ProcterGamble$Date[301:432], ProcterGamble$StockPrice[301:432], col = "blue")
lines(IBM$Date[301:432], IBM$StockPrice[301:432], col = "green")
lines(GE$Date[301:432], GE$StockPrice[301:432], col = "purple")
lines(Boeing$Date[301:432], Boeing$StockPrice[301:432], col = "orange")
abline(v = as.Date(c("1997-09-1")))
abline(v = as.Date(c("1997-11-1")))
```



3.4: In the last two years of this time period (2004 and 2005) which stock seems to be performing the best, in terms of increasing stock price?
Answer: Boeing

4.1: In which months has IBM historically had a higher stock price (on average)?
Answer: January, February, March, April, May

```
tapply(IBM$StockPrice, months(IBM$Date), mean) > mean(IBM$StockPrice)
```

```
  April    August  December  February   January      July      June     March
   TRUE     FALSE     FALSE      TRUE      TRUE     FALSE     FALSE      TRUE
    May  November   October September
   TRUE     FALSE     FALSE     FALSE
```

4.2: General Electric and Coca-Cola both have their highest average stock price in the same month. Which month is this?
Answer: April

```
tapply(GE$StockPrice, months(GE$Date), mean) == max(tapply(GE$StockPrice, months(GE$Date),
```

```
  April    August  December  February   January      July      June     March
   TRUE     FALSE     FALSE     FALSE     FALSE     FALSE     FALSE     FALSE
    May  November   October September
  FALSE     FALSE     FALSE     FALSE
```

4.3: For the months of December and January, every company's average stock is higher in one month and lower in the other. In which month are the stock prices lower?
Answer: December

```
tapply(GE$StockPrice, months(GE$Date), mean)
```

```
   April    August  December  February   January      July      June     March
64.48009  56.50315  59.10217  62.52080  62.04511  56.73349  56.46844  63.15055
     May  November   October September
60.87135  57.28879  56.23897  56.23913
```

Demographics and Employment in the United States