PROJECTPART1

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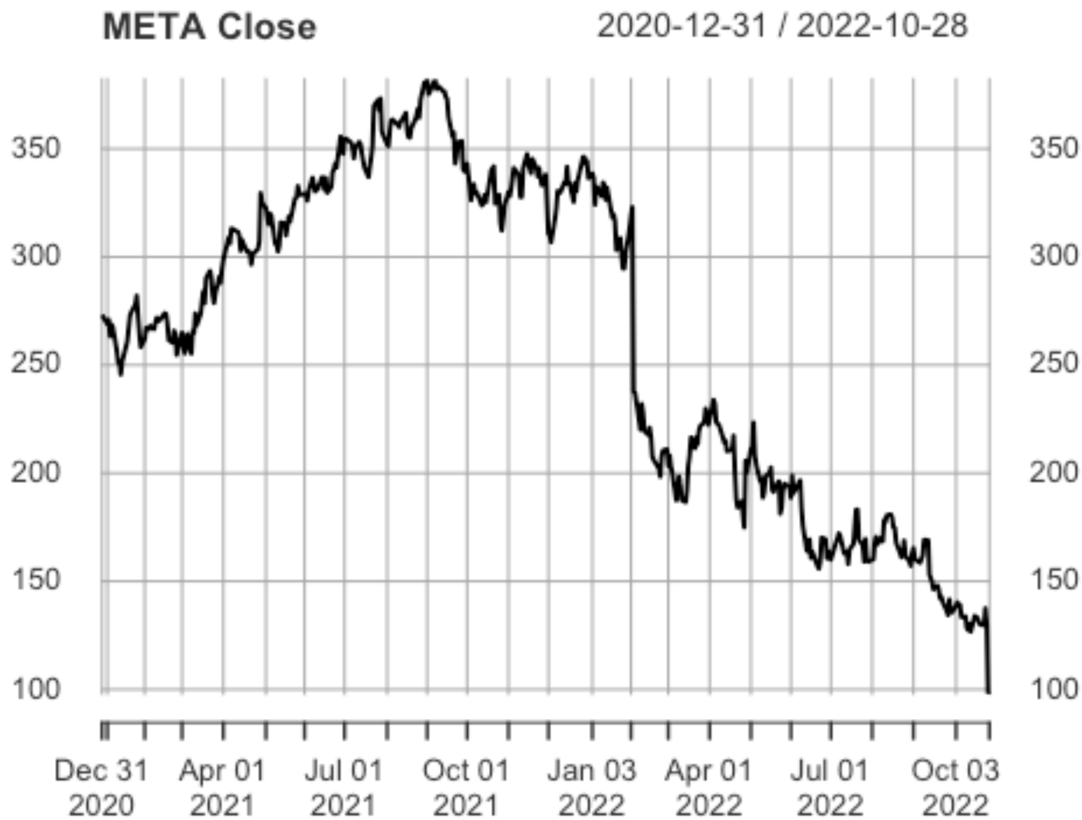
```
#library(dplyr)

#install.packages("quantmod")

#install.packages("PerformanceAnalytics")

###PART1A##
### Import Stock Prices of 3 companies, over a span of about 2 years.
Estimate the μ, σ of those stocks.
### Need to check:
### i) The log-returns fit into a Noise process (Normal; with Zero serial
###correlation).
### ii) Calculate μ, σ (Follow Part C) ###

library(quantmod)

## Loading required package: xts

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

## Loading required package: TTR

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

library(PerformanceAnalytics)

##
## Attaching package: 'PerformanceAnalytics'

## The following object is masked from 'package:graphics':
##
##     legend

tickers<- c("META","BABA","BAC")
weights<- c(1/3,1/3,1/3) #equally weighted portfolio
```

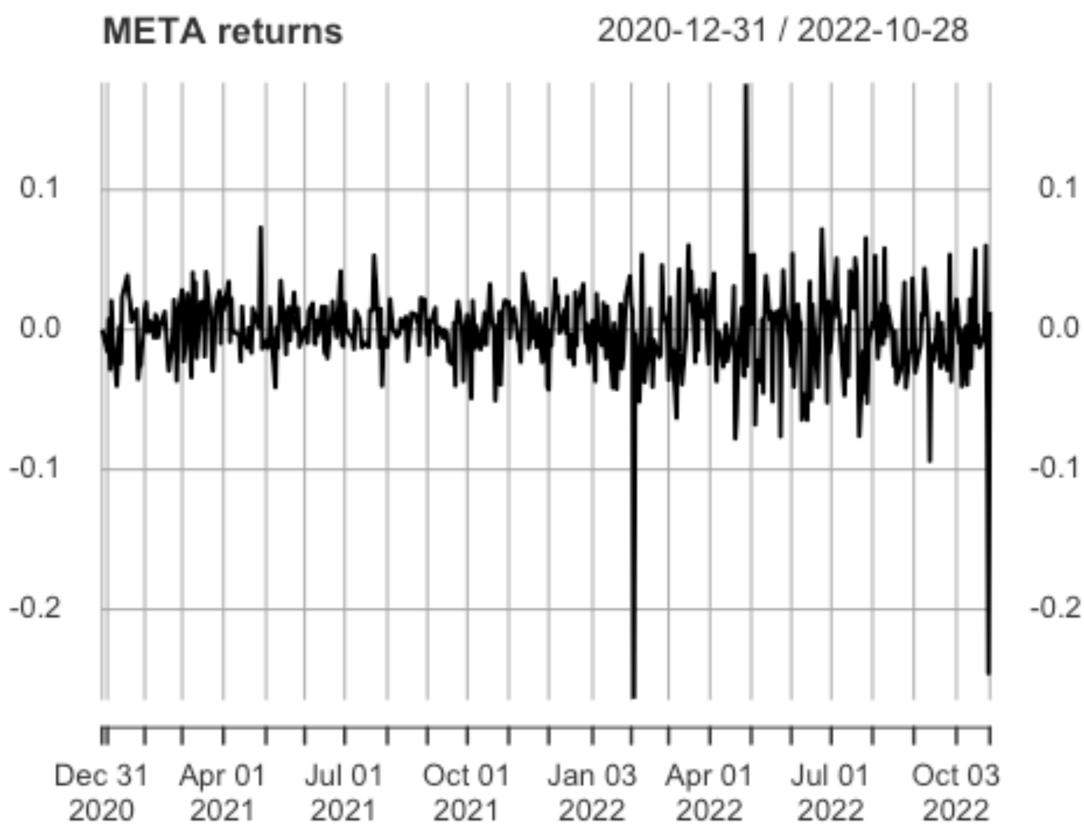
```r
#NOTES:
## ln53: "[,4]" gets us close column

#Getting data for this portfolio
PfPrices<- NULL
# We will populate it with all the columns of data that we want from quantmod
for(ticker in tickers){
  PfPrices<-cbind(PfPrices,
                getSymbols.yahoo(ticker,from="2020-12-31",to="2022-10-
31",periodicity='daily',auto.assign=FALSE)[,4])
}
PfReturns<- na.omit(ROC(PfPrices))#ROC just calculates daily change in each
individual column
head(PfReturns)

##              META.Close   BABA.Close    BAC.Close
## 2021-01-04 -0.015569405 -0.021191422 -0.009280743
## 2021-01-05  0.007519804  0.053616634  0.007629793
## 2021-01-06 -0.028676080 -0.054670535  0.060585805
## 2021-01-07  0.020412295 -0.003124277  0.021843630
## 2021-01-08 -0.004363092  0.040127209 -0.010093433
## 2021-01-11 -0.040927933 -0.038057950  0.016463817

#check to see if we have any missing values(especially important for machine
learning models)
colSums(is.na(PfPrices))

## META.Close BABA.Close  BAC.Close
##          0          0          0

#no missing data

#creating benchmark using SP500
bench<-getSymbols.yahoo("^GSPC",from="2020-12-31",to="2022-10-
31",periodicity='daily',auto.assign=FALSE)[,4]
benchReturns<- dailyReturn(bench)

#colSums(is.na(benchmarkPrices))

#Calculate Pf values at the end of the day
#Aggregate the returns by using the ways we provided to output the return

#PfReturn <- Return.portfolio(PfReturns)
#head(PfReturn)

META.return<- dailyReturn(PfPrices$META.Close)
BABA.return<- dailyReturn(PfPrices$BABA.Close)
BAC.return<- dailyReturn(PfPrices$BAC.Close)

plot(PfPrices$META.Close,type="l",main="META Close")
```



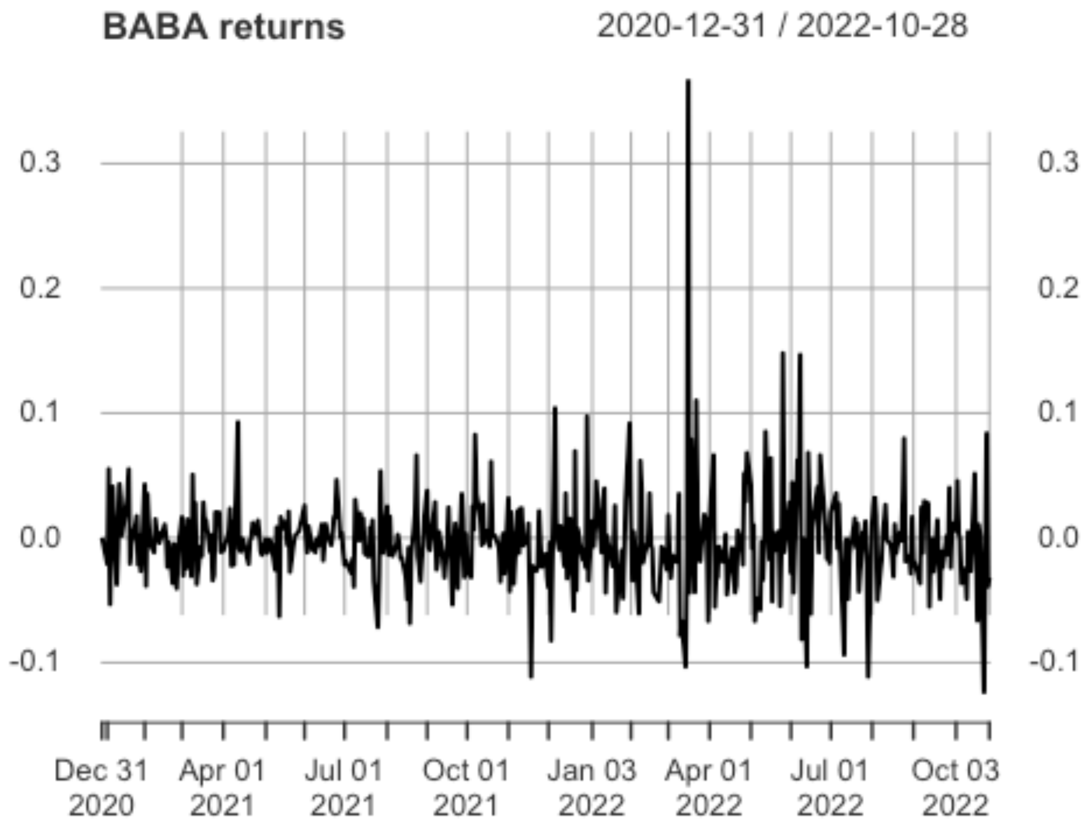

```
plot(PfPrices$BABA.Close,type="l",main="BABA Close")
```


```
plot(PfPrices$BAC.Close,type="l",main="BAC Close")
```

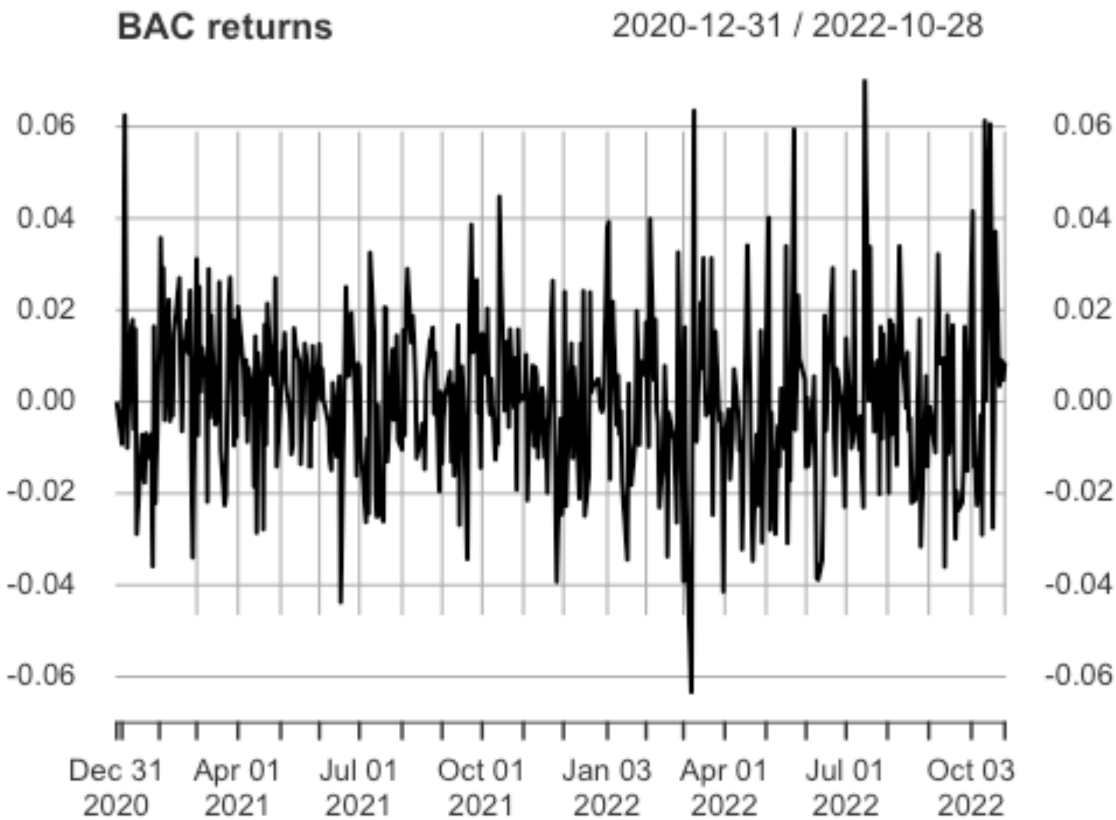

```
plot(META.return,type ="l",main="META returns")
```



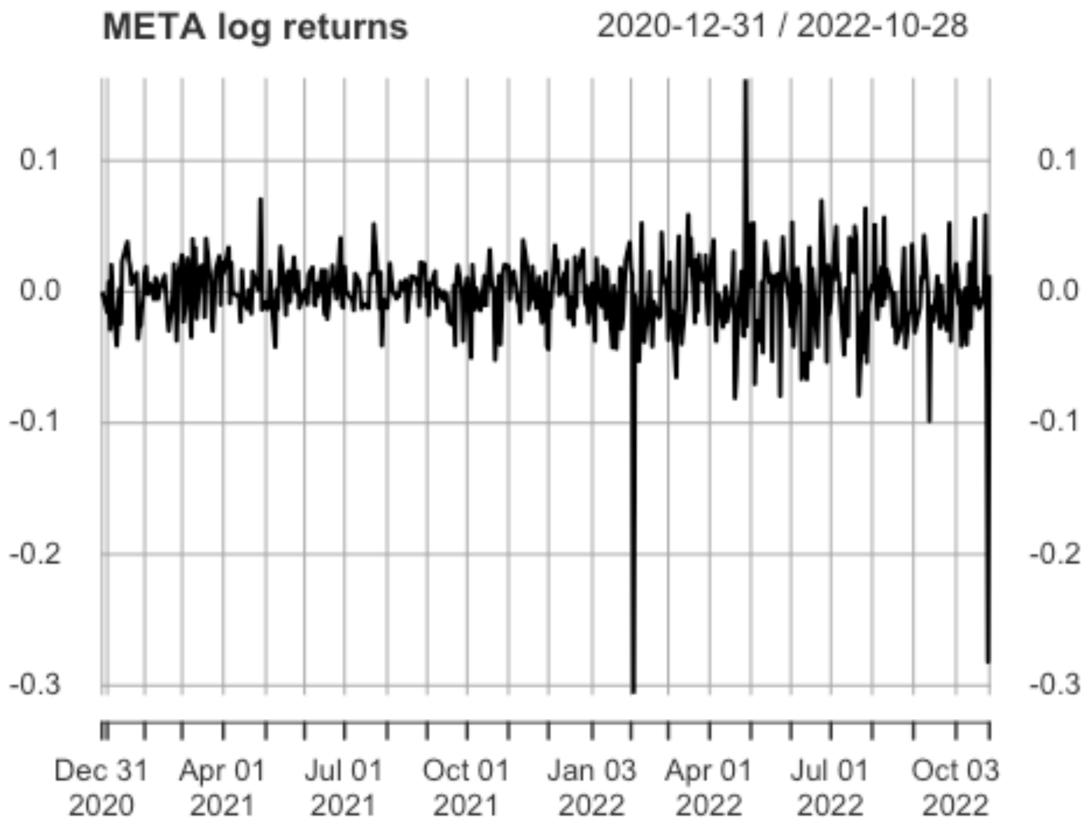

```
plot(BABA.return,type ="l",main="BABA returns")
```



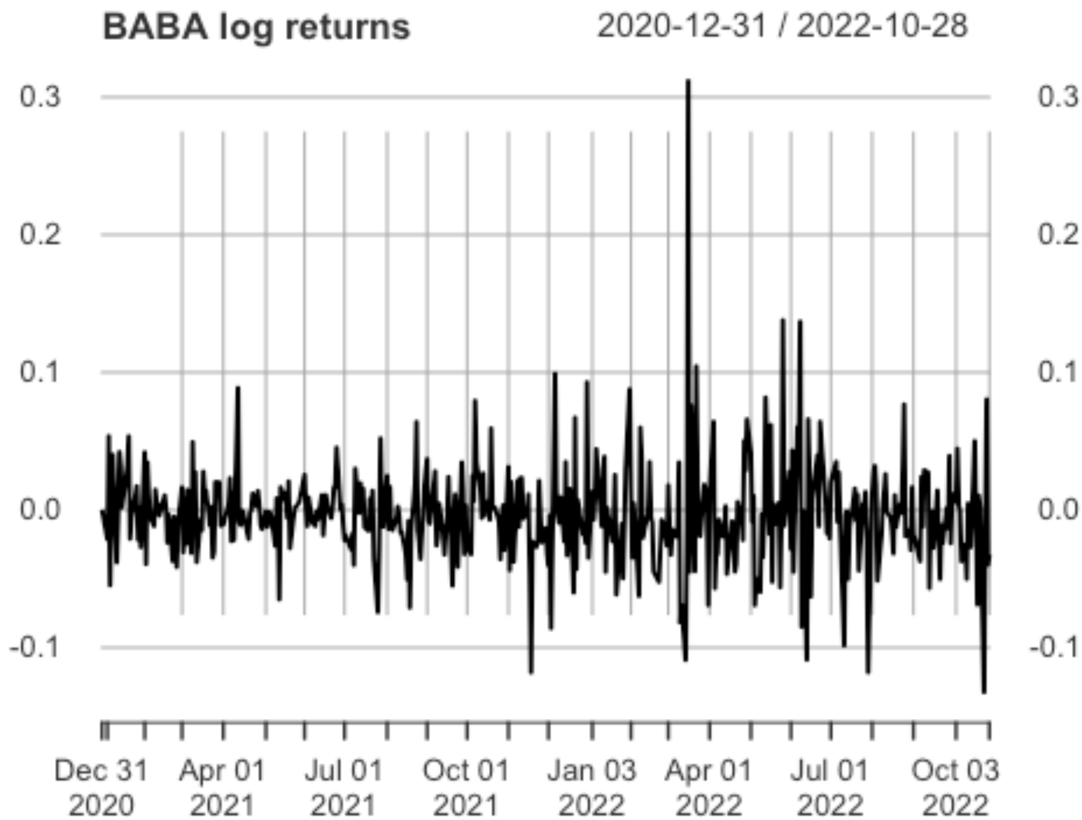

```
plot(BAC.return,type ="l",main="BAC returns")
```



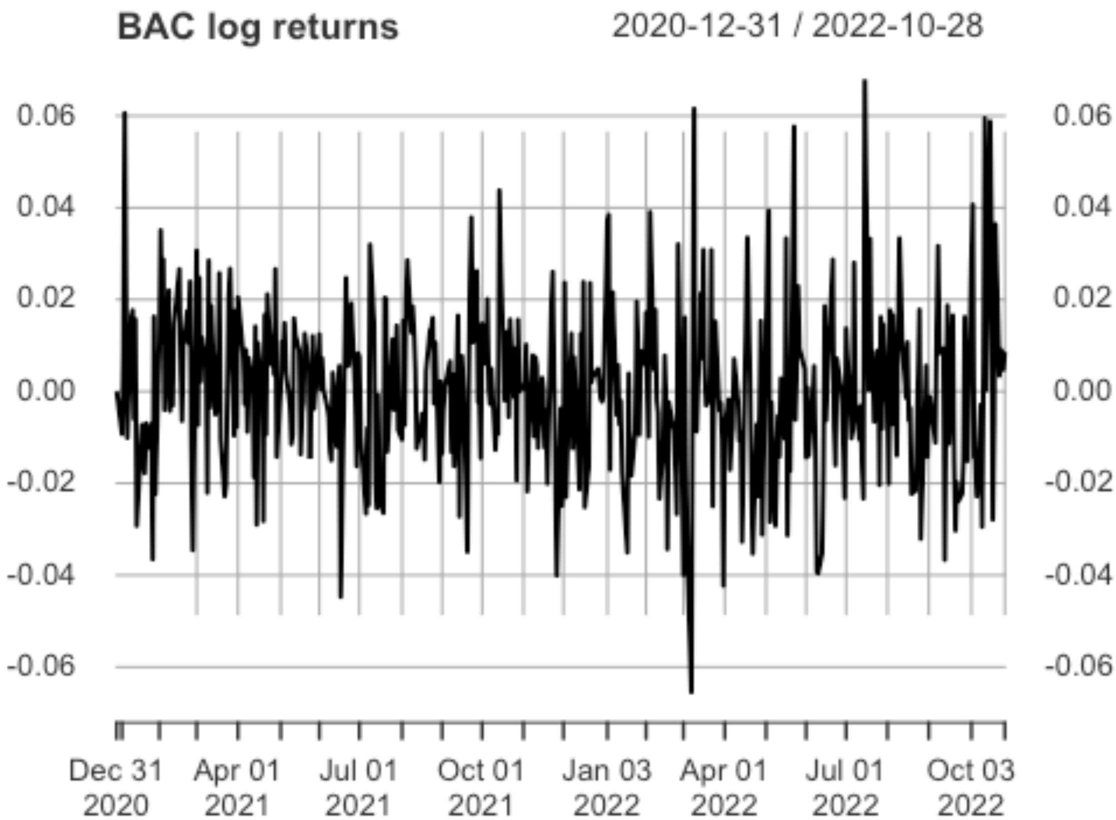

```
plot(log(1+META.return),type ="l",main="META log returns")
```




```
plot(log(1+BABA.return),type ="l",main="BABA log returns")
```




```
plot(log(1+BAC.return),type ="l",main="BAC log returns")
```




```
logreturn.META<-log(1+META.return)
logreturn.BABA<-log(1+BABA.return)
logreturn.BAC<-log(1+BAC.return)

#Estimation of mu and sigma from log returns
#Calculate rbar

rbarMETA= mean(logreturn.META$daily.returns)
rbarBABA=mean(logreturn.BABA$daily.returns)
rbarBAC = mean(logreturn.BAC$daily.returns)

#Calculate s
sMETA= sd(logreturn.META)
sBABA= sd(logreturn.BABA)
sBAC= sd(logreturn.BAC)

#annualized sigma
sigmaMETA <- sMETA * sqrt(504)
sigmaBABA <- sBABA * sqrt(504)
sigmaBAC<- sBAC * sqrt(504)

#annualized mu
muMETA <- (rbarMETA*504)+((sigmaMETA)^2)/2
```

```r
muBABA <- (rbarBABA*504)+((sigmaBABA)^2)/2
muBAC <- (rbarBAC*504)+((sigmaBAC)^2)/2

sigmaMETA

## [1] 0.7310755

sigmaBABA

## [1] 0.8341251

sigmaBAC

## [1] 0.4166854

muMETA

## [1] -0.8401646

muBABA

## [1] -1.067982

muBAC

## [1] 0.2803546

######################################
#### A function to calculate mu, sigma
######################################


mu.sigma<- function(sample, lag=1){

  N<-length(sample)
  if (N < 1+lag){

    stop("sample must be greater than 2 +lag")
  }

  ct <- sample[(1+lag):N]
  pt<- sample[1: (N-lag)]
  t=1
  dt=t/N
  returns <- (ct-pt)/pt

  logreturns <- log(1+returns)
  logreturns.bar  <- mean(logreturns)

  s <- sd(logreturns)
```

```r
  drift <- logreturns.bar*N  + s^2*N/2

  volatility <- sqrt(s^2*N)

  #cat("mu =",    round(drift, 4) ,"sigma=",round(volatility,4) ,   "\n")

  c(drift, volatility)

}
Meta.close <- data.frame(PfPrices$META)
head(Meta.close)
```

```
##            META.Close
## 2020-12-31     273.16
## 2021-01-04     268.94
## 2021-01-05     270.97
## 2021-01-06     263.31
## 2021-01-07     268.74
## 2021-01-08     267.57
```

```r
dim(Meta.close)
```

```
## [1] 461   1
```

```r
mu.sigma(Meta.close$META.Close,lag=1)
```

```
## [1] -0.7701558  0.6999513
```

```r
Box.test(logreturn.META,lag = 365)
```

```
##
##  Box-Pierce test
##
## data:  logreturn.META
## X-squared = 217.92, df = 365, p-value = 1
```

```r
Box.test(logreturn.BABA,lag = 365)
```

```
##
##  Box-Pierce test
##
## data:  logreturn.BABA
## X-squared = 217.23, df = 365, p-value = 1
```

```r
Box.test(logreturn.BAC,lag = 365)
```

```
##
##  Box-Pierce test
##
## data:  logreturn.BAC
## X-squared = 213.16, df = 365, p-value = 1
```

```r
#Calculating Beta
beta.META<- cov(META.return,benchReturns)/var(benchReturns)
beta.META # >1 therefore performed atleast 1.6 times better than the market
```

```
##                daily.returns
## daily.returns      1.642219
```

```r
beta.BABA<- cov(BABA.return,benchReturns)/var(benchReturns)
beta.BABA # >1 therefore performed atleast 1.1 times better the market
```

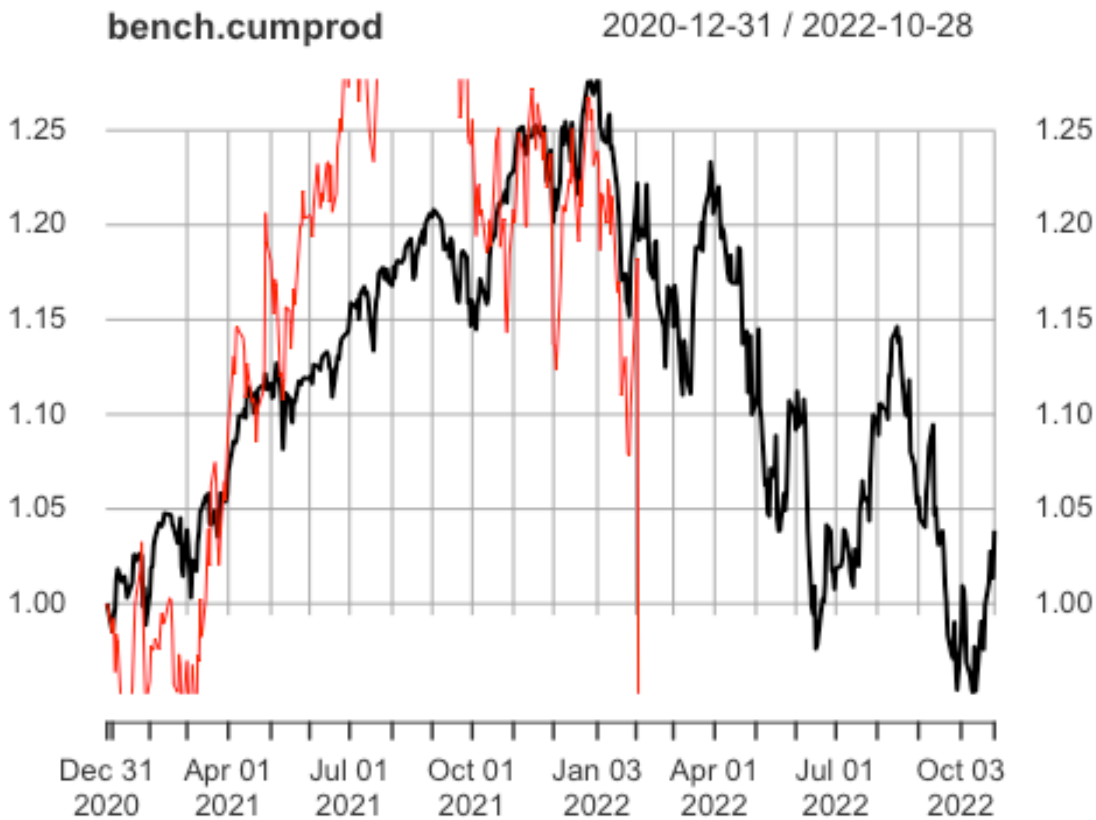
```
##                daily.returns
## daily.returns      1.147015
```

```r
beta.BAC<- cov(BAC.return,benchReturns)/var(benchReturns)
beta.BAC # <1 therefore did not perform better than the market although its
almost 1
```

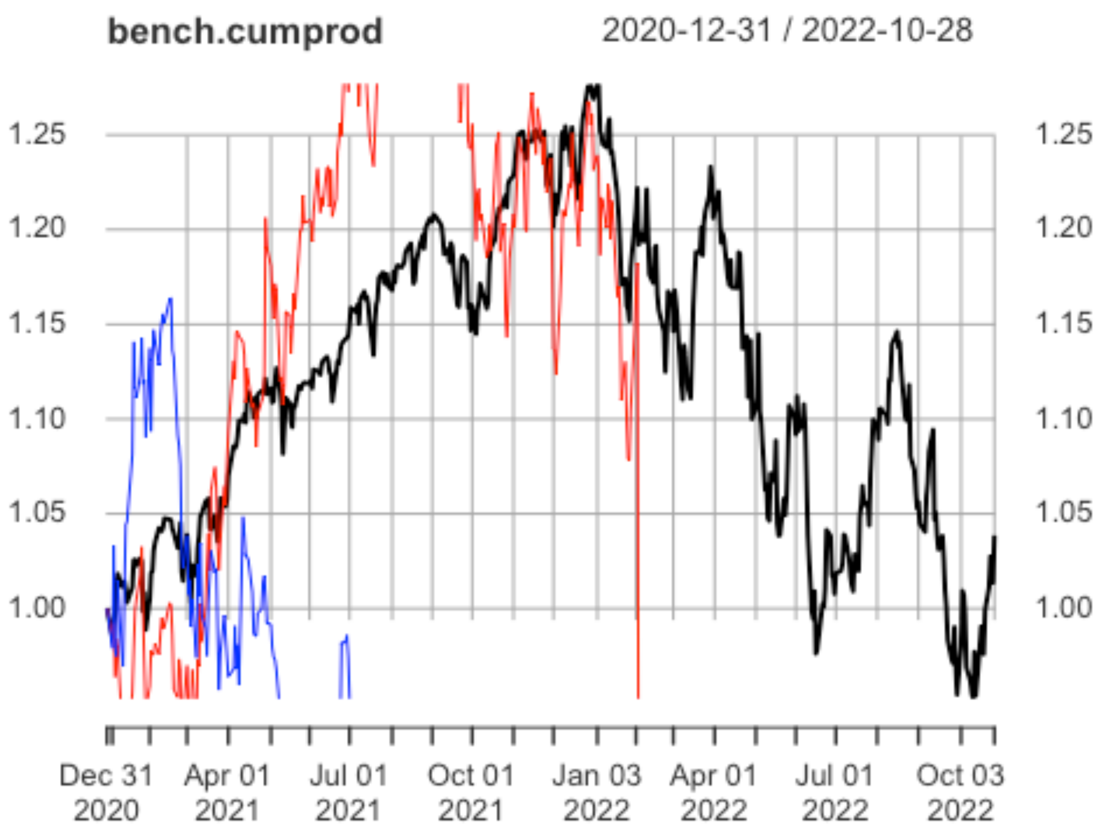
```
##                daily.returns
## daily.returns     0.9772168
```

```r
#Plot the cumulative product of  (1+ returns) to compare stocks

META.cumprod <- cumprod(1+ META.return)
BABA.cumprod <- cumprod(1+ BABA.return)
BAC.cumprod <- cumprod(1+BAC.return)

bench.cumprod <- cumprod(1+ benchReturns)
plot(bench.cumprod, type="l")
```

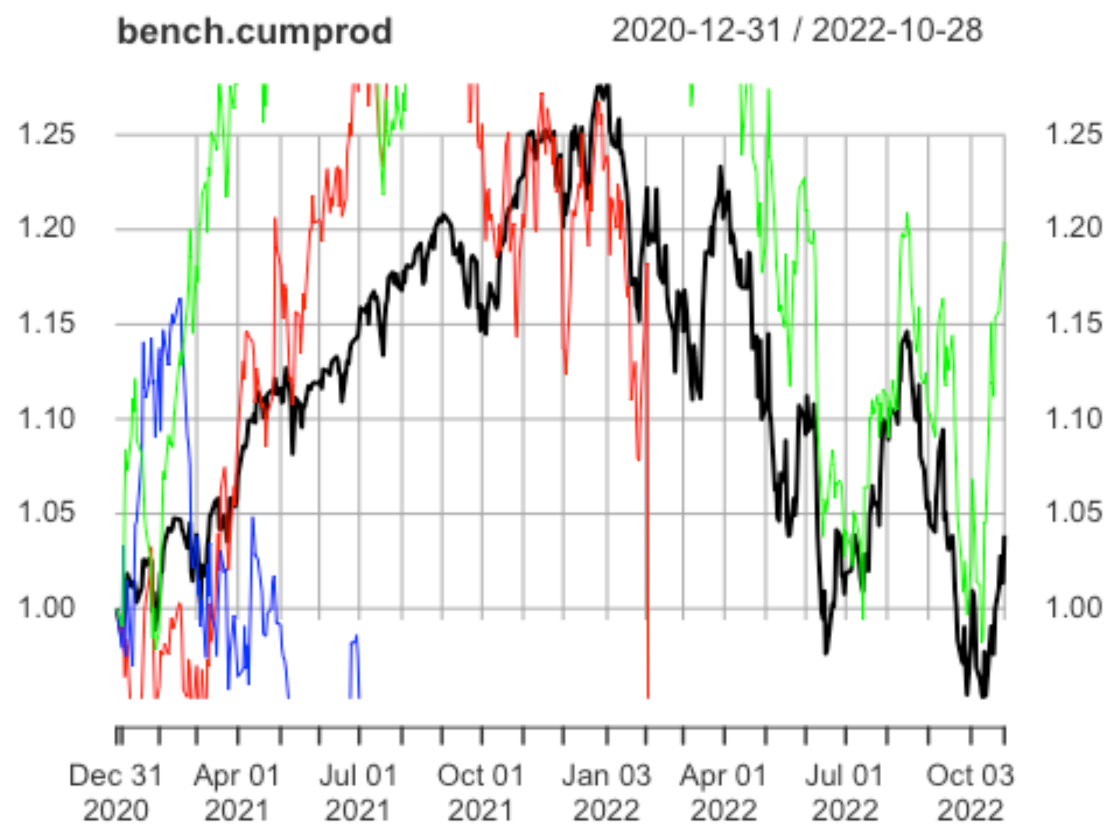

```
lines(META.cumprod, col="red")
```




```
lines(BABA.cumprod, col="blue")
```




```
lines(BAC.cumprod, col="green")
```




```
#EXPECTED RETURN
returns<- cbind(META.return,BABA.return,BAC.return)
mean.returns<- apply(returns,2,mean)
mean.returns

##   daily.returns daily.returns.1 daily.returns.2
##   -0.0016823886   -0.0021050641    0.0005563398

ff<-read.csv("FamaFrench.csv", header=T, skip=4)
#dim(ff)

colnames(ff) <- c("date", "MkRF","SMB", "HML", "RF")
head(ff)

##       date  MkRF   SMB   HML    RF
## 1 19260708  0.21 -0.38  0.19 0.009
## 2 19260709 -0.71  0.43  0.57 0.009
## 3 19260710  0.62 -0.53 -0.10 0.009
## 4 19260712  0.04 -0.03  0.64 0.009
## 5 19260713  0.48 -0.28 -0.20 0.009
## 6 19260714  0.04  0.07 -0.43 0.009

ff$date <- as.Date(ff$date,"%Y%m%d")
head(ff)
```

```
##          date  MkRF   SMB   HML    RF
## 1 1926-07-08  0.21 -0.38  0.19 0.009
## 2 1926-07-09 -0.71  0.43  0.57 0.009
## 3 1926-07-10  0.62 -0.53 -0.10 0.009
## 4 1926-07-12  0.04 -0.03  0.64 0.009
## 5 1926-07-13  0.48 -0.28 -0.20 0.009
## 6 1926-07-14  0.04  0.07 -0.43 0.009
```

```
ff.new<- ff[ff$date >="2020-12-31"& ff$date<="2022-09-30",]
head(ff.new)
```

```
##              date  MkRF   SMB   HML RF
## 24892 2020-12-31  0.39 -0.89  0.41  0
## 24893 2021-01-04 -1.41  0.22  0.58  0
## 24894 2021-01-05  0.86  1.23  0.48  0
## 24895 2021-01-06  0.79  2.14  3.93  0
## 24896 2021-01-07  1.76  0.33 -0.83  0
## 24897 2021-01-08  0.51 -0.75 -1.38  0
```

```
#Convert the return into dfs
META.return.df<- data.frame(META.return)
BABA.return.df<- data.frame(BABA.return)
BAC.return.df<- data.frame(BAC.return)

#add date column to later merge on

META.return.df$date <- index(META.return)
BABA.return.df$date <- index(BABA.return)
BAC.return.df$date <- index(BAC.return)

#merge
META.1 <- merge(ff.new, META.return.df, by="date", all.x=TRUE)
BABA.1 <- merge(ff.new, BABA.return.df, by="date", all.x=TRUE)
BAC.1 <- merge(ff.new, BAC.return.df, by="date", all.x=TRUE)

head(META.1)
```

```
##          date  MkRF   SMB   HML RF daily.returns
## 1 2020-12-31  0.39 -0.89  0.41  0   0.000000000
## 2 2021-01-04 -1.41  0.22  0.58  0  -0.015448828
## 3 2021-01-05  0.86  1.23  0.48  0   0.007548148
## 4 2021-01-06  0.79  2.14  3.93  0  -0.028268823
## 5 2021-01-07  1.76  0.33 -0.83  0   0.020622050
## 6 2021-01-08  0.51 -0.75 -1.38  0  -0.004353587
```

```
attach(META.1)
META.mod<-lm(daily.returns - RF~ MkRF + SMB+HML, META.1)
summary(META.mod)
```

```
##
## Call:
```

```
## lm(formula = daily.returns - RF ~ MkRF + SMB + HML, data = META.1)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.215081 -0.008646  0.000268  0.010700  0.138549
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.0018500  0.0009885  -1.872   0.0619 .
## MkRF         0.0146452  0.0009092  16.108  < 2e-16 ***
## SMB         -0.0018200  0.0013281  -1.370   0.1713
## HML         -0.0048597  0.0008979  -5.413 1.03e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0207 on 437 degrees of freedom
##   (2 observations deleted due to missingness)
## Multiple R-squared:  0.5043, Adjusted R-squared:  0.5009
## F-statistic: 148.2 on 3 and 437 DF,  p-value: < 2.2e-16

#some general analysis notes
 #t value high magnitude, the coefficient is going to be statistically significant.
# R-squared gives us a measurement of what percent of the variance in the response variable can be explained by the regression
#y-variable response variable
# mult R sq typically increases each time you add a predictor variable(x)
# mult R sq amount of variation in the response variable explained by the predictor variable
#adj R sq controls for each additional predictor added(to prevent from overfitting) so it may not increase as you add more variables
#F-statistic indicates if the model as a whole is statistically significant(number further from 1 is better)
# p-value <.05 indicates this model is statistically sign
```