

ROI on Hand Picked Stocks 2007-2020

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```
portfolio <- read.csv('all_portfolio_prices.csv', header=TRUE,
na.strings=c('', ' '),
row.names=1)

portfolio$Date <- row.names(portfolio)

Vol <- grep('Volume', colnames(portfolio))
close <- grep('Close', colnames(portfolio))
Close <- portfolio[,close]
Volume <- portfolio[,Vol]
colnames(Close)
```

## [1] "TGT.Close"	"FTR.Close"	"UBSI.Close"	"HD.Close"
"JPM.Close"			
## [6] "XOM.Close"	"CVX.Close"	"NSANY.Close"	"GNBT.Close"
"MGM.Close"			
## [11] "TEVA.Close"	"HST.Close"	"FCAU.Close"	"WFC.Close"
"WWE.Close"			
## [16] "INO.Close"	"QSR.Close"	"GRPN.Close"	"SCE.PB.Close"
"FFIN.Close"			
## [21] "GOOG.Close"	"WM.Close"	"ONCY.Close"	"S.Close"
"GM.Close"			
## [26] "F.Close"	"ASCCY.Close"	"ARWR.Close"	"COST.Close"
"AAL.Close"			
## [31] "JWN.Close"	"CSSEP.Close"	"NUS.Close"	"AMC.Close"
"ADDYY.Close"			
## [36] "KSS.Close"	"MSFT.Close"	"LUV.Close"	"HMC.Close"
"PCG.Close"			
## [41] "DLTR.Close"	"KGJI.Close"	"NKE.Close"	"AMZN.Close"
"ROST.Close"			
## [46] "TMUS.Close"	"WMT.Close"	"TJX.Close"	"TM.Close"
"PBYI.Close"			
## [51] "T.Close"	"JNJ.Close"	"C.Close"	"EPD.Close"
"VZ.Close"			
## [56] "HRB.Close"	"NFLX.Close"	"AAP.Close"	"HOFT.Close"
"SIG.Close"			
## [61] "SDC.Close"	"RRGB.Close"	"M.Close"	"JBLU.Close"
"YELP.Close"			

Remove NAs from the data. The `colSums(is.na(Close))` isn't returning the columns with NAs, so this must be done manually.

```
Close_noNAs <- Close[, -c(9,13,17,18,25,27,32,34,46,50,61,65)]
Volume_noNAs <- Volume[, -c(9,13,17,18,25,27,32,34,46,50,61,65)]
```

```
Close_noNAs$SCE.PB.Close <- as.numeric(Close_noNAs$SCE.PB.Close)
Volume_noNAs$SCE.PB.Volume <- as.numeric(Volume_noNAs$SCE.PB.Volume)
```

Add in a value of the portfolio column for each day's closing price of all stock that don't have NAs.

```
Close_noNAs$DailyValue <- rowSums(Close_noNAs, na.rm=TRUE)
```

Add in a daily change column of the portfolio closing prices.

```
dayVal <- as.data.frame(Close_noNAs$DailyValue)
colnames(dayVal) <- 'previousDayValue'
zero <- as.data.frame(as.numeric(dayVal$previousDayValue[1]))
colnames(zero) <- 'previousDayValue'
prevDay <- rbind(zero, dayVal)
Close_noNAs$prevDay <- prevDay[1:length(prevDay$previousDayValue)-1,1]
dailyChange <- as.data.frame(Close_noNAs$DailyValue-Close_noNAs$prevDay)
colnames(dailyChange) <- 'dailyValueChange'

Close1 <- cbind(Close_noNAs, dailyChange)
```

Add a column that gives the return in dollars on initial dollars invested.

```
Close1$ROI_dollars <- Close1$DailyValue-Close1$DailyValue[1]
```

Add some date fields to look at the values by date, day of the week, month, and year in analyzing this data.

```
Close1$Date <- as.Date.character(row.names(Close1))
Close1$DayOfWeek <- weekdays(as.Date(Close1$Date))

month <- month(as.Date(Close1$Date))
Month <- month.abb[month]
Close1$Month <- Month
```

Add in the year of the Date column.

```
Year <- year(as.Date(Close1$Date))

Close1$Year <- Year

Close1$MonthYear <- paste(Close1$Month, Close1$Year, sep='-')
Close1$MonthYear <- as.factor(Close1$MonthYear)
```

Add in some [unemployment](#) information as a column to see how the portfolio is doing by date.

```
ue <- read.delim('BLS_unemploymentRates2007-2020.txt', sep=',', header=TRUE,
                na.strings=c('', ' '))
UE <- ue[, -14] #remove the empty 'Annual' column
```

Use tidyr to gather the month fields with their respective unemployment rates per month.

```
gatherMonths <- gather(UE, 'UE_Month', 'UE_monthlyRate', 2:13)

gatherMonths$MonthYear <- paste(gatherMonths$UE_Month, gatherMonths$Year,
                                sep='-')
gatherMonths$MonthYear <- as.factor(gatherMonths$MonthYear)

UE2 <- gatherMonths[, 3:4]
Close2 <- merge(Close1, UE2, by.x='MonthYear', by.y='MonthYear')
row.names(Close2) <- Close2$Date
colnames(Close2)[55:58] <- paste('portfolio', colnames(Close2)[55:58],
                                sep='_')

write.csv(Close2, 'ROI_UE_2007_2020.csv', row.names=FALSE)
```

Lets add in the volume of trades per day from the Volume_noNAs data set. But lets add in some fields for total portfolio trades per day,

```
Volume1 <- Volume_noNAs
Volume1$portfolio_DailyVolume <- rowSums(Volume1, na.rm=TRUE)

dayVol <- as.data.frame(Volume1$portfolio_DailyVolume)
colnames(dayVol) <- 'portfolio_previousDayVolume'
zero <- as.data.frame(as.numeric(dayVol$portfolio_previousDayVolume[1]))
colnames(zero) <- 'portfolio_previousDayVolume'
prevDay1 <- rbind(zero, dayVol)
Volume1$portfolio_prevDayVolume <-
  prevDay1[1:(length(prevDay1$portfolio_previousDayVolume)-1), 1]

dailyVolumeChange <- as.data.frame(Volume1$portfolio_DailyVolume -
  Volume1$portfolio_prevDayVolume)
colnames(dailyVolumeChange) <- 'portfolio_dailyVolumeChange'

Volume2 <- cbind(Volume1, dailyVolumeChange)
Volume2$portfolio_VolumeRatioDaily2Initial <-
  Volume2$portfolio_DailyVolume / Volume2$portfolio_prevDayVolume[1]

Volume2$Date <- as.Date(row.names(Volume2))

stocks <- cbind(Close2, Volume2)

Stocks <- stocks[, c(2:54, 64:116, 1, 55:63, 117:120)]
colnames(Stocks)

## [1] "TGT.Close" "FTR.Close"
## [3] "UBSI.Close" "HD.Close"
```

##	[5]	"JPM.Close"	"XOM.Close"
##	[7]	"CVX.Close"	"NSANY.Close"
##	[9]	"MGM.Close"	"TEVA.Close"
##	[11]	"HST.Close"	"WFC.Close"
##	[13]	"WWE.Close"	"INO.Close"
##	[15]	"SCE.PB.Close"	"FFIN.Close"
##	[17]	"GOOG.Close"	"WM.Close"
##	[19]	"ONCY.Close"	"S.Close"
##	[21]	"F.Close"	"ARWR.Close"
##	[23]	"COST.Close"	"AAL.Close"
##	[25]	"JWN.Close"	"NUS.Close"
##	[27]	"ADDYY.Close"	"KSS.Close"
##	[29]	"MSFT.Close"	"LUV.Close"
##	[31]	"HMC.Close"	"PCG.Close"
##	[33]	"DLTR.Close"	"KGJI.Close"
##	[35]	"NKE.Close"	"AMZN.Close"
##	[37]	"ROST.Close"	"WMT.Close"
##	[39]	"TJX.Close"	"TM.Close"
##	[41]	"T.Close"	"JNJ.Close"
##	[43]	"C.Close"	"EPD.Close"
##	[45]	"VZ.Close"	"HRB.Close"
##	[47]	"NFLX.Close"	"AAP.Close"
##	[49]	"HOFT.Close"	"SIG.Close"
##	[51]	"RRGB.Close"	"M.Close"
##	[53]	"JBLU.Close"	"TGT.Volume"
##	[55]	"FTR.Volume"	"UBSI.Volume"
##	[57]	"HD.Volume"	"JPM.Volume"
##	[59]	"XOM.Volume"	"CVX.Volume"
##	[61]	"NSANY.Volume"	"MGM.Volume"
##	[63]	"TEVA.Volume"	"HST.Volume"
##	[65]	"WFC.Volume"	"WWE.Volume"
##	[67]	"INO.Volume"	"SCE.PB.Volume"
##	[69]	"FFIN.Volume"	"GOOG.Volume"
##	[71]	"WM.Volume"	"ONCY.Volume"
##	[73]	"S.Volume"	"F.Volume"
##	[75]	"ARWR.Volume"	"COST.Volume"
##	[77]	"AAL.Volume"	"JWN.Volume"
##	[79]	"NUS.Volume"	"ADDYY.Volume"
##	[81]	"KSS.Volume"	"MSFT.Volume"
##	[83]	"LUV.Volume"	"HMC.Volume"
##	[85]	"PCG.Volume"	"DLTR.Volume"
##	[87]	"KGJI.Volume"	"NKE.Volume"
##	[89]	"AMZN.Volume"	"ROST.Volume"
##	[91]	"WMT.Volume"	"TJX.Volume"
##	[93]	"TM.Volume"	"T.Volume"
##	[95]	"JNJ.Volume"	"C.Volume"
##	[97]	"EPD.Volume"	"VZ.Volume"
##	[99]	"HRB.Volume"	"NFLX.Volume"
##	[101]	"AAP.Volume"	"HOFT.Volume"
##	[103]	"SIG.Volume"	"RRGB.Volume"

```
## [105] "M.Volume" "JBLU.Volume"
## [107] "MonthYear" "portfolio_DailyValue"
## [109] "portfolio_prevDay" "portfolio_dailyValueChange"
## [111] "portfolio_ROI_dollars" "Date"
## [113] "DayOfWeek" "Month"
## [115] "Year" "UE_monthlyRate"
## [117] "portfolio_DailyVolume" "portfolio_prevDayVolume"
## [119] "portfolio_dailyVolumeChange"
"portfolio_VolumeRatioDaily2Initial"
```

Add a value of stock daily to the initial value as a ratio.

```
Stocks$portfolio_ValueRatioDaily2Initial <-
  Stocks$portfolio_DailyValue/Stocks$portfolio_DailyValue[1]
```

Add a field that multiplies the daily value and daily volume ratios compared to the initial value and volume by the unemployment rate.

```
Stocks$portfolio_DailyRatios_X_UE <-

Stocks$portfolio_ValueRatioDaily2Initial*Stocks$portfolio_VolumeRatioDaily2Initial*Stocks$UE_monthlyRate
```

Add an exponential calculation field based on the unemployment rate for rate, and using $t=1/12$ for 12 months, and a binary value of 1 or 2 where the daily change is positive is assigned a 1 and a negative is a 2. This will make those values decreasing daily have a lower poisson and those values increasing a higher poisson value. This is a modified poisson used for probability of an outcome occurring with a constant rate. Added to rank daily changes based on unemployment rate of each month.

```
Stocks <- Stocks[complete.cases(Stocks$UE_monthlyRate),]
Stocks$dayOfMonth <- day(Stocks$Date)
dayOfMonth <- day(Stocks$Date)
ue1 <- Stocks$UE_monthlyRate

incrDecr <- ifelse(Stocks$portfolio_dailyValueChange>0,1,2)

Stocks$portfolio_poisson <- round((exp(-(ue1*1/12))*(ue1*1/12)^incrDecr)/(factorial(incrDecr)),5)

summary(Stocks$portfolio_poisson)

##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## 0.03177 0.07392 0.22652 0.19506 0.29808 0.36217

write.csv(Stocks, 'StocksStats.csv', row.names=TRUE)
```

Make a daily ROI dollars column for each of the stocks in this set.

```
stocks1 <- Stocks[,1:53]
colnames(stocks1)
```

```
## [1] "TGT.Close"      "FTR.Close"      "UBSI.Close"     "HD.Close"
"JPM.Close"
## [6] "XOM.Close"      "CVX.Close"      "NSANY.Close"    "MGM.Close"
"TEVA.Close"
## [11] "HST.Close"      "WFC.Close"      "WWE.Close"      "INO.Close"
"SCE.PB.Close"
## [16] "FFIN.Close"     "GOOG.Close"     "WM.Close"       "ONCY.Close"     "S.Close"
## [21] "F.Close"        "ARWR.Close"     "COST.Close"     "AAL.Close"
"JWN.Close"
## [26] "NUS.Close"      "ADDYY.Close"    "KSS.Close"      "MSFT.Close"
"LUV.Close"
## [31] "HMC.Close"      "PCG.Close"      "DLTR.Close"     "KGJI.Close"
"NKE.Close"
## [36] "AMZN.Close"     "ROST.Close"     "WMT.Close"      "TJX.Close"
"TM.Close"
## [41] "T.Close"        "JNJ.Close"      "C.Close"        "EPD.Close"
"VZ.Close"
## [46] "HRB.Close"      "NFLX.Close"     "AAP.Close"      "HOFT.Close"
"SIG.Close"
## [51] "RRGB.Close"     "M.Close"        "JBLU.Close"
```

```
stocks1$TGT_ROI_dollars <- stocks1$TGT.Close-stocks1$TGT.Close[1]
stocks1$FTR_ROI_dollars <- stocks1$FTR.Close-stocks1$FTR.Close[1]
stocks1$UBSI_ROI_dollars <- stocks1$UBSI.Close-stocks1$UBSI.Close[1]
stocks1$HD_ROI_dollars <- stocks1$HD.Close-stocks1$HD.Close[1]
stocks1$JPM_ROI_dollars <- stocks1$JPM.Close-stocks1$JPM.Close[1]
```

```
stocks1$XOM_ROI_dollars <- stocks1$XOM.Close-stocks1$XOM.Close[1]
stocks1$CVX_ROI_dollars <- stocks1$CVX.Close-stocks1$CVX.Close[1]
stocks1$NSANY_ROI_dollars <- stocks1$NSANY.Close-stocks1$NSANY.Close[1]
stocks1$MGM_ROI_dollars <- stocks1$MGM.Close-stocks1$MGM.Close[1]
stocks1$TEVA_ROI_dollars <- stocks1$TEVA.Close-stocks1$TEVA.Close[1]
```

```
stocks1$HST_ROI_dollars <- stocks1$HST.Close-stocks1$HST.Close[1]
stocks1$WFC_ROI_dollars <- stocks1$WFC.Close-stocks1$WFC.Close[1]
stocks1$WWE_ROI_dollars <- stocks1$WWE.Close-stocks1$WWE.Close[1]
stocks1$INO_ROI_dollars <- stocks1$INO.Close-stocks1$INO.Close[1]
stocks1$SCE.PB_ROI_dollars <- stocks1$SCE.PB.Close-stocks1$SCE.PB.Close[1]
```

```
stocks1$FFIN_ROI_dollars <- stocks1$FFIN.Close-stocks1$FFIN.Close[1]
stocks1$GOOG_ROI_dollars <- stocks1$GOOG.Close-stocks1$GOOG.Close[1]
stocks1$WM_ROI_dollars <- stocks1$WM.Close-stocks1$WM.Close[1]
stocks1$ONCY_ROI_dollars <- stocks1$ONCY.Close-stocks1$ONCY.Close[1]
stocks1$S_ROI_dollars <- stocks1$S.Close-stocks1$S.Close[1]
```

```
stocks1$F_ROI_dollars <- stocks1$F.Close-stocks1$F.Close[1]
stocks1$ARWR_ROI_dollars <- stocks1$ARWR.Close-stocks1$ARWR.Close[1]
stocks1$COST_ROI_dollars <- stocks1$COST.Close-stocks1$COST.Close[1]
stocks1$AAL_ROI_dollars <- stocks1$AAL.Close-stocks1$AAL.Close[1]
stocks1$JWN_ROI_dollars <- stocks1$JWN.Close-stocks1$JWN.Close[1]
```

```

stocks1$NUS_ROI_dollars <- stocks1$NUS.Close-stocks1$NUS.Close[1]
stocks1$HMC_ROI_dollars <- stocks1$HMC.Close-stocks1$HMC.Close[1]
stocks1$AMZN_ROI_dollars <- stocks1$AMZN.Close-stocks1$AMZN.Close[1]
stocks1$T_ROI_dollars <- stocks1$T.Close-stocks1$T.Close[1]
stocks1$HRB_ROI_dollars <- stocks1$HRB.Close-stocks1$HRB.Close[1]
stocks1$RRGB_ROI_dollars <- stocks1$RRGB.Close-stocks1$RRGB.Close[1]

stocks1$ADDYY_ROI_dollars <- stocks1$ADDYY.Close-stocks1$ADDYY.Close[1]
stocks1$PCG_ROI_dollars <- stocks1$PCG.Close-stocks1$PCG.Close[1]
stocks1$ROST_ROI_dollars <- stocks1$ROST.Close-stocks1$ROST.Close[1]
stocks1$JNJ_ROI_dollars <- stocks1$JNJ.Close-stocks1$JNJ.Close[1]
stocks1$NFLX_ROI_dollars <- stocks1$NFLX.Close-stocks1$NFLX.Close[1]
stocks1$M_ROI_dollars <- stocks1$M.Close-stocks1$M.Close[1]

stocks1$KSS_ROI_dollars <- stocks1$KSS.Close-stocks1$KSS.Close[1]
stocks1$DLTR_ROI_dollars <- stocks1$DLTR.Close-stocks1$DLTR.Close[1]
stocks1$WMT_ROI_dollars <- stocks1$WMT.Close-stocks1$WMT.Close[1]
stocks1$C_ROI_dollars <- stocks1$C.Close-stocks1$C.Close[1]
stocks1$AAP_ROI_dollars <- stocks1$AAP.Close-stocks1$AAP.Close[1]
stocks1$JBLU_ROI_dollars <- stocks1$JBLU.Close-stocks1$JBLU.Close[1]

stocks1$MSFT_ROI_dollars <- stocks1$MSFT.Close-stocks1$MSFT.Close[1]
stocks1$KGJI_ROI_dollars <- stocks1$KGJI.Close-stocks1$KGJI.Close[1]
stocks1$EPD_ROI_dollars <- stocks1$EPD.Close-stocks1$EPD.Close[1]
stocks1$TJX_ROI_dollars <- stocks1$TJX.Close-stocks1$TJX.Close[1]
stocks1$HOFT_ROI_dollars <- stocks1$HOFT.Close-stocks1$HOFT.Close[1]

stocks1$LUV_ROI_dollars <- stocks1$LUV.Close-stocks1$LUV.Close[1]
stocks1$NKE_ROI_dollars <- stocks1$NKE.Close-stocks1$NKE.Close[1]
stocks1$TM_ROI_dollars <- stocks1$TM.Close-stocks1$TM.Close[1]
stocks1$VZ_ROI_dollars <- stocks1$VZ.Close-stocks1$VZ.Close[1]
stocks1$SIG_ROI_dollars <- stocks1$SIG.Close-stocks1$SIG.Close[1]

```

These are the values of the stock the previous day that will be subtracted from each day to get the daily change from the day before in dollars.

```

TGTa <- c(0,stocks1$TGT.Close[1:(length(stocks1$TGT.Close)-1)])
FTRa <- c(0, stocks1$FTR.Close[1:(length(stocks1$TGT.Close)-1)])
UBSIa <- c(0,stocks1$UBSI.Close[1:(length(stocks1$TGT.Close)-1)])
HDa <- c(0,stocks1$HD.Close[1:(length(stocks1$TGT.Close)-1)])
JPMa <- c(0,stocks1$JPM.Close[1:(length(stocks1$TGT.Close)-1)])
XOMa <- c(0,stocks1$XOM.Close[1:(length(stocks1$TGT.Close)-1)])
CVXa <- c(0,stocks1$CVX.Close[1:(length(stocks1$TGT.Close)-1)])
NSANYa <- c(0,stocks1$NSANY.Close[1:(length(stocks1$TGT.Close)-1)])
MGMa <- c(0,stocks1$MGM.Close[1:(length(stocks1$TGT.Close)-1)])
TEVAa <- c(0, stocks1$TEVA.Close[1:(length(stocks1$TGT.Close)-1)])
HSTa <- c(0, stocks1$HST.Close[1:(length(stocks1$TGT.Close)-1)])
WFCa <- c(0, stocks1$WFC.Close[1:(length(stocks1$TGT.Close)-1)])
WWEa <- c(0, stocks1$WWE.Close[1:(length(stocks1$TGT.Close)-1)])

```



```

IN0a <- c(0,stocks1$IN0.Close[1:(length(stocks1$TGT.Close)-1)])
SCEa <- c(0,stocks1$SCE.PB.Close[1:(length(stocks1$TGT.Close)-1)])
FFINa <- c(0,stocks1$FFIN.Close[1:(length(stocks1$TGT.Close)-1)])
GOOGa <- c(0,stocks1$GOOG.Close[1:(length(stocks1$TGT.Close)-1)])
WMa <- c(0,stocks1$WM.Close[1:(length(stocks1$TGT.Close)-1)])
ONCYa <- c(0,stocks1$ONCY.Close[1:(length(stocks1$TGT.Close)-1)])
Sa <- c(0,stocks1$S.Close[1:(length(stocks1$TGT.Close)-1)])
Fa <- c(0,stocks1$F.Close[1:(length(stocks1$TGT.Close)-1)])
ARWRa <- c(0,stocks1$ARWR.Close[1:(length(stocks1$TGT.Close)-1)])
COSTa <- c(0,stocks1$COST.Close[1:(length(stocks1$TGT.Close)-1)])
AALa <- c(0,stocks1$AAL.Close[1:(length(stocks1$TGT.Close)-1)])
JWNa <- c(0,stocks1$JWN.Close[1:(length(stocks1$TGT.Close)-1)])
NUSa <- c(0,stocks1$NUS.Close[1:(length(stocks1$TGT.Close)-1)])
ADDYYa <- c(0,stocks1$ADDYY.Close[1:(length(stocks1$TGT.Close)-1)])
KSSa <- c(0,stocks1$KSS.Close[1:(length(stocks1$TGT.Close)-1)])
MSFTa <- c(0,stocks1$MSFT.Close[1:(length(stocks1$TGT.Close)-1)])
LUVa <- c(0,stocks1$LUV.Close[1:(length(stocks1$TGT.Close)-1)])
HMCa <- c(0,stocks1$HMC.Close[1:(length(stocks1$TGT.Close)-1)])
PCGa <- c(0,stocks1$PCG.Close[1:(length(stocks1$TGT.Close)-1)])
DLTRa <- c(0,stocks1$DLTR.Close[1:(length(stocks1$TGT.Close)-1)])
KGJJa <- c(0,stocks1$KGJI.Close[1:(length(stocks1$TGT.Close)-1)])
NKEa <- c(0,stocks1$NKE.Close[1:(length(stocks1$TGT.Close)-1)])
AMZNa <- c(0,stocks1$AMZN.Close[1:(length(stocks1$TGT.Close)-1)])
ROSTa <- c(0,stocks1$ROST.Close[1:(length(stocks1$TGT.Close)-1)])
WMTa <- c(0,stocks1$WMT.Close[1:(length(stocks1$TGT.Close)-1)])
TJXa <- c(0,stocks1$TJX.Close[1:(length(stocks1$TGT.Close)-1)])
TMa <- c(0,stocks1$TM.Close[1:(length(stocks1$TGT.Close)-1)])
Ta <- c(0,stocks1$T.Close[1:(length(stocks1$TGT.Close)-1)])
JNJ a <- c(0,stocks1$JNJ.Close[1:(length(stocks1$TGT.Close)-1)])
Ca <- c(0,stocks1$C.Close[1:(length(stocks1$TGT.Close)-1)])
EPDa <- c(0,stocks1$EPD.Close[1:(length(stocks1$TGT.Close)-1)])
VZa <- c(0,stocks1$VZ.Close[1:(length(stocks1$TGT.Close)-1)])
HRBa <- c(0,stocks1$HRB.Close[1:(length(stocks1$TGT.Close)-1)])
NFLXa <- c(0,stocks1$NFLX.Close[1:(length(stocks1$TGT.Close)-1)])
AAPa <- c(0,stocks1$AAP.Close[1:(length(stocks1$TGT.Close)-1)])
HOFTa <- c(0,stocks1$HOFT.Close[1:(length(stocks1$TGT.Close)-1)])
SIGa <- c(0,stocks1$SIG.Close[1:(length(stocks1$TGT.Close)-1)])
RRGBa <- c(0,stocks1$RRGB.Close[1:(length(stocks1$TGT.Close)-1)])
Ma <- c(0,stocks1$M.Close[1:(length(stocks1$TGT.Close)-1)])
JBLUa <- c(0,stocks1$JBLU.Close[1:(length(stocks1$TGT.Close)-1)])

```

This creates the DailyChange per stock columns.

```

stocks1$TGT_dailyChange <- stocks1$TGT.Close-TGTa
stocks1$FTR_dailyChange <- stocks1$FTR.Close-FTRa
stocks1$UBSI_dailyChange <- stocks1$UBSI.Close-UBSIa
stocks1$HD_dailyChange <- stocks1$HD.Close-HDa
stocks1$JPM_dailyChange <- stocks1$JPM.Close-JPMa

stocks1$XOM_dailyChange <- stocks1$XOM.Close-XOMa

```



```
stocks1$CVX_dailyChange <- stocks1$CVX.Close-CVXa
stocks1$NSANY_dailyChange <- stocks1$NSANY.Close-NSANYa
stocks1$MGM_dailyChange <- stocks1$MGM.Close-MGMA
stocks1$TEVA_dailyChange <- stocks1$TEVA.Close-TEVAa
```

```
stocks1$HST_dailyChange <- stocks1$HST.Close-HSTa
stocks1$WFC_dailyChange <- stocks1$WFC.Close-WFCa
stocks1$WWE_dailyChange <- stocks1$WWE.Close-WWEa
stocks1$INO_dailyChange <- stocks1$INO.Close-INOa
stocks1$SCE.PB_dailyChange <- stocks1$SCE.PB.Close-SCEa
```

```
stocks1$FFIN_dailyChange <- stocks1$FFIN.Close-FFINa
stocks1$GOOG_dailyChange <- stocks1$GOOG.Close-GOOGa
stocks1$WM_dailyChange <- stocks1$WM.Close-WMa
stocks1$ONCY_dailyChange <- stocks1$ONCY.Close-ONCYa
stocks1$S_dailyChange <- stocks1$S.Close-Sa
```

```
stocks1$F_dailyChange <- stocks1$F.Close-Fa
stocks1$ARWR_dailyChange <- stocks1$ARWR.Close-ARWRa
stocks1$COST_dailyChange <- stocks1$COST.Close-COSTa
stocks1$AAL_dailyChange <- stocks1$AAL.Close-AALa
stocks1$JWN_dailyChange <- stocks1$JWN.Close-JWNa
```

```
stocks1$NUS_dailyChange <- stocks1$NUS.Close-NUSa
stocks1$HMC_dailyChange <- stocks1$HMC.Close-HMCA
stocks1$AMZN_dailyChange <- stocks1$AMZN.Close-AMZNa
stocks1$T_dailyChange <- stocks1$T.Close-Ta
stocks1$HRB_dailyChange <- stocks1$HRB.Close-HRBA
stocks1$RRGB_dailyChange <- stocks1$RRGB.Close-RRGBa
```

```
stocks1$ADDYY_dailyChange <- stocks1$ADDYY.Close-ADDYYa
stocks1$PCG_dailyChange <- stocks1$PCG.Close-PCGa
stocks1$ROST_dailyChange <- stocks1$ROST.Close-ROSTa
stocks1$JNJ_dailyChange <- stocks1$JNJ.Close-JNJa
stocks1$NFLX_dailyChange <- stocks1$NFLX.Close-NFLXa
stocks1$M_dailyChange <- stocks1$M.Close-Ma
```

```
stocks1$KSS_dailyChange <- stocks1$KSS.Close-KSSa
stocks1$DLTR_dailyChange <- stocks1$DLTR.Close-DLTRa
stocks1$WMT_dailyChange <- stocks1$WMT.Close-WMTa
stocks1$C_dailyChange <- stocks1$C.Close-Ca
stocks1$AAP_dailyChange <- stocks1$AAP.Close-AAPa
stocks1$JBLU_dailyChange <- stocks1$JBLU.Close-JBLUa
```

```
stocks1$MSFT_dailyChange <- stocks1$MSFT.Close-MSFTa
stocks1$KGJI_dailyChange <- stocks1$KGJI.Close-KGJIa
stocks1$EPD_dailyChange <- stocks1$EPD.Close-EPDa
stocks1$TJX_dailyChange <- stocks1$TJX.Close-TJXa
stocks1$HOFT_dailyChange <- stocks1$HOFT.Close-HOFTa
```

```
stocks1$LUV_dailyChange <- stocks1$LUV.Close-LUVa
stocks1$NKE_dailyChange <- stocks1$NKE.Close-NKEa
stocks1$TM_dailyChange <- stocks1$TM.Close-TMa
stocks1$VZ_dailyChange <- stocks1$VZ.Close-VZa
stocks1$SIG_dailyChange <- stocks1$SIG.Close-SIGa
```

Combine the stocks1 stats of ROI and daily change in dollars per stock to the stocks stats data table.

```
stocks2 <- stocks1[, -c(1:53)]
StocksSTATS <- cbind(Stocks, stocks2)
```

All the columns we now have are:

```
StocksSTATS <- StocksSTATS[, c(1:106, 125:230, 107:124)]
colnames(StocksSTATS)
```

##	[1]	"TGT.Close"	"FTR.Close"
##	[3]	"UBSI.Close"	"HD.Close"
##	[5]	"JPM.Close"	"XOM.Close"
##	[7]	"CVX.Close"	"NSANY.Close"
##	[9]	"MGM.Close"	"TEVA.Close"
##	[11]	"HST.Close"	"WFC.Close"
##	[13]	"WWE.Close"	"INO.Close"
##	[15]	"SCE.PB.Close"	"FFIN.Close"
##	[17]	"GOOG.Close"	"WM.Close"
##	[19]	"ONCY.Close"	"S.Close"
##	[21]	"F.Close"	"ARWR.Close"
##	[23]	"COST.Close"	"AAL.Close"
##	[25]	"JWN.Close"	"NUS.Close"
##	[27]	"ADDYY.Close"	"KSS.Close"
##	[29]	"MSFT.Close"	"LUV.Close"
##	[31]	"HMC.Close"	"PCG.Close"
##	[33]	"DLTR.Close"	"KGJI.Close"
##	[35]	"NKE.Close"	"AMZN.Close"
##	[37]	"ROST.Close"	"WMT.Close"
##	[39]	"TJX.Close"	"TM.Close"
##	[41]	"T.Close"	"JNJ.Close"
##	[43]	"C.Close"	"EPD.Close"
##	[45]	"VZ.Close"	"HRB.Close"
##	[47]	"NFLX.Close"	"AAP.Close"
##	[49]	"HOFT.Close"	"SIG.Close"
##	[51]	"RRGB.Close"	"M.Close"
##	[53]	"JBLU.Close"	"TGT.Volume"
##	[55]	"FTR.Volume"	"UBSI.Volume"
##	[57]	"HD.Volume"	"JPM.Volume"
##	[59]	"XOM.Volume"	"CVX.Volume"
##	[61]	"NSANY.Volume"	"MGM.Volume"
##	[63]	"TEVA.Volume"	"HST.Volume"
##	[65]	"WFC.Volume"	"WWE.Volume"

## [67]	"INO.Volume"	"SCE.PB.Volume"
## [69]	"FFIN.Volume"	"GOOG.Volume"
## [71]	"WM.Volume"	"ONCY.Volume"
## [73]	"S.Volume"	"F.Volume"
## [75]	"ARWR.Volume"	"COST.Volume"
## [77]	"AAL.Volume"	"JWN.Volume"
## [79]	"NUS.Volume"	"ADDYY.Volume"
## [81]	"KSS.Volume"	"MSFT.Volume"
## [83]	"LUV.Volume"	"HMC.Volume"
## [85]	"PCG.Volume"	"DLTR.Volume"
## [87]	"KGJI.Volume"	"NKE.Volume"
## [89]	"AMZN.Volume"	"ROST.Volume"
## [91]	"WMT.Volume"	"TJX.Volume"
## [93]	"TM.Volume"	"T.Volume"
## [95]	"JNJ.Volume"	"C.Volume"
## [97]	"EPD.Volume"	"VZ.Volume"
## [99]	"HRB.Volume"	"NFLX.Volume"
## [101]	"AAP.Volume"	"HOFT.Volume"
## [103]	"SIG.Volume"	"RRGB.Volume"
## [105]	"M.Volume"	"JBLU.Volume"
## [107]	"TGT_ROI_dollars"	"FTR_ROI_dollars"
## [109]	"UBSI_ROI_dollars"	"HD_ROI_dollars"
## [111]	"JPM_ROI_dollars"	"XOM_ROI_dollars"
## [113]	"CVX_ROI_dollars"	"NSANY_ROI_dollars"
## [115]	"MGM_ROI_dollars"	"TEVA_ROI_dollars"
## [117]	"HST_ROI_dollars"	"WFC_ROI_dollars"
## [119]	"WWE_ROI_dollars"	"INO_ROI_dollars"
## [121]	"SCE.PB_ROI_dollars"	"FFIN_ROI_dollars"
## [123]	"GOOG_ROI_dollars"	"WM_ROI_dollars"
## [125]	"ONCY_ROI_dollars"	"S_ROI_dollars"
## [127]	"F_ROI_dollars"	"ARWR_ROI_dollars"
## [129]	"COST_ROI_dollars"	"AAL_ROI_dollars"
## [131]	"JWN_ROI_dollars"	"NUS_ROI_dollars"
## [133]	"HMC_ROI_dollars"	"AMZN_ROI_dollars"
## [135]	"T_ROI_dollars"	"HRB_ROI_dollars"
## [137]	"RRGB_ROI_dollars"	"ADDYY_ROI_dollars"
## [139]	"PCG_ROI_dollars"	"ROST_ROI_dollars"
## [141]	"JNJ_ROI_dollars"	"NFLX_ROI_dollars"
## [143]	"M_ROI_dollars"	"KSS_ROI_dollars"
## [145]	"DLTR_ROI_dollars"	"WMT_ROI_dollars"
## [147]	"C_ROI_dollars"	"AAP_ROI_dollars"
## [149]	"JBLU_ROI_dollars"	"MSFT_ROI_dollars"
## [151]	"KGJI_ROI_dollars"	"EPD_ROI_dollars"
## [153]	"TJX_ROI_dollars"	"HOFT_ROI_dollars"
## [155]	"LUV_ROI_dollars"	"NKE_ROI_dollars"
## [157]	"TM_ROI_dollars"	"VZ_ROI_dollars"
## [159]	"SIG_ROI_dollars"	"TGT_dailyChange"
## [161]	"FTR_dailyChange"	"UBSI_dailyChange"
## [163]	"HD_dailyChange"	"JPM_dailyChange"
## [165]	"XOM_dailyChange"	"CVX_dailyChange"

```
## [167] "NSANY_dailyChange"      "MGM_dailyChange"
## [169] "TEVA_dailyChange"      "HST_dailyChange"
## [171] "WFC_dailyChange"       "WWE_dailyChange"
## [173] "INO_dailyChange"       "SCE.PB_dailyChange"
## [175] "FFIN_dailyChange"      "GOOG_dailyChange"
## [177] "WM_dailyChange"        "ONCY_dailyChange"
## [179] "S_dailyChange"         "F_dailyChange"
## [181] "ARWR_dailyChange"      "COST_dailyChange"
## [183] "AAL_dailyChange"       "JWN_dailyChange"
## [185] "NUS_dailyChange"       "HMC_dailyChange"
## [187] "AMZN_dailyChange"      "T_dailyChange"
## [189] "HRB_dailyChange"       "RRGB_dailyChange"
## [191] "ADDYY_dailyChange"     "PCG_dailyChange"
## [193] "ROST_dailyChange"      "JNJ_dailyChange"
## [195] "NFLX_dailyChange"      "M_dailyChange"
## [197] "KSS_dailyChange"       "DLTR_dailyChange"
## [199] "WMT_dailyChange"       "C_dailyChange"
## [201] "AAP_dailyChange"       "JBLU_dailyChange"
## [203] "MSFT_dailyChange"      "KGJI_dailyChange"
## [205] "EPD_dailyChange"       "TJX_dailyChange"
## [207] "HOFT_dailyChange"      "LUV_dailyChange"
## [209] "NKE_dailyChange"       "TM_dailyChange"
## [211] "VZ_dailyChange"        "SIG_dailyChange"
## [213] "MonthYear"             "portfolio_DailyValue"
## [215] "portfolio_prevDay"     "portfolio_dailyValueChange"
## [217] "portfolio_ROI_dollars" "Date"
## [219] "DayOfWeek"            "Month"
## [221] "Year"                 "UE_monthlyRate"
## [223] "portfolio_DailyVolume" "portfolio_prevDayVolume"
## [225] "portfolio_dailyVolumeChange"
"portfolio_VolumeRatioDaily2Initial"
## [227] "portfolio_ValueRatioDaily2Initial" "portfolio_DailyRatios_X_UE"
## [229] "dayOfMonth"           "portfolio_poisson"

write.csv(StocksSTATS, 'STOCKS_STATS.csv', row.names=TRUE)
```

Lets us pick one stock, look at the stats we added for that stock and then pull out some googled articles of that stock as a company in the news since 2007 till today's date of Feb. 18, 2020 to compare the sentiments on the company with words that we will count the number of times the company is in the news, the comments by readers, zoom in on the dates of those articles, and see how the company behaved. Lets choose the highest ROI in dollars out of our stocks and compare it to the lowest ROI in dollars.

```
m <- StocksSTATS[order(StocksSTATS$Date,
decreasing=FALSE)[length(StocksSTATS$Date)], 107:159]
t <- as.data.frame(t(m))
colnames(t) <- row.names(m)
t$StockROI <- row.names(t)

Troi <- t[order(t$'2020-01-31', decreasing=TRUE),]
```

```

mostLeast <- rbind(head(Troi,3),tail(Troi,3))
mostLeast <- na.omit(mostLeast)
mostLeast

##              2020-01-31              StockROI
## AMZN_ROI_dollars    1968.300    AMZN_ROI_dollars
## GOOG_ROI_dollars    1205.821    GOOG_ROI_dollars
## SCE.PB_ROI_dollars    679.000    SCE.PB_ROI_dollars
## MGM_ROI_dollars      -40.520    MGM_ROI_dollars
## FTR_ROI_dollars     -225.200    FTR_ROI_dollars
## C_ROI_dollars        -436.090    C_ROI_dollars

```

The above table shows the three highest returns on investment and the three lowest since Jan 3, 2007 to Jan 31, 2020. Lets use the lowest stock for now (C is Citigroup bank), because AMZN (Amazon) is always in the news and it would fluctuate a lot I would think, but we could look at the quartiles for each and get the news releases of each date where the stock was in that quartile range, look at the median ROI, the min and max too, and cross referencing with the other stat fields.

```

amzn <- grep('AMZN', colnames(StocksSTATS))
c <- grep('^C[.|_]', colnames(StocksSTATS))
C_stock <- StocksSTATS[,c(c,213:230)]
amzn_stock <- StocksSTATS[,c(amzn,213:230)]

```

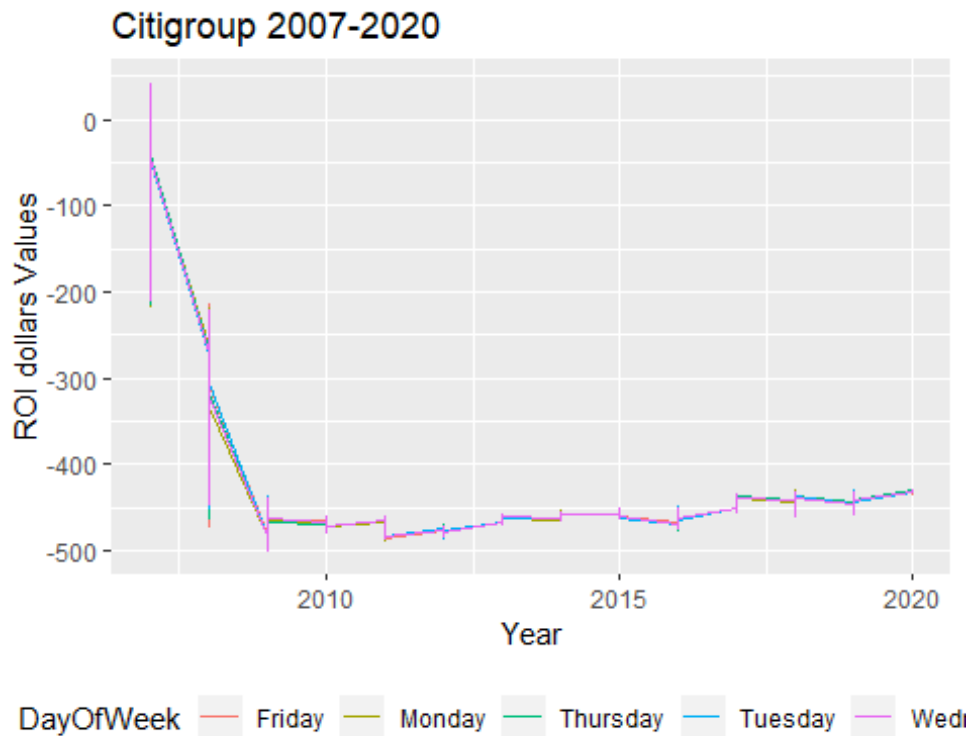
Citigroup is our C_stock table and Amazon is our amzn_stock table. Lets look at the daily ratios of volume and ROI in dollars times the unemployment rate column and the day of the week and day of the year and poisson columns.

```

ggplot(data = C_stock, aes(x=Year, y=C_ROI_dollars,group=DayOfWeek)) +
  geom_line(aes(color=DayOfWeek))+
  scale_y_continuous()+
  scale_fill_brewer(palette="paired") +
  theme(legend.position="bottom")+
  ggtitle('Citigroup 2007-2020')+
  ylab('ROI dollars Values')

## Warning in pal_name(palette, type): Unknown palette paired

```



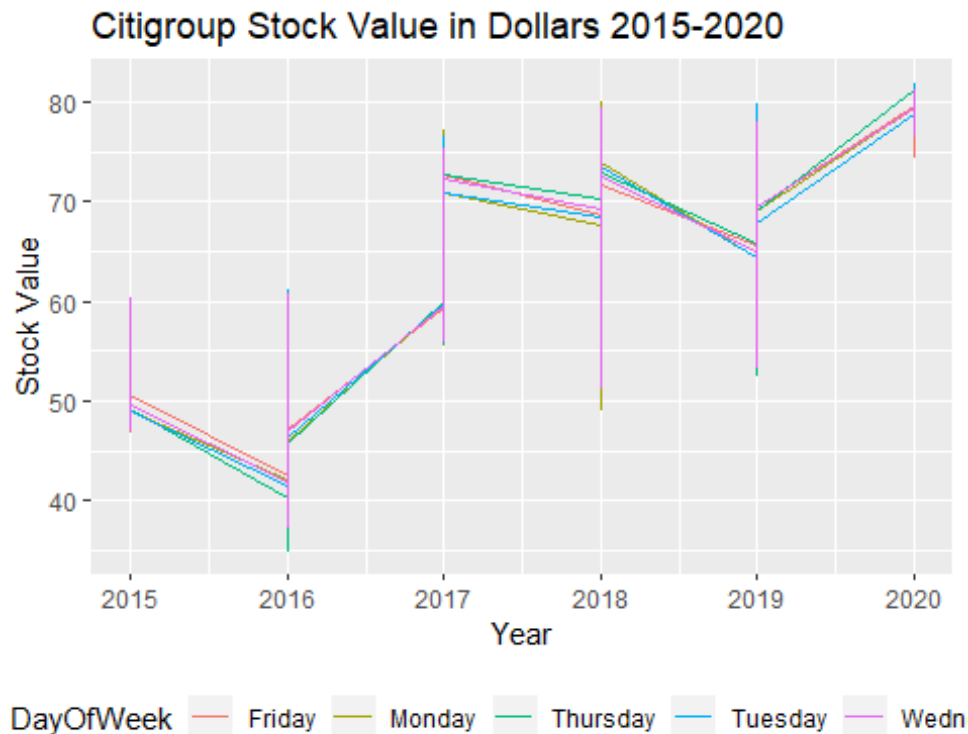
We can see from the plot above that buying Citigroup stock anywhere before 2010, was a bad idea. But we also see that the stock would have been good to buy around 2010-2016, as it overall increased its return on investment in dollars initially invested.

Lets look at the years from 2016-2020 to see this plotted Citigroup stock.

```
y2015plus <- subset(C_stock, C_stock$Year>2014)

ggplot(data = y2015plus, aes(x=Year, y=C.Close,group=DayOfWeek)) +
  geom_line(aes(color=DayOfWeek))+
  scale_y_continuous()+
  scale_fill_brewer(palette="paired") +
  theme(legend.position="bottom")+
  ggtitle('Citigroup Stock Value in Dollars 2015-2020')+
  ylab('Stock Value')

## Warning in pal_name(palette, type): Unknown palette paired
```

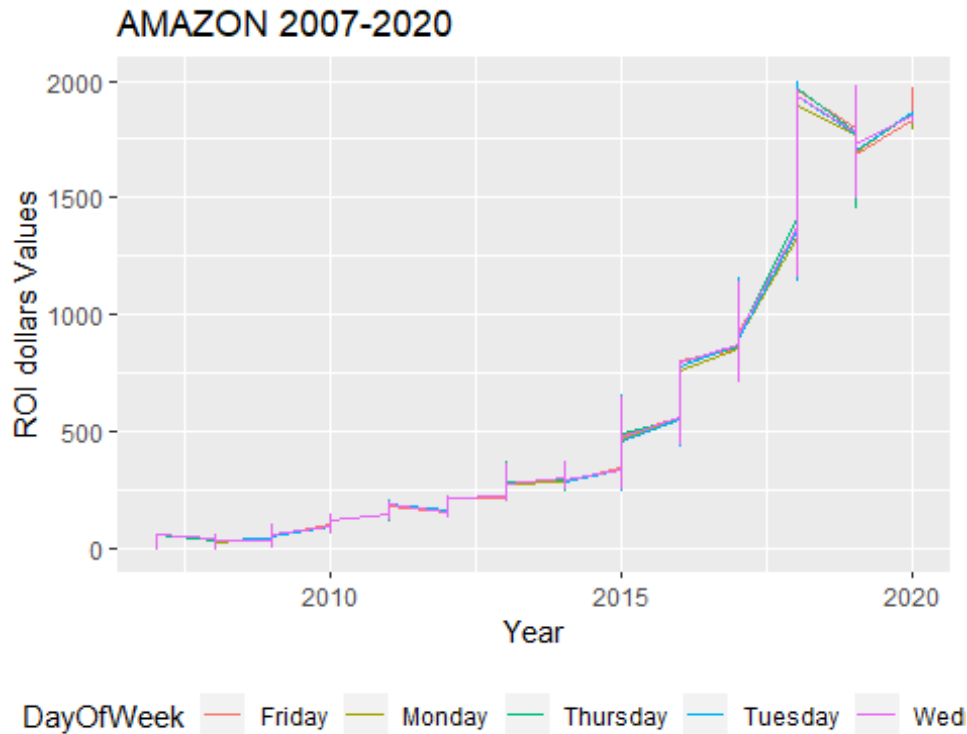


We see from the above plot that Citigroup was good to buy at the start of 2016 or 2019 if you want to see an increase all year long, but in 2017-2018 it decreased. Overall, if investing since 2016, the stock increased from the high \$40 to the mid-high \$70 range. This would be good to cross reference with unemployment rates and the news articles online text mined for public sentiment on Citigroup.

Lets look at amazon for the same quick plotted analysis as done with Citigroup.

```
ggplot(data = amzn_stock, aes(x=Year, y=AMZN_ROI_dollars, group=DayOfWeek)) +
  geom_line(aes(color=DayOfWeek)) +
  scale_y_continuous() +
  scale_fill_brewer(palette="paired") +
  theme(legend.position="bottom") +
  ggtitle('AMAZON 2007-2020') +
  ylab('ROI dollars Values')
```

```
## Warning in pal_name(palette, type): Unknown palette paired
```

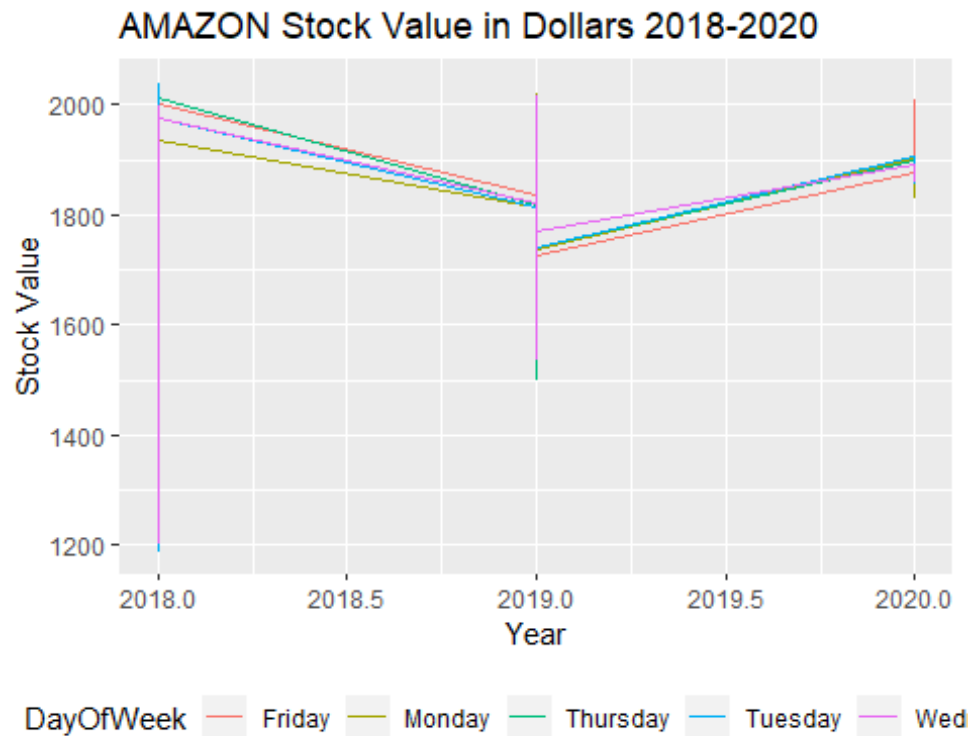
We can see from the plot above that buying AMAZON stock anywhere before 2010, was a great idea. But we also see that the stock would have been good to buy around 2010-2018 or 2019 but not in 2018, as it overall increased its return on investment in dollars initially invested. In 2018, you bought high and it decreased the entire year. This would be great to see what happened in 2018 with the value. So we will.

Lets look at the years from 2018-2020 to see this plotted Citigroup stock.

```
y2015plus <- subset(amzn_stock, amzn_stock$Year>2017)

ggplot(data = y2015plus, aes(x=Year, y=AMZN.Close, group=DayOfWeek)) +
  geom_line(aes(color=DayOfWeek)) +
  scale_y_continuous() +
  scale_fill_brewer(palette="paired") +
  theme(legend.position="bottom") +
  ggtitle('AMAZON Stock Value in Dollars 2018-2020') +
  ylab('Stock Value')

## Warning in pal_name(palette, type): Unknown palette paired
```



The chart above shows how the value in dollars and day of the week from 2018-2020 decreases in 2018 and increases in 2019. If you bought in 2018, you lost money the entire year, but you gained it back in 2019 plus some additional earnings.

Lets group by the day of the month in this time series of the Citigroup stock and get the median value for the volume of stocks traded for Citigroup by days 1-31 of the month.

```
v1 <- as.vector(colnames(C_stock)[2])
Citi <- C_stock %>% group_by(dayOfMonth) %>% summarise_at(vars(v1), median,
                                                             na.rm=T)

Citi <- as.data.frame(Citi)
colnames(Citi)[2] <- 'Citi_Median_Volume'
Citi <- Citi[order(Citi$Citi_Median_Volume, decreasing=T),]
headTail_Citi_volume <- rbind(head(Citi,3), tail(Citi,3))
headTail_Citi_volume
```

##	dayOfMonth	Citi_Median_Volume
## 16	16	22388100
## 31	31	22302200
## 3	3	21221500
## 25	25	17960700
## 20	20	17548500
## 2	2	17134600

From the above table we see that the most volume of trades for Citigroup is at the middle and end of the month, and the lowest volume of trades are at the beginning of the new month and the third week of the month.

Lets look at the statistics of citigroup.

```
summary(C_stock)
```

```
##      C.Close      C.Volume      C_ROI_dollars      C_dailyChange
## Min.   : 10.20   Min.   : 1005100   Min.   :-500.3   Min.   :-298.300
## 1st Qu.: 41.80   1st Qu.: 13019600   1st Qu.: -468.7   1st Qu.: -0.680
## Median : 51.49   Median : 19493900   Median : -459.0   Median : -0.010
## Mean   : 93.38   Mean   : 26987469   Mean   : -417.1   Mean   :  0.021
## 3rd Qu.: 69.46   3rd Qu.: 33280800   3rd Qu.: -441.0   3rd Qu.:  0.650
## Max.   :552.50   Max.   :377263800   Max.   :  42.0   Max.   : 510.500
##
##      MonthYear      portfolio_DailyValue      portfolio_prevDay
## Aug-2007: 23   Min.   :1229      Min.   :1229
## Aug-2011: 23   1st Qu.:2821      1st Qu.:2821
## Aug-2012: 23   Median :3542      Median :3541
## Aug-2016: 23   Mean    :3988      Mean    :3986
## Aug-2017: 23   3rd Qu.:5104      3rd Qu.:5104
## Aug-2018: 23   Max.    :7910      Max.    :7910
## (Other) :3155
## portfolio_dailyValueChange      portfolio_ROI_dollars      Date
## Min.   :-1014.322      Min.   :-1748.9      Min.   :2007-01-03
## 1st Qu.: -39.065      1st Qu.: -157.4      1st Qu.:2010-04-12
## Median :  2.276      Median :  563.9      Median :2013-07-18
## Mean    :  1.475      Mean    : 1009.6      Mean    :2013-07-16
## 3rd Qu.: 43.517      3rd Qu.: 2126.4      3rd Qu.:2016-10-21
## Max.    :1025.453      Max.    : 4931.7      Max.    :2020-01-31
##
##      DayOfWeek      Month      Year      UE_monthlyRate
## Length:3293      Length:3293      Min.   :2007      Min.   : 3.500
## Class :character      Class :character      1st Qu.:2010      1st Qu.: 4.600
## Mode  :character      Mode  :character      Median :2013      Median : 5.600
##                                     Mean    :2013      Mean    : 6.282
##                                     3rd Qu.:2016      3rd Qu.: 8.200
##                                     Max.    :2020      Max.    :10.000
##
## portfolio_DailyVolume      portfolio_prevDayVolume      portfolio_dailyVolumeChange
## Min.   :1.133e+08      Min.   :1.133e+08      Min.   : -714176400
## 1st Qu.:3.370e+08      1st Qu.:3.370e+08      1st Qu.: -50722061
## Median :4.194e+08      Median :4.196e+08      Median :  250560
## Mean   :4.752e+08      Mean   :4.753e+08      Mean   : -55791
## 3rd Qu.:5.716e+08      3rd Qu.:5.716e+08      3rd Qu.: 50561500
## Max.   :1.611e+09      Max.   :1.611e+09      Max.   : 620907605
##
## portfolio_VolumeRatioDaily2Initial      portfolio_ValueRatioDaily2Initial
## Min.   :0.1981      Min.   :0.4236
## 1st Qu.:0.5891      1st Qu.:0.9720
## Median :0.7333      Median :1.2206
## Mean    :0.8307      Mean    :1.3742
## 3rd Qu.:0.9992      3rd Qu.:1.7591
```

```
## Max.      :2.8163                      Max.      :2.7259
##
## portfolio_DailyRatios_X_UE  dayOfMonth  portfolio_poisson
## Min.      : 0.9658          Min.      : 1.00      Min.      :0.03177
## 1st Qu.: 4.4923            1st Qu.: 8.00      1st Qu.:0.07392
## Median : 5.6528            Median :16.00      Median :0.22652
## Mean    : 6.4285            Mean    :15.74      Mean    :0.19506
## 3rd Qu.: 7.8497            3rd Qu.:23.00      3rd Qu.:0.29808
## Max.     :24.2627          Max.     :31.00      Max.     :0.36217
##
```

From the above summary statistics of Citigroup, we see the min, quantiles, median, mean, and max numeric values as well as length and class type for the non-numeric features of this data set.

Some interesting insights into the above table are that considering an initial investment of 510 USD, the return on the initial investment in dollars is almost the entire amount invested but not quite. Definitely about 80% from the quantile and statistics on the ROI column.

The daily changes fluctuated from a loss of 298 USD in one day to a profit of 510 USD on another day. These are good indicators of where to look on these days, to see if the public sentiment on these dates for Citigroup would indicate more people getting rid of their Citi stock or buying up more of it.

Also, the max and min volume of stock is much more and less respectively than the median volume of trades for this Citigroup stock. These dates for information would also be an interesting place to start to find a pattern with buying/selling stock and combining web scraped text from news articles and comments about Citigroup on those dates.

First, we should grab those points of interest in the data and create a table to compare these values.

```
C_stock_minmaxValueChanges <- subset(C_stock,
C_stock$C_dailyChange==min(C_stock$C_dailyChange) |
C_stock$C_dailyChange==max(C_stock$C_dailyChange) |
C_stock$C.Volume==min(C_stock$C.Volume) |
C_stock$C.Volume==max(C_stock$C.Volume))
C_stock_minmaxValueChanges

##           C.Close  C.Volume C_ROI_dollars C_dailyChange MonthYear
## 2007-04-02  510.50   2282100         0.00    510.500000  Apr-2007
## 2013-04-02   44.11   1005100        -466.39     0.320000  Apr-2013
## 2015-12-28   52.38  377263800        -458.12    -0.329998  Dec-2015
## 2008-06-02  214.60  15302800        -295.90   -298.300018  Jun-2008
##           portfolio_DailyValue portfolio_prevDay
```

```

portfolio_dailyValueChange
## 2007-04-02          2901.650          2891.963
9.686608
## 2013-04-02          3433.938          3354.901
79.037872
## 2015-12-28          5005.455          4984.970
20.485009
## 2008-06-02          3120.541          3144.698          -
24.157199
##          portfolio_ROI_dollars          Date DayOfWeek Month Year
UE_monthlyRate
## 2007-04-02          -76.28907 2007-04-02   Monday   Apr 2007
4.5
## 2013-04-02          455.99978 2013-04-02  Tuesday   Apr 2013
7.6
## 2015-12-28          2027.51641 2015-12-28   Monday   Dec 2015
5.0
## 2008-06-02          142.60220 2008-06-02   Monday   Jun 2008
5.6
##          portfolio_DailyVolume portfolio_prevDayVolume
## 2007-04-02          572035712          572035712
## 2013-04-02          258084601          330998801
## 2015-12-28          975152259          752607802
## 2008-06-02          464823559          265152951
##          portfolio_dailyVolumeChange portfolio_VolumeRatioDaily2Initial
## 2007-04-02          0          1.0000000
## 2013-04-02          -72914200          0.4511687
## 2015-12-28          222544457          1.7047052
## 2008-06-02          199670608          0.8125779
##          portfolio_ValueRatioDaily2Initial portfolio_DailyRatios_X_UE
## 2007-04-02          1.000000          4.500000
## 2013-04-02          1.183444          4.057888
## 2015-12-28          1.725038          14.703404
## 2008-06-02          1.075437          4.893707
##          dayOfMonth portfolio_poisson
## 2007-04-02          2          0.25773
## 2013-04-02          2          0.33619
## 2015-12-28          28          0.27468
## 2008-06-02          2          0.06828

```

From the above information, Monday is the day of the week with the highest and lowest daily change, as well as the highest volume of trade. Tuesday is the day with the lowest volume of trade. The dates to pull an internet search of news articles about Citigroup to analyze public sentiment on Citi stock are:

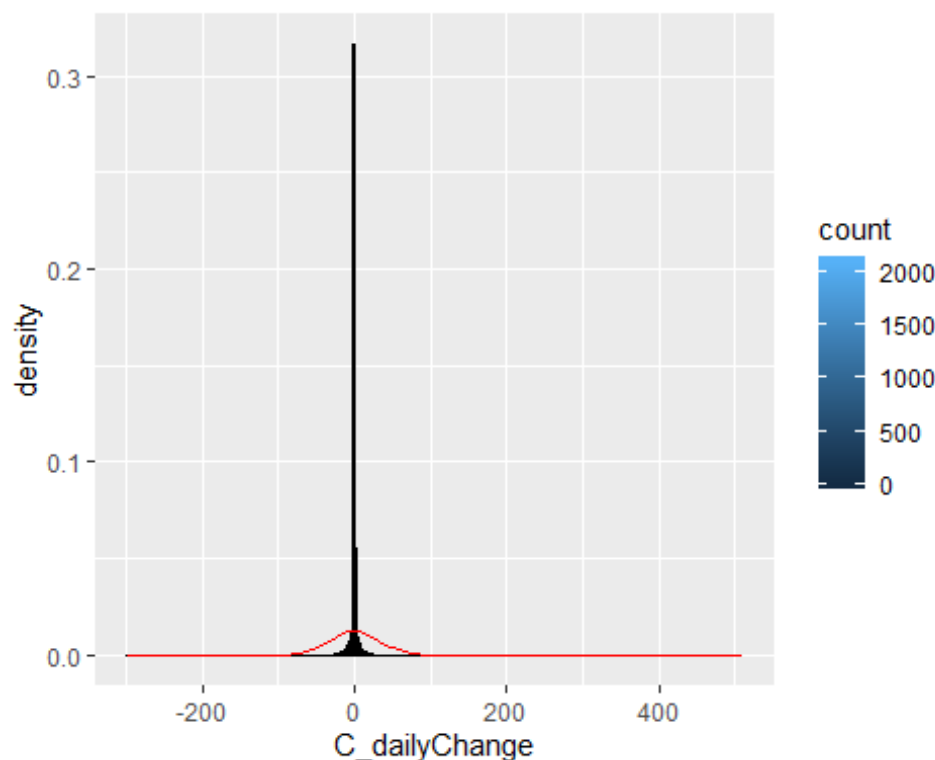
- April 2, 2007
- April 2, 2013
- December 28, 2015
- June 2, 2008

This should be interesting to see what type of articles are available on line with a google search of those dates and citigroup.

Lets see if there are any other outlier dates to examine by looking at the standard deviation of the daily change on Citigroup stock. We want to see if there are any days where the stock has a daily change more than or less than this amount times three then times two. Because most values will be within the standard deviation for the Gaussian curve.

```
gg <- ggplot(C_stock, aes(x=C_dailyChange))
gg <- gg + geom_histogram(binwidth=2, colour="black",
                          aes(y=..density.., fill=..count..))
#gg <- gg + scale_fill_gradient("Count", low="#DCDCDC", high="#7C7C7C")
gg <- gg + stat_function(fun=dnorm,
                        color="red",
                        args=list(mean=mean(C_stock$C_dailyChange),
                                sd=sd(C_stock$C_dailyChange)))
```

gg



```
sdC <- sd(C_stock$C_dailyChange)
out <- sdC*3
sdC;out

## [1] 32.16953
## [1] 96.50858
```

The standard error for the daily change in dollars is 32.17 USD and our threshold to find dates outside this normal range of daily change dollar values is 96.51 USD.

Lets add another column to this data set called threshold3 for those daily change values inside the threshold and those outside the threshold.

```
C_stock$Threshold3 <- ifelse(C_stock$C_dailyChange < out, 'inside','outside')
```

```
C_outer_SD <- subset(C_stock, C_stock$Threshold3=='outside')
summary(C_outer_SD)
```

```
##      C.Close      C.Volume      C_ROI_dollars      C_dailyChange
##  Min.   :330.6    Min.    : 2282100    Min.    :-179.90    Min.    :266.2
##  1st Qu.:471.2    1st Qu.:13456250    1st Qu.: -39.30    1st Qu.:399.6
##  Median :510.6    Median :19551450    Median :   0.15    Median :441.4
##  Mean   :488.2    Mean   :30425167    Mean    :-22.32    Mean   :424.4
##  3rd Qu.:542.8    3rd Qu.:35952375    3rd Qu.: 32.27    3rd Qu.:475.4
##  Max.   :552.5    Max.    :81343800    Max.     : 42.00    Max.    :510.5
##
##      MonthYear portfolio_DailyValue portfolio_prevDay
portfolio_dailyValueChange
## Apr-2007:1    Min.    :2724          Min.    :2744          Min.    :-85.034
## Aug-2007:1    1st Qu.:2899          1st Qu.:2878          1st Qu.: -4.048
## Dec-2007:1    Median :2974          Median :2942          Median : -1.393
## Feb-2007:1    Mean   :3104          Mean   :3044          Mean   : 59.150
## Jan-2007:1    3rd Qu.:3343          3rd Qu.:3076          3rd Qu.: 20.755
## Jul-2007:1    Max.    :3656          Max.    :3619          Max.    :734.207
## (Other) :6
## portfolio_ROI_dollars      Date      DayOfWeek
## Min.    :-253.961          Min.    :2007-01-03    Length:12
## 1st Qu.: -79.356          1st Qu.:2007-03-25    Class :character
## Median :  -4.371          Median :2007-06-16    Mode  :character
## Mean    : 125.597          Mean    :2007-06-17
## 3rd Qu.: 364.923          3rd Qu.:2007-09-10
## Max.    : 677.926          Max.    :2007-12-03
##
##      Month      Year      UE_monthlyRate      portfolio_DailyVolume
## Length:12          Min.    :2007    Min.    :4.400    Min.    :2.160e+08
## Class :character    1st Qu.:2007    1st Qu.:4.500    1st Qu.:3.962e+08
## Mode  :character    Median :2007    Median :4.600    Median :4.644e+08
##                      Mean   :2007    Mean   :4.617    Mean   :5.398e+08
##                      3rd Qu.:2007    3rd Qu.:4.700    3rd Qu.:6.314e+08
##                      Max.    :2007    Max.    :5.000    Max.    :1.005e+09
##
##      portfolio_prevDayVolume      portfolio_dailyVolumeChange
## Min.    :198190500          Min.    :-197842207
## 1st Qu.:387785669          1st Qu.: -23781530
## Median :564614969          Median : 26069930
## Mean    :528884214          Mean    : 10878309
## 3rd Qu.:594041737          3rd Qu.: 70618878
```



```
## Max. :971072459 Max. : 124348468
##
## portfolio_VolumeRatioDaily2Initial portfolio_ValueRatioDaily2Initial
## Min. :0.3776 Min. :0.9388
## 1st Qu.:0.6926 1st Qu.:0.9989
## Median :0.8118 Median :1.0248
## Mean :0.9436 Mean :1.0696
## 3rd Qu.:1.1038 3rd Qu.:1.1521
## Max. :1.7576 Max. :1.2599
##
## portfolio_DailyRatios_X_UE dayOfMonth portfolio_poisson Threshold3
## Min. :1.654 Min. :1.00 Min. :0.04659 Length:12
## 1st Qu.:3.696 1st Qu.:1.00 1st Qu.:0.05008 Class
:character
## Median :4.400 Median :1.00 Median :0.05454 Mode
:character
## Mean :4.641 Mean :1.75 Mean :0.13836
## 3rd Qu.:5.116 3rd Qu.:2.25 3rd Qu.:0.25948
## Max. :8.297 Max. :4.00 Max. :0.26474
##
```

We can see from the above statistics on the subset of Citigroup stock that are outside this threshold that there are 12 dates to select in the range of Jan 2007 through Sep 2008. So we will add those dates to our data set of text scraped news articles on Citigroup.

```
NLP_dates_Citi <- rbind(C_stock_minmaxValueChanges, C_outer_SD[, -23])
NLP_dates_Citi
```

```
## C.Close C.Volume C_ROI_dollars C_dailyChange MonthYear
## 2007-04-02 510.50 2282100 0.000000 510.500000 Apr-2007
## 2013-04-02 44.11 1005100 -466.389999 0.320000 Apr-2013
## 2015-12-28 52.38 377263800 -458.119999 -0.329998 Dec-2015
## 2008-06-02 214.60 15302800 -295.899994 -298.300018 Jun-2008
## 2007-04-02 510.50 2282100 0.000000 510.500000 Apr-2007
## 2007-08-01 468.50 13495700 -42.000000 397.800003 Aug-2007
## 2007-12-03 330.60 81343800 -179.899994 266.250008 Dec-2007
## 2007-02-01 547.30 80864600 36.799988 467.409989 Feb-2007
## 2007-01-03 552.50 43508100 42.000000 488.520000 Jan-2007
## 2007-07-02 516.40 32822200 5.900024 441.990020 Jul-2007
## 2007-06-01 545.10 23057000 34.599976 473.939972 Jun-2007
## 2007-03-01 510.80 8981300 0.299988 440.769989 Mar-2007
## 2007-05-01 542.00 13337900 31.500000 479.779999 May-2007
## 2007-11-01 385.10 33433800 -125.399994 322.950004 Nov-2007
## 2007-10-01 477.20 16045900 -33.299988 402.080009 Oct-2007
## 2007-09-04 472.10 15929600 -38.399994 400.240005 Sep-2007
## portfolio_DailyValue portfolio_prevDay
portfolio_dailyValueChange
## 2007-04-02 2901.650 2891.963
9.686608
## 2013-04-02 3433.938 3354.901
```

79.037872					
## 2015-12-28	5005.455	4984.970			
20.485009					
## 2008-06-02	3120.541	3144.698		-	
24.157199					
## 2007-04-021	2901.650	2891.963			
9.686608					
## 2007-08-01	2778.299	2781.133		-	
2.834138					
## 2007-12-03	2723.978	2743.972		-	
19.993872					
## 2007-02-01	3279.015	3281.965		-	
2.949476					
## 2007-01-03	2977.939	2977.939			
0.000000					
## 2007-07-02	2969.196	2946.619			
22.576765					
## 2007-06-01	3003.989	3006.774		-	
2.785581					
## 2007-03-01	2889.381	2896.725		-	
7.344424					
## 2007-05-01	2957.539	2937.392			
20.147648					
## 2007-11-01	3534.398	3619.433		-	
85.034241					
## 2007-10-01	3655.864	3611.738			
44.126353					
## 2007-09-04	3571.178	2836.972			
734.206543					
##	portfolio_ROI_dollars	Date	DayOfWeek	Month	Year
## 2007-04-02	-76.289072	2007-04-02	Monday	Apr	2007
## 2013-04-02	455.999776	2013-04-02	Tuesday	Apr	2013
## 2015-12-28	2027.516411	2015-12-28	Monday	Dec	2015
## 2008-06-02	142.602196	2008-06-02	Monday	Jun	2008
## 2007-04-021	-76.289072	2007-04-02	Monday	Apr	2007
## 2007-08-01	-199.639490	2007-08-01	Wednesday	Aug	2007
## 2007-12-03	-253.960930	2007-12-03	Monday	Dec	2007
## 2007-02-01	301.076786	2007-02-01	Thursday	Feb	2007
## 2007-01-03	0.000000	2007-01-03	Wednesday	Jan	2007
## 2007-07-02	-8.742779	2007-07-02	Monday	Jul	2007
## 2007-06-01	26.049900	2007-06-01	Friday	Jun	2007
## 2007-03-01	-88.557542	2007-03-01	Thursday	Mar	2007
## 2007-05-01	-20.399119	2007-05-01	Tuesday	May	2007
## 2007-11-01	556.459753	2007-11-01	Thursday	Nov	2007
## 2007-10-01	677.925528	2007-10-01	Monday	Oct	2007
## 2007-09-04	593.239860	2007-09-04	Tuesday	Sep	2007
##	UE_monthlyRate	portfolio_DailyVolume	portfolio_prevDayVolume		
## 2007-04-02	4.5	572035712	572035712		
## 2013-04-02	7.6	258084601	330998801		
## 2015-12-28	5.0	975152259	752607802		

##	2008-06-02	5.6	464823559	265152951
##	2007-04-021	4.5	572035712	572035712
##	2007-08-01	4.6	686001371	572681959
##	2007-12-03	5.0	1005429691	971072459
##	2007-02-01	4.5	933350159	809001691
##	2007-01-03	4.6	613250413	565411759
##	2007-07-02	4.7	460278863	658121070
##	2007-06-01	4.6	381151267	397701502
##	2007-03-01	4.4	215973129	198190500
##	2007-05-01	4.4	314742689	233827359
##	2007-11-01	4.7	468477291	563818179
##	2007-10-01	4.7	401234791	446710205
##	2007-09-04	4.7	425224899	358038171
##	portfolio_dailyVolumeChange portfolio_VolumeRatioDaily2Initial			
##	2007-04-02		0	1.0000000
##	2013-04-02		-72914200	0.4511687
##	2015-12-28		222544457	1.7047052
##	2008-06-02		199670608	0.8125779
##	2007-04-021		0	1.0000000
##	2007-08-01		113319412	1.1992282
##	2007-12-03		34357232	1.7576345
##	2007-02-01		124348468	1.6316292
##	2007-01-03		47838654	1.0720492
##	2007-07-02		-197842207	0.8046331
##	2007-06-01		-16550235	0.6663068
##	2007-03-01		17782629	0.3775518
##	2007-05-01		80915330	0.5502151
##	2007-11-01		-95340888	0.8189651
##	2007-10-01		-45475414	0.7014156
##	2007-09-04		67186728	0.7433538
##	portfolio_ValueRatioDaily2Initial portfolio_DailyRatios_X_UE			
##	2007-04-02		1.0000000	4.500000
##	2013-04-02		1.1834435	4.057888
##	2015-12-28		1.7250378	14.703404
##	2008-06-02		1.0754368	4.893707
##	2007-04-021		1.0000000	4.500000
##	2007-08-01		0.9574896	5.281943
##	2007-12-03		0.9387687	8.250061
##	2007-02-01		1.1300522	8.297218
##	2007-01-03		1.0262916	5.061081
##	2007-07-02		1.0232786	3.869810
##	2007-06-01		1.0352692	3.173112
##	2007-03-01		0.9957719	1.654204
##	2007-05-01		1.0192614	2.467577
##	2007-11-01		1.2180652	4.688499
##	2007-10-01		1.2599262	4.153540
##	2007-09-04		1.2307408	4.299916
##	dayOfMonth portfolio_poisson			
##	2007-04-02	2	0.25773	
##	2013-04-02	2	0.33619	

## 2015-12-28	28	0.27468
## 2008-06-02	2	0.06828
## 2007-04-021	2	0.25773
## 2007-08-01	1	0.05008
## 2007-12-03	3	0.05723
## 2007-02-01	1	0.04833
## 2007-01-03	3	0.05008
## 2007-07-02	2	0.26474
## 2007-06-01	1	0.05008
## 2007-03-01	1	0.04659
## 2007-05-01	1	0.25411
## 2007-11-01	1	0.05184
## 2007-10-01	1	0.26474
## 2007-09-04	4	0.26474

I am going to pull the data from these dates with the Google Search for the specific date on Citigroup stock, put it in a table with the date, the article title, reference, article content, and the comments if available.

Note: when searching the internet, there were limited articles and [most](#) were about Citi's involvement in the sub-prime mortgage crisis of 2007-2008, and a [bailout](#) of Citigroup by the US. For the month and years of the two dates not in or around 2007-2008, there are only two for April 2013 and December 2015. Where Citi settled a [lawsuit](#) for covering up bad mortgage loans in August 2012 and a [person reported](#) on a forum about FICO scores how he was approved for a 4600 USD credit card with Citi. There isn't enough data to rely on the web for NLP on Citigroup for these time frames.

We could pull based on the keywords: 'settlement', 'bail-out', 'sub-prime loans', but we would only get the obvious negative sentiment for these keywords. A New York Times article posted an article in Dec 2015 about the remodeling that Citigroup was doing to their offices, but the full article would have to be purchased. The fact that they spent money on remodeling could have some public sentiment of either they aren't distributing their profits to shareholders or they are making enough profits to spend money on remodeling, which is also reported at the end of the year in 2015 to write off for that tax year. Although, I was told by an accountant that some corporations and small businesses have a different tax year and a quick search on Google returned the fiscal year is any consecutive 12-month business cycle that usually ends at the end of each quarter.

We can see that the volume of trades is highest in December 2015 from our dates, but we should compare this to which quantile this number is within for the volume of trades of Citi stock.

```
summary(C_stock$C.Volume)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	1005100	13019600	19493900	26987469	33280800	377263800

We already know that this is the date that the most trades in stock of Citi occurred as it is the reason we added this date to our NLP data set of dates to pull information from the web for. The above will refresh the comparisons of the trade volume to this date.

It looks like public sentiment thinks Citi is going back to its old bail-out days of 2007-2008 and not a trust-worthy stock for their personal portfolios. But they are still around, and the fact that people that have a less than trust-worthy credit profile were given a credit card with a high value could indicate some people also consider that they are building a new demographic of people to invest in by earning the trust of those who have sub-par trust worthiness with credit. And, yet some other investors could also think this is a bad move to make as it depends on those same people realizing their mistakes and not making them again. Which really turns into the reason some stocks are volatile to begin with and possibly a reason to understand Game Theory, a class I dropped in my undergrad college. But nonetheless I am a data scientist with other conventional and non-conventional ways of extracting useful information, and this approach uses my math and analytic skills to fully understand the stock market and certain stocks and trends with public sentiment.

On this highest trade day, the daily change in dollars was still within the standard error by only dropping 0.33 USD. Where the standard error is 32.00 USD.

Of note is whether or not those making these trades are doing so to lower their Capital Gains at the end of the year, because there is a slight loss on it to balance out the portfolio. Also, this is the end of the year, possibly the last trading day of the year as it is. Let's look at all monthYear dates equal to Dec-2015 to see if there are any other dates past Dec 28, 2015.

```
dec2015 <- subset(C_stock, C_stock$MonthYear=='Dec-2015')
tail(dec2015)
```

##		C.Close	C.Volume	C_ROI_dollars	C_dailyChange	MonthYear
##	2015-12-23	52.63	93423000	-457.87	0.620003	Dec-2015
##	2015-12-24	52.71	119108100	-457.79	0.079998	Dec-2015
##	2015-12-28	52.38	377263800	-458.12	-0.329998	Dec-2015
##	2015-12-29	52.98	281369700	-457.52	0.599999	Dec-2015
##	2015-12-30	52.30	62625000	-458.20	-0.680001	Dec-2015
##	2015-12-31	51.75	49092600	-458.75	-0.549999	Dec-2015
##		portfolio_DailyValue		portfolio_prevDay		
	portfolio_dailyValueChange					
##	2015-12-23		4998.690		4968.045	
	30.64500					
##	2015-12-24		4984.970		4998.690	-
	13.72002					
##	2015-12-28		5005.455		4984.970	
	20.48501					
##	2015-12-29		4738.190		5005.455	-
	267.26507					
##	2015-12-30		4800.285		4738.190	
	62.09506					
##	2015-12-31		4707.685		4800.285	-

```

92.59999
##          portfolio_ROI_dollars          Date DayOfWeek Month Year
UE_monthlyRate
## 2015-12-23          2020.751 2015-12-23 Wednesday   Dec 2015
5
## 2015-12-24          2007.031 2015-12-24  Thursday   Dec 2015
5
## 2015-12-28          2027.516 2015-12-28   Monday    Dec 2015
5
## 2015-12-29          1760.251 2015-12-29  Tuesday    Dec 2015
5
## 2015-12-30          1822.346 2015-12-30 Wednesday   Dec 2015
5
## 2015-12-31          1729.746 2015-12-31  Thursday   Dec 2015
5
##          portfolio_DailyVolume portfolio_prevDayVolume
## 2015-12-23          903674159          619024059
## 2015-12-24          752607802          903674159
## 2015-12-28          975152259          752607802
## 2015-12-29          1248436459          975152259
## 2015-12-30          534260059          1248436459
## 2015-12-31          504630159          534260059
##          portfolio_dailyVolumeChange portfolio_VolumeRatioDaily2Initial
## 2015-12-23          284650100          1.5797513
## 2015-12-24          -151066357          1.3156658
## 2015-12-28          222544457          1.7047052
## 2015-12-29          273284200          2.1824450
## 2015-12-30          -714176400          0.9339628
## 2015-12-31          -29629900          0.8821655
##          portfolio_ValueRatioDaily2Initial portfolio_DailyRatios_X_UE
## 2015-12-23          1.722706          13.607238
## 2015-12-24          1.717978          11.301424
## 2015-12-28          1.725038          14.703404
## 2015-12-29          1.632930          17.818897
## 2015-12-30          1.654330          7.725412
## 2015-12-31          1.622417          7.156201
##          dayOfMonth portfolio_poisson Threshold3
## 2015-12-23          23          0.27468   inside
## 2015-12-24          24          0.05723   inside
## 2015-12-28          28          0.27468   inside
## 2015-12-29          29          0.05723   inside
## 2015-12-30          30          0.27468   inside
## 2015-12-31          31          0.05723   inside

```

We now know that Dec-28-2015 is not the last trading day of the year, because the 29th through 31st for Tuesday through Thursday are also trading days. There was a fluctuation in dollars earned and lost all under a dollar. Some useful information to add in would be who or where are these trades derived. Are they financial advisors, trust fund managers,

independent investors, foreign or national investors, are they hobbyists just playing the stock market on an e-trade, are they educated, experienced, and so on?

To get this information we could first find out how much it costs for a hobbyist to make a trade online from e-trade or similar and whether or not this information is shared on demographics of the stock ownership. We could also look at the American Survey on Census data from the census bureau for number of financial workers there are and how many people graduated with a BS, MS, or Phd in Finance or Economics. If there is location data on where these stock owners live attach this information gathered to it to make a better inference on this stock and what motivates the trades. Any volunteers?

For now, we will just continue with what we have on hand for Citi. We can answer the question of whether or not, historically there are more trades in December than any other month in our data by grouping by month year and getting the median trades per month and year.

```
Citi_trades_monthYear <- C_stock %>% group_by(MonthYear) %>%  
  summarise_at(vars(colnames(C_stock[2])), mean)  
Citi_trades_monthYear <-  
Citi_trades_monthYear[order(Citi_trades_monthYear$C.Volume,decreasing=TRUE),]  
Citi_trades_monthYear  
  
## # A tibble: 157 x 2  
##   MonthYear    C.Volume  
##   <fct>         <dbl>  
## 1 Dec-2011  102284343.  
## 2 Dec-2012   97253820  
## 3 Feb-2007   94010711.  
## 4 Feb-2008   80151765  
## 5 Dec-2019   79458262.  
## 6 Aug-2019   72849682.  
## 7 Feb-2015   70393405.  
## 8 Dec-2015   67380332.  
## 9 Jan-2010   64943774.  
## 10 Jan-2012  63211745  
## # ... with 147 more rows
```

From the above table ordered from most trades to least trades per month and year by mean number of trades per month, we see that December is in the top 10 month years of high trades in 2011,2012, 2015, and 2019. February has the next highest trades but the years are the same years of the sub-prime mortgage crisis that Citigroup was involved in, but also in 2015. looking at the next top ten months we see that Dec, Jan, and Feb are in the highest mean of the trades per day grouped by month and year. What do we know about Jan and Feb outside of the assumption about December being the last day of the tax year to offset capital gains with capital losses?

Well, I know that being a student, some people get their student loans around winter quarter in January and that many people expecting tax refunds get their refunds in February. We would have to see if there are any other assumptions about these months.

But we would be able to ascertain if students receiving an education are investing, and if consumers with tax refunds are using some of that money to invest. There are certainly other assumptions that could be made for why the last month of the year and the first two months of the first quarter are high trade volume days. But for now let's stick with these assumptions.

July starts to show up in the following set of ten top month years from 21-30, as the 30th highest trade month year. Jan and Feb are still in the top 40 high volume trade month years, while June shows up three times in the 30-40 top high volume trade month and years. July could also be the start of the third quarter and the remaining balance on student loans made. Let's see where September/October show up in these top ordered volumes. They are near the end of the top trade months.

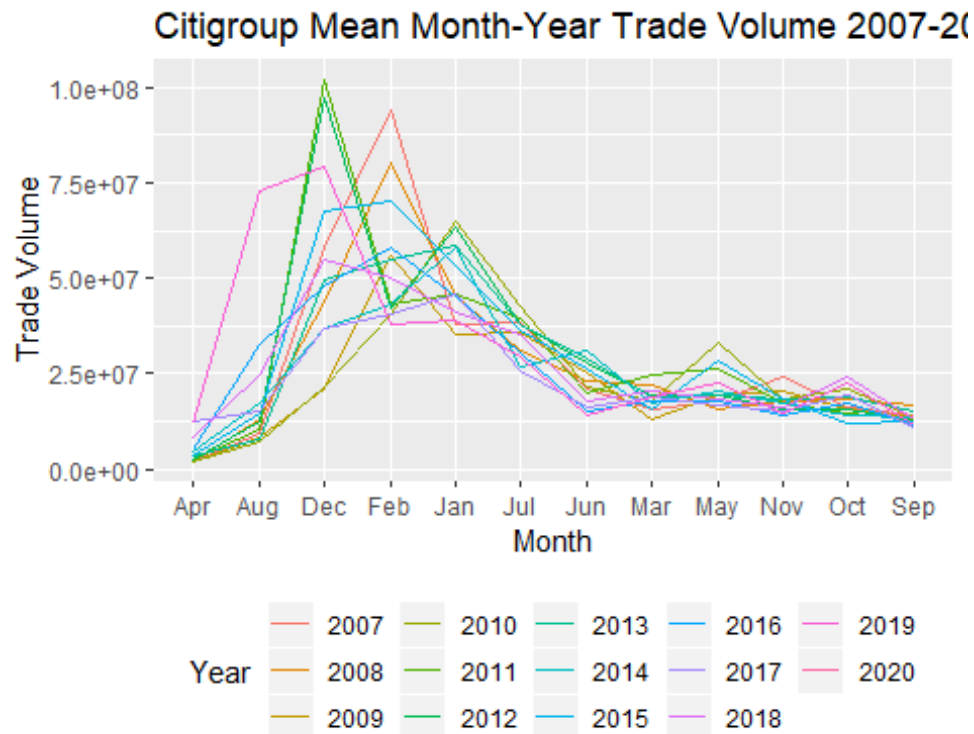
So, possibly this indicates no ties to student loan payments, but tax refunds could be likely for February being a high trade month. We definitely know December is a top trade day.

Let's plot this data.

```
Citi_trades_monthYear$Month <- gsub('-[0-9]{4}', '', Citi_trades_monthYear$MonthYear)
Citi_trades_monthYear$Year <- gsub('[a-zA-z]{3}-', '', Citi_trades_monthYear$MonthYear)

ggplot(data = Citi_trades_monthYear, aes(x=Month, y=C.Volume, group=Year)) +
  geom_line(aes(color=Year)) +
  scale_y_continuous() +
  scale_fill_brewer(palette="paired") +
  theme(legend.position="bottom") +
  ggtitle('Citigroup Mean Month-Year Trade Volume 2007-2020') +
  ylab('Trade Volume')

## Warning in pal_name(palette, type): Unknown palette paired
```



We can see that December is definitely the highest trading month, then February as the next highest, and January as the third highest trading month.

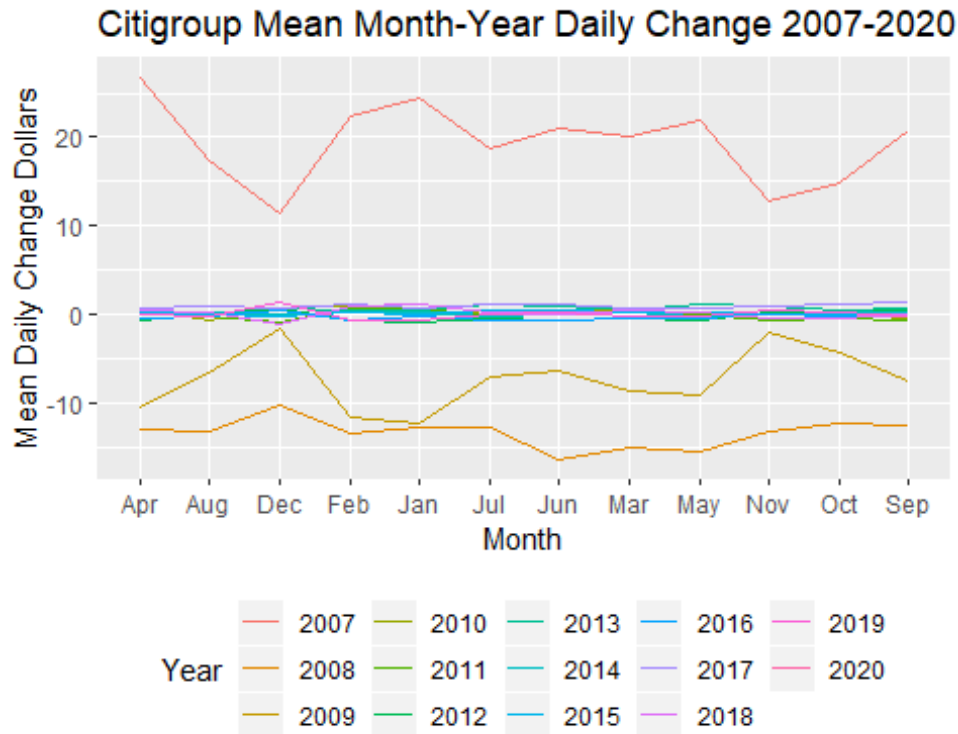
Lets look at the daily change mean values per month, by grouping by MonthYear and taking the mean value of the daily change, order by highest to smallest, and plot.

```
Citi_meanMonthly_dailyChange <- C_stock %>% group_by(MonthYear) %>%
  summarise_at(vars(as.vector(colnames(C_stock))[4]), mean)

Citi_meanMonthly_dailyChange$Year <-
  gsub('[a-zA-Z]{3}-', '', Citi_meanMonthly_dailyChange$MonthYear)
Citi_meanMonthly_dailyChange$Month <-
  gsub('-[0-9]{4}', '', Citi_meanMonthly_dailyChange$MonthYear)

ggplot(data = Citi_meanMonthly_dailyChange, aes(x=Month,
y=C_dailyChange, group=Year)) +
  geom_line(aes(color=Year)) +
  scale_y_continuous() +
  scale_fill_brewer(palette="paired") +
  theme(legend.position="bottom") +
  ggtitle('Citigroup Mean Month-Year Daily Change 2007-2020') +
  ylab('Mean Daily Change Dollars')

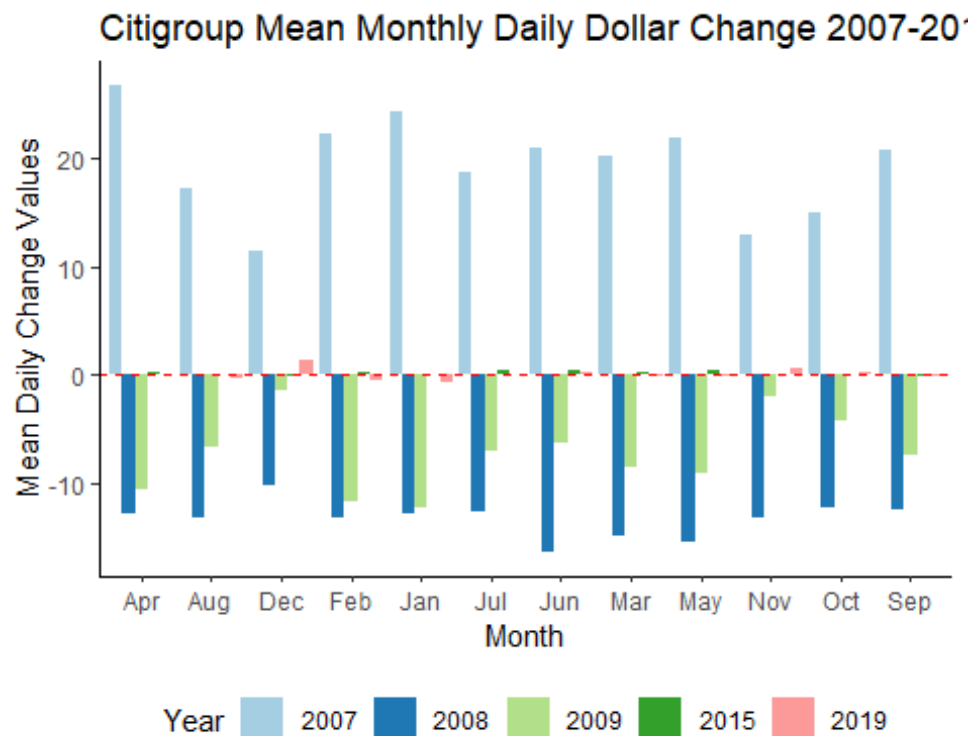
## Warning in pal_name(palette, type): Unknown palette paired
```



From the above line chart, it is not obvious what years those years having almost no change are. The year 2007 is at the top with the highest positive mean daily change values fluctuating to around 20 USD per day. While the years 2008 and 2009 have the highest negative mean of daily change values per month with average daily decreases around a daily loss of 5-15 USD.

Lets make a bar chart of 2007, 2008, 2009, 2015, and 2019 of this data on mean daily value changes per month.

```
y4 <- subset(Citi_meanMonthly_dailyChange,
              Citi_meanMonthly_dailyChange$Year==2008 |
              Citi_meanMonthly_dailyChange$Year==2009 |
              Citi_meanMonthly_dailyChange$Year==2007 |
              Citi_meanMonthly_dailyChange$Year==2015 |
              Citi_meanMonthly_dailyChange$Year==2019)
ggplot(data = y4, aes(x=Month, y=C_dailyChange, fill=Year)) +
  geom_bar(stat='identity', position=position_dodge()) +
  scale_y_continuous() +
  scale_fill_brewer(palette='Paired') +
  geom_hline(yintercept=0, linetype="dashed", color = "red") +
  theme_classic() +
  theme(legend.position="bottom") +
  ggtitle('Citigroup Mean Monthly Daily Dollar Change 2007-2019') +
  ylab('Mean Daily Change Values')
```



From the above, we can see the Citigroup stock had increases per day in value from the previous day in 2007, but that in 2008 and 2009 those daily increases turned to daily decreases from day to day as the sub-prime loans collapsed that Citigroup held. And in 2015 and 2019 years after Citigroup's bailout there was a mean monthly daily change value next to nothing as the daily change from day to day fluctuated around zero dollars for the month.

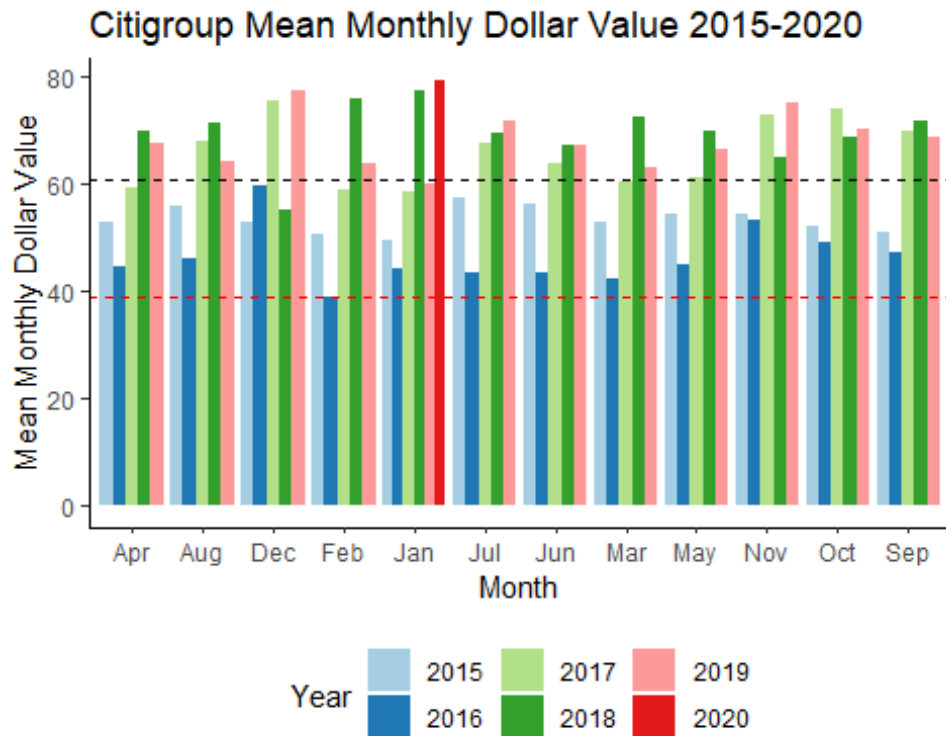
This could mean it is gaining strength and remains as is safe to buy as it increases. But lets look at the years 2015-2019 to see how the value of the Citigroup stock has faired by month year to confirm this assertion just made.

```
y4value <- subset(C_stock, C_stock$Year>2014)
y4valMY <- y4value %>% group_by(MonthYear) %>%
  summarise_at(vars(as.vector(colnames(y4value)[1])), mean)

y4valMY$Year <- gsub('[a-zA-Z]{3}-', '', y4valMY$MonthYear)
y4valMY$Month <- gsub('-[0-9]{4}', '', y4valMY$MonthYear)

ggplot(data = y4valMY, aes(x=Month, y=C.Close, fill=Year)) +
  geom_bar(stat='identity', position=position_dodge()) +
  scale_y_continuous() +
  scale_fill_brewer(palette='Paired') +
  geom_hline(yintercept=min(y4valMY$C.Close), linetype="dashed", color =
"red") +
  geom_hline(yintercept=mean(y4valMY$C.Close), linetype="dashed", color =
"black") +
```

```
theme_classic()+
theme(legend.position="bottom")+
ggtitle('Citigroup Mean Monthly Dollar Value 2015-2020')+
ylab('Mean Monthly Dollar Value')
```

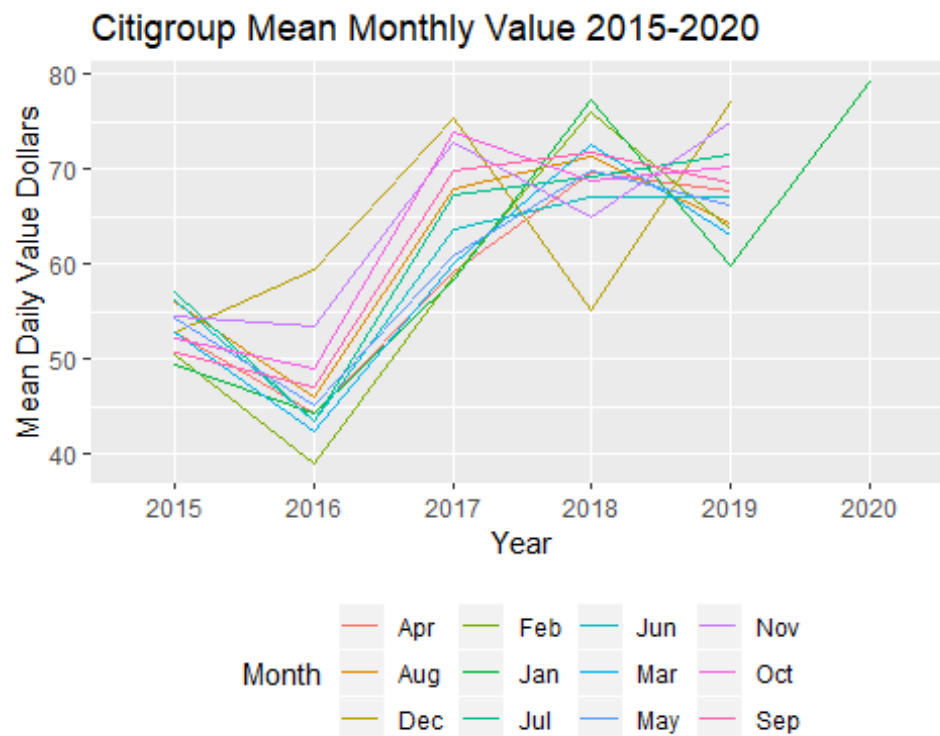


From the above bar chart, we can see that the minimum value is the dashed red line which occurred in February 2016. And that every month since 2016 has been above this minimum value. It has almost double from its minimum value in January and February 2020. The mean value from 2015-2020 (Jan-Feb) is just above 60 USD which is 1 1/2 times its minimum value.

Lets look at the line chart of this by years 2015-2020.

```
ggplot(data = y4valMY, aes(x=Year, y=C.Close,group=Month)) +
  geom_line(aes(color=Month))+
  scale_y_continuous()+
  scale_fill_brewer(palette="paired") +
  theme(legend.position="bottom")+
  ggtitle('Citigroup Mean Monthly Value 2015-2020')+
  ylab('Mean Daily Value Dollars')
```

```
## Warning in pal_name(palette, type): Unknown palette paired
```



The above line chart of the mean monthly dollar value of the Citigroup stock show that all months move the same direction of decreasing in 2015, increasing in 2016, except for in 2017 and 2018 where 3-6 months decreased and 6-9 months increased monthly mean values. The span of 2019 through 2020 can't be analyzed yet, but January increased since the year prior. Overall, since 2015 the value has increased from 50-60 USD to between 75-80 USD. This could make it a good stock to have in your portfolio as it has steadily been increasing since it's historical rough patches of the sub-prime mortgage loan accounts, the public bailout, and the lawsuit settlement payout. But nothing has been in the news about them to discourage investors from dropping this stock from their stock folder.