Vivek_FE570_Final.R

viveksathyanarayana

Tue May 14 21:37:39 2019

```
#Vivek Sathyanarayana
#FE 570 Spring 2019
#Final Exam

#Problem 8-- (1)

library('TTR')

#Read file from text file
data <- read.csv("sp500hst.txt", head=T);

#To enlarge the numbers to print.
options(max.print=40000)

#Declare constants
nf = 12
ns = 26
m1 = 9

#Extract BAC
dataBAC <- data[data[,2]=="BAC",]

r<-vector(mode="numeric",length=(nrow(dataBAC)-1))
for(i in 1:(nrow(dataBAC)-1))
{
  r[i] <- dataBAC$Close[i]
}

MACDsig <- MACD(r,nFast = nf,nSlow = ns, nSig = m1)
MACDsig[is.na(MACDsig)] <- 0

#Counter to assess when MACD line is less than signal line to identify
crossover
j=0
count <- vector(mode = "numeric")
for (i in 1:length(MACDsig[,1])) {
  j=j+1
  if(MACDsig[i,1]<MACDsig[i,2])
    count[j]= 1
  else
    count[j]=0
```

```
}

buyMACD <- vector(mode="numeric")
sellMACD <- vector(mode="numeric")
#Loop starts from 34 as the first 33 values are 0 for the signal line
#and hence the program shouldn't accidentally recognize
#the first spike as a buy/sell signal

for (a in (34:((length(count)-1)))) {
  if((count[a+1]==0)&(count[a]==1)) {
    buyMACD <-cbind(buyMACD,a)
  }
  else if((count[a+1]==1)&(count[a]==0)) {
    sellMACD <-cbind(sellMACD,a)
  }
}

#MACD Returns Analysis
P = 10000 #initial amount
tcost = 5 #transaction cost

buyMACD <- cbind(buyMACD,length(r))
weightl <- vector(mode = "numeric")
weightsh <- vector(mode = "numeric")
weightl <- floor(P/r[buyMACD])
weightsh <- floor(P/r[sellMACD])

longAmt <- r[buyMACD]*weightl
shortAmt <- r[sellMACD]*weightsh
profitsh <- vector(mode="numeric")
profitl <- vector(mode="numeric")

#Long position profit
for (i in 1:length(shortAmt)-1) {
  profitl[i] <- ((weightl[i]*r[sellMACD[i+1]])-longAmt[i]) -(tcost) #Two
transactions --open and close
}

#Short position profit
for (i in 1:length(shortAmt)) {
  profitsh[i] <- (-(weightsh[i]*r[buyMACD[i]])+shortAmt[i])-(tcost)
}

#Comput P&L as percentage
ReturnPerc <- vector(mode = "numeric")

for (k in 1:length(sellMACD)) {
  ReturnPerc[2*k-1] <- (profitsh[k]/shortAmt[k])*100
}
```

```r
for (k in 1:(length(buyMACD)-1)) {
  ReturnPerc[2*k] <- (profitl[k]/longAmt[k])*100
}

#Create vectors with price at entry and exit
longP <- r[buyMACD]
shortP <- r[sellMACD]

#ROI Table for MACD
ROIMACD1 <- data.frame()
for (i in 1:length(sellMACD)) {
  ROIMACD1[(2*i-1),1] <- sellMACD[i]
  ROIMACD1[(2*i-1),2] <- buyMACD[i]
  ROIMACD1[(2*i-1),3] <- "SHORT"
  ROIMACD1[(2*i-1),4] <- shortP[i]
  ROIMACD1[(2*i-1),5] <- longP[i]
  ROIMACD1[(2*i-1),6] <- weightsh[i]
  ROIMACD1[(2*i-1),7] <- profitsh[i]
  ROIMACD1[(2*i-1),8] <- ReturnPerc[(2*i)-1]
}
for (i in 1:length(buyMACD)-1) {
  ROIMACD1[(2*i),1] <- buyMACD[i]
  ROIMACD1[(2*i),2] <- sellMACD[i+1]
  ROIMACD1[(2*i),3] <- "LONG"
  ROIMACD1[(2*i),4] <- longP[i]
  ROIMACD1[(2*i),5] <- shortP[i+1]
  ROIMACD1[(2*i),6] <- weightl[i]
  ROIMACD1[(2*i),7] <- profitl[i]
  ROIMACD1[(2*i),8] <- ReturnPerc[(2*i)]
}

colnames(ROIMACD1) <- c("Start","End","Position","Entry Price ($)",
                        "Exit Price ($)","No. of Shares","P/L (Amount)","P/L
(%)")

#Create vector with trading times for plot
tvec <- vector(mode="numeric")
tvec <- cbind(tvec,buyMACD)
tvec <- cbind(tvec,sellMACD)
tradevec <- vector(mode = "numeric")
tradevec <- MACDsig[tvec,1]



#Problem 8-- (2)
#Trading period  is over 2 years to rf is taken to be as the mean of the two
rates
rf = ((26.46+15.06)/2)/100
```

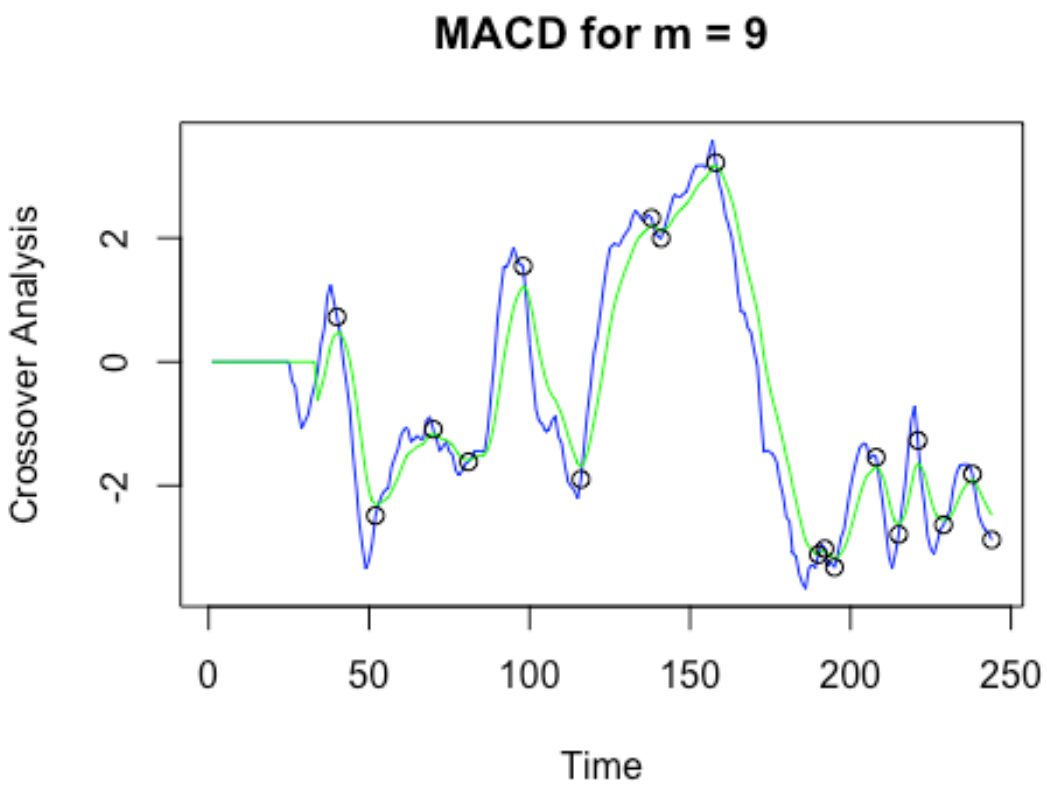
```r
#Calculate Sharpe Ratio
Sharpe9 <- (sum((ReturnPerc/100-
rf))/length(ReturnPerc/100))/sqrt(var((ReturnPerc/100)-rf))
#Sharpe ratio is low because Risk-free rate is extremely high

#Problem 8-- (3)
m2 = 7
m3 = 11
MACDsig2 <- MACD(r,nFast = nf,nSlow = ns, nSig = m2)
MACDsig2[is.na(MACDsig2)] <- 0

#Counter to assess when MACD line is less than signal line to identify
crossover
j=0
count2 <- vector(mode = "numeric")
for (i in 1:length(MACDsig2[,1])) {
  j=j+1
  if(MACDsig2[i,1]<MACDsig2[i,2])
    count2[j]= 1
  else
    count2[j]=0
}

buyMACD2 <- vector(mode="numeric")
sellMACD2 <- vector(mode="numeric")
#Loop starts from 34 as the first 33 values are 0 for the signal line
#and hence the program shouldn't accidentally recognize
#the first spike as a buy/sell signal

for (a in (34:((length(count2)-1)))) {
  if((count2[a+1]==0)&(count2[a]==1)) {
    buyMACD2 <-cbind(buyMACD2,a)
  }
  else if((count2[a+1]==1)&(count2[a]==0)) {
    sellMACD2 <-cbind(sellMACD2,a)
  }
}

#MACD Returns Analysis
buyMACD2 <- cbind(buyMACD2,length(r))
weightl2 <- vector(mode = "numeric")
weightsh2 <- vector(mode = "numeric")
weightl2 <- floor(P/r[buyMACD2])
weightsh2 <- floor(P/r[sellMACD2])

longAmt2 <- r[buyMACD2]*weightl2
shortAmt2 <- r[sellMACD2]*weightsh2
profitsh2 <- vector(mode="numeric")
```

```
profitl2 <- vector(mode="numeric")

#Long position profit
for (i in 1:length(shortAmt2)-1) {
  profitl2[i] <- ((weightl2[i]*r[sellMACD2[i+1]])-longAmt2[i]) -(tcost) #Two
transactions --open and close
}

#Short position profit
for (i in 1:length(shortAmt2)) {
  profitsh2[i] <- (-(weightsh2[i]*r[buyMACD2[i]])+shortAmt2[i])-(tcost)
}

#Comput P&L as percentage
ReturnPerc2 <- vector(mode = "numeric")

for (k in 1:length(sellMACD2)) {
  ReturnPerc2[2*k-1] <- (profitsh2[k]/shortAmt2[k])*100
}

for (k in 1:(length(buyMACD2)-1)) {
  ReturnPerc2[2*k] <- (profitl2[k]/longAmt2[k])*100
}

#Create vectors with price at entry and exit
longP2 <- r[buyMACD2]
shortP2 <- r[sellMACD2]

#ROI Table for MACD
ROIMACD2 <- data.frame()
for (i in 1:length(sellMACD2)) {
  ROIMACD2[(2*i-1),1] <- sellMACD2[i]
  ROIMACD2[(2*i-1),2] <- buyMACD2[i]
  ROIMACD2[(2*i-1),3] <- "SHORT"
  ROIMACD2[(2*i-1),4] <- shortP2[i]
  ROIMACD2[(2*i-1),5] <- longP2[i]
  ROIMACD2[(2*i-1),6] <- weightsh2[i]
  ROIMACD2[(2*i-1),7] <- profitsh2[i]
  ROIMACD2[(2*i-1),8] <- ReturnPerc2[(2*i)-1]
}
for (i in 1:length(buyMACD2)-1) {
  ROIMACD2[(2*i),1] <- buyMACD2[i]
  ROIMACD2[(2*i),2] <- sellMACD2[i+1]
  ROIMACD2[(2*i),3] <- "LONG"
  ROIMACD2[(2*i),4] <- longP2[i]
  ROIMACD2[(2*i),5] <- shortP2[i+1]
  ROIMACD2[(2*i),6] <- weightl2[i]
  ROIMACD2[(2*i),7] <- profitl2[i]
  ROIMACD2[(2*i),8] <- ReturnPerc2[(2*i)]
```

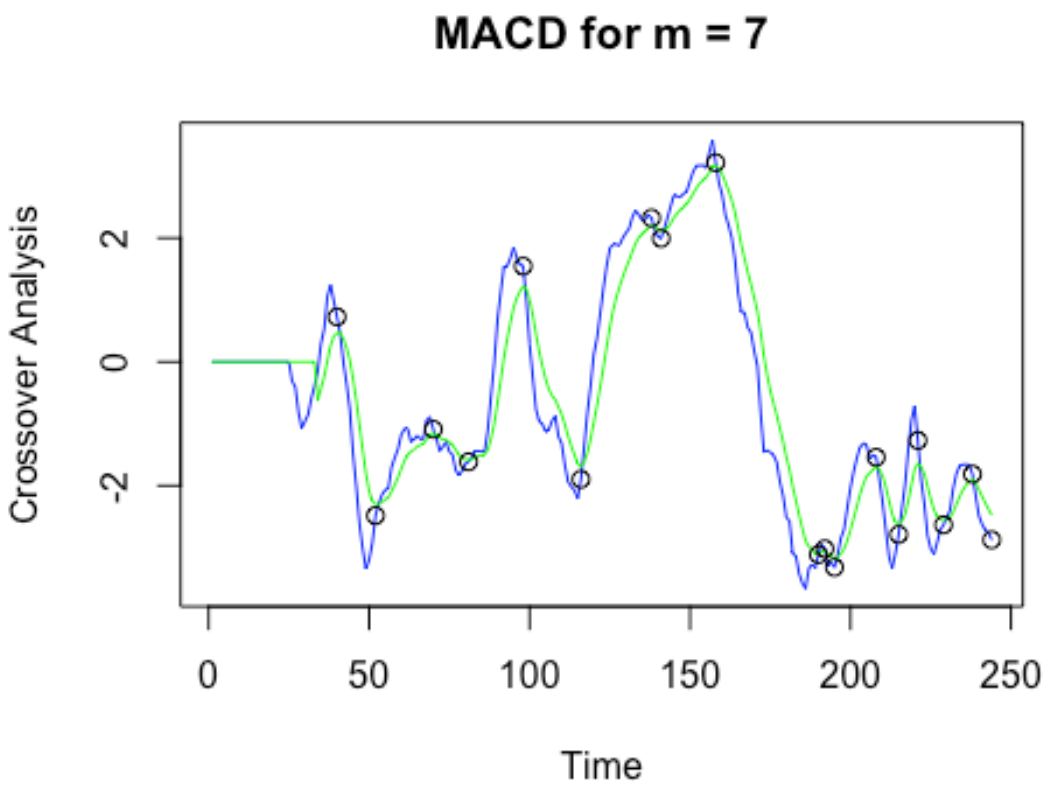
```
}

colnames(ROIMACD2) <- c("Start","End","Position","Entry Price ($)",
                        "Exit Price ($)","No. of Shares","P/L (Amount)","P/L
(%)")

#Create vector with trading times for plot
tvec2 <- vector(mode="numeric")
tvec2 <- cbind(tvec2,buyMACD2)
tvec2 <- cbind(tvec2,sellMACD2)
tradevec2 <- vector(mode = "numeric")
tradevec2 <- MACDsig2[tvec2,1]

#Calculate Sharpe Ratio for m = 7
Sharpe7 <- (sum((ReturnPerc2/100-
rf))/length(ReturnPerc2/100))/sqrt(var((ReturnPerc2/100)-rf))

#Recompute strategy for m = 11
MACDsig3 <- MACD(r,nFast = nf,nSlow = ns, nSig = m3)
MACDsig3[is.na(MACDsig3)] <- 0

#Counter to assess when MACD line is less than signal line to identify
crossover
j=0
count3 <- vector(mode = "numeric")
for (i in 1:length(MACDsig3[,1])) {
  j=j+1
  if(MACDsig3[i,1]<MACDsig3[i,2])
    count3[j]= 1
  else
    count3[j]=0
}

buyMACD3 <- vector(mode="numeric")
sellMACD3 <- vector(mode="numeric")
#Loop starts from 34 as the first 33 values are 0 for the signal line
#and hence the program shouldn't accidentally recognize
#the first spike as a buy/sell signal

for (a in (34:((length(count3)-1)))) {
  if((count3[a+1]==0)&(count3[a]==1)) {
    buyMACD3 <-cbind(buyMACD3,a)
  }
  else if((count3[a+1]==1)&(count3[a]==0)) {
    sellMACD3 <-cbind(sellMACD3,a)
  }
}

#MACD Returns Analysis
```

```
buyMACD3 <- cbind(buyMACD3,length(r))
weightl3 <- vector(mode = "numeric")
weightsh3 <- vector(mode = "numeric")
weightl3 <- floor(P/r[buyMACD3])
weightsh3 <- floor(P/r[sellMACD3])

longAmt3 <- r[buyMACD3]*weightl3
shortAmt3 <- r[sellMACD3]*weightsh3
profitsh3 <- vector(mode="numeric")
profitl3 <- vector(mode="numeric")

#Long position profit
for (i in 1:length(longAmt3)) {
  profitl3[i] <- ((weightl3[i]*r[sellMACD3[i]])-longAmt3[i]) -(tcost) #Two
transactions --open and close
}

#Short position profit
for (i in 1:length(shortAmt3)) {
  profitsh3[i] <- (-(weightsh3[i]*r[buyMACD3[i+1]])+shortAmt3[i])-(tcost)
}

#Comput P&L as percentage
ReturnPerc3 <- vector(mode = "numeric")

for (k in 1:length(sellMACD3)) {
  ReturnPerc3[2*k] <- (profitsh3[k]/shortAmt3[k])*100
}

for (k in 1:(length(buyMACD3)-1)) {
  ReturnPerc3[2*k-1] <- (profitl3[k]/longAmt3[k])*100
}

#Create vectors with price at entry and exit
longP3 <- r[buyMACD3]
shortP3 <- r[sellMACD3]

#ROI Table for MACD
ROIMACD3 <- data.frame()
for (i in 1:length(sellMACD3)) {
  ROIMACD3[(2*i),1] <- sellMACD3[i]
  ROIMACD3[(2*i),2] <- buyMACD3[i+1]
  ROIMACD3[(2*i),3] <- "SHORT"
  ROIMACD3[(2*i),4] <- shortP3[i]
  ROIMACD3[(2*i),5] <- longP3[i+1]
  ROIMACD3[(2*i),6] <- weightsh3[i]
  ROIMACD3[(2*i),7] <- profitsh3[i]
  ROIMACD3[(2*i),8] <- ReturnPerc3[(2*i)]
}
```

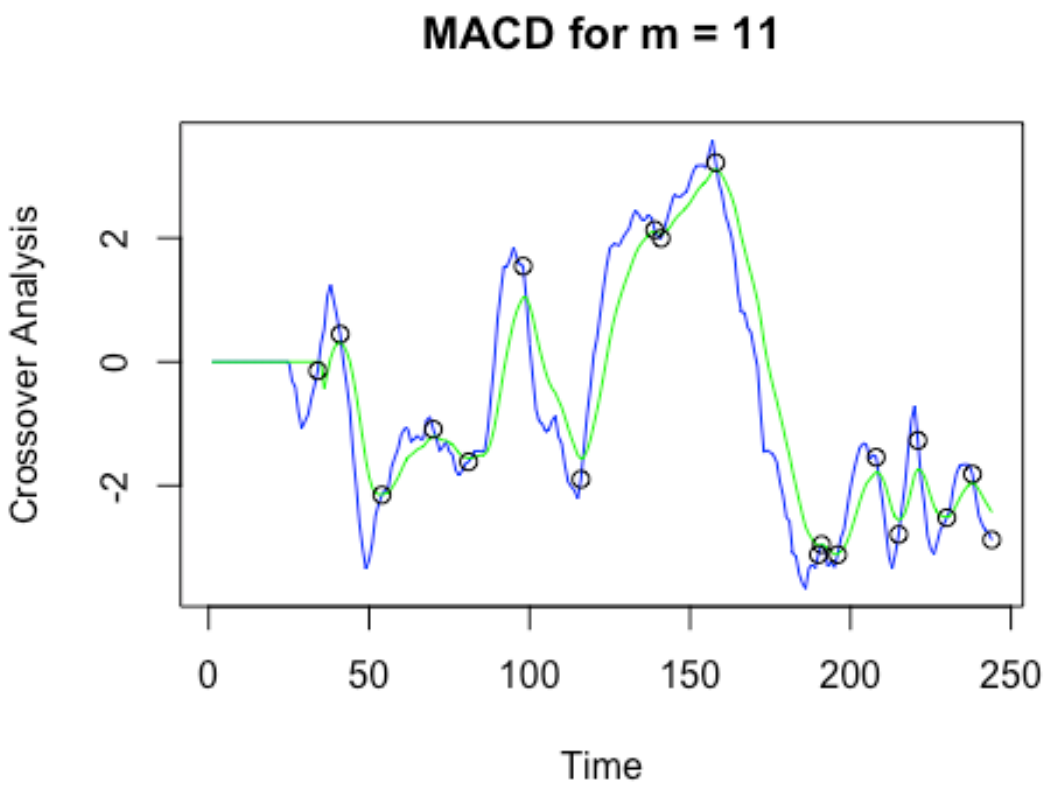
```r
for (i in 1:(length(buyMACD3)-1)) {
  ROIMACD3[(2*i-1),1] <- buyMACD3[i]
  ROIMACD3[(2*i-1),2] <- sellMACD3[i]
  ROIMACD3[(2*i-1),3] <- "LONG"
  ROIMACD3[(2*i-1),4] <- longP3[i]
  ROIMACD3[(2*i-1),5] <- shortP3[i]
  ROIMACD3[(2*i-1),6] <- weightl3[i]
  ROIMACD3[(2*i-1),7] <- profitl3[i]
  ROIMACD3[(2*i-1),8] <- ReturnPerc3[(2*i-1)]
}

colnames(ROIMACD3) <- c("Start","End","Position","Entry Price ($)",
                        "Exit Price ($)","No. of Shares","P/L (Amount)","P/L
(%)")

#Create vector with trading times for plot
tvec3 <- vector(mode="numeric")
tvec3 <- cbind(tvec3,buyMACD3)
tvec3 <- cbind(tvec3,sellMACD3)
tradevec3 <- vector(mode = "numeric")
tradevec3 <- MACDsig3[tvec3,1]



#Calculate Sharpe Ratio for m = 11
Sharpe11 <- (sum((ReturnPerc3/100-
rf))/length(ReturnPerc3/100))/sqrt(var((ReturnPerc3/100)-rf))

Sharpe <- data.frame(c(Sharpe7,Sharpe9,Sharpe11))
colnames(Sharpe) <- "Sharpe Ratio"
rownames(Sharpe) <- c("m = 7","m = 9","m = 11")

#Plots
plot(1:length(MACDsig[,1]),MACDsig[,1],type="l", main="MACD for m = 9",
xlab="Time",
     ylab="Crossover Analysis", col="blue")
lines(1:length(MACDsig[,2]), MACDsig[,2],col="green")
lines(tvec,tradevec,type = "p")
```




```
plot(1:length(MACDsig2[,1]),MACDsig2[,1],type="l", main="MACD for m = 7",
xlab="Time",
     ylab="Crossover Analysis", col="blue")
lines(1:length(MACDsig[,2]), MACDsig[,2],col="green")
lines(tvec,tradevec,type = "p")
```




```
plot(1:length(MACDsig3[,1]),MACDsig3[,1],type="l", main="MACD for m = 11",
xlab="Time",
     ylab="Crossover Analysis", col="blue")
lines(1:length(MACDsig3[,2]), MACDsig3[,2],col="green")
lines(tvec3,tradevec3,type = "p")
```




```
#Data Tables
#m=9
ROIMACD1
```

	Start	End	Position	Entry Price ($)	Exit Price ($)	No. of Shares	P/L (Amount)	P/L (%)
1	40	52	SHORT	17.16	16.43	582		
2	52	70	LONG	16.43	15.41	608		
3	70	81	SHORT	15.41	15.19	648		
4	81	98	LONG	15.19	16.49	658		
5	98	116	SHORT	16.49	15.16	606		
6	116	138	LONG	15.16	17.08	659		
7	138	141	SHORT	17.08	17.13	585		
8	141	158	LONG	17.13	18.41	583		
9	158	190	SHORT	18.41	15.89	543		
10	190	192	LONG	15.89	15.35	629		
11	192	195	SHORT	15.35	15.01	651		
12	195	208	LONG	15.01	15.24	666		
13	208	215	SHORT	15.24	14.86	656		
14	215	221	LONG	14.86	13.98	672		
15	221	229	SHORT	13.98	13.99	715		
16	229	238	LONG	13.99	13.63	714		
17	238	244	SHORT	13.63	13.02	733		

```
## 1        419.86  4.2040148
## 2       -625.16 -6.2582087
## 3        137.56  1.3775727
## 4        850.40  8.5082371
## 5        800.98  8.0154589
## 6       1260.28 12.6148598
## 7        -34.25 -0.3427811
## 8        741.24  7.4222047
## 9       1363.36 13.6381961
## 10      -344.66 -3.4483897
## 11       216.34  2.1649479
## 12       148.18  1.4822951
## 13       244.28  2.4434255
## 14      -596.36 -5.9720086
## 15       -12.15 -0.1215523
## 16      -262.04 -2.6233224
## 17       442.13  4.4253758

#m=7
ROIMACD2

##    Start End Position Entry Price ($) Exit Price ($) No. of Shares
## 1     40  51    SHORT           17.16          16.03           582
## 2     51  70     LONG           16.03          15.41           623
## 3     70  81    SHORT           15.41          15.19           648
## 4     81  98     LONG           15.19          16.49           658
## 5     98 116    SHORT           16.49          15.16           606
## 6    116 138     LONG           15.16          17.08           659
## 7    138 141    SHORT           17.08          17.13           585
## 8    141 157     LONG           17.13          19.48           583
## 9    157 189    SHORT           19.48          15.44           513
## 10   189 192     LONG           15.44          15.35           647
## 11   192 195    SHORT           15.35          15.01           651
## 12   195 208     LONG           15.01          15.24           666
## 13   208 215    SHORT           15.24          14.86           656
## 14   215 221     LONG           14.86          13.98           672
## 15   221 229    SHORT           13.98          13.99           715
## 16   229 238     LONG           13.99          13.63           714
## 17   238 244    SHORT           13.63          13.02           733
##    P/L (Amount)    P/L (%)
## 1        652.66  6.5350171
## 2       -391.26 -3.9178146
## 3        137.56  1.3775727
## 4        850.40  8.5082371
## 5        800.98  8.0154589
## 6       1260.28 12.6148598
## 7        -34.25 -0.3427811
## 8       1365.05 13.6685562
## 9       2067.52 20.6891859
## 10       -63.23 -0.6329532
```

```
## 11       216.34  2.1649479
## 12       148.18  1.4822951
## 13       244.28  2.4434255
## 14      -596.36 -5.9720086
## 15       -12.15 -0.1215523
## 16      -262.04 -2.6233224
## 17       442.13  4.4253758
```

```
#m=11
ROIMACD3
```

```
##    Start End Position Entry Price ($) Exit Price ($) No. of Shares
## 1     34  41     LONG           17.50          17.01           571
## 2     41  54    SHORT           17.01          15.98           587
## 3     54  70     LONG           15.98          15.41           625
## 4     70  81    SHORT           15.41          15.19           648
## 5     81  98     LONG           15.19          16.49           658
## 6     98 116    SHORT           16.49          15.16           606
## 7    116 139     LONG           15.16          16.82           659
## 8    139 141    SHORT           16.82          17.13           594
## 9    141 158     LONG           17.13          18.41           583
## 10   158 190    SHORT           18.41          15.89           543
## 11   190 191     LONG           15.89          15.81           629
## 12   191 196    SHORT           15.81          15.46           632
## 13   196 208     LONG           15.46          15.24           646
## 14   208 215    SHORT           15.24          14.86           656
## 15   215 221     LONG           14.86          13.98           672
## 16   221 230    SHORT           13.98          14.03           715
## 17   230 238     LONG           14.03          13.63           712
## 18   238 244    SHORT           13.63          13.02           733
##    P/L (Amount)    P/L (%)
## 1       -284.79 -2.8500375
## 2        599.61  6.0051858
## 3       -361.25 -3.6170213
## 4        137.56  1.3775727
## 5        850.40  8.5082371
## 6        800.98  8.0154589
## 7       1088.94 10.8998202
## 8       -189.14 -1.8930886
## 9        741.24  7.4222047
## 10      1363.36 13.6381961
## 11       -55.32 -0.5534873
## 12       216.20  2.1637483
## 13      -147.12 -1.4730914
## 14       244.28  2.4434255
## 15      -596.36 -5.9720086
## 16       -40.75 -0.4076753
## 17      -289.80 -2.9010868
## 18       442.13  4.4253758
```

```
#Output Sharpe
Sharpe

##         Sharpe Ratio
## m = 7     -2.410793
## m = 9     -3.064755
## m = 11    -3.291109

#As you can see from the table, m = 7 is the best strategy
```