Part II

(1)

For the first problem, we first generate the MACD line using the package "TTR" . Using the MACD function, the first column of the result is the MACD data, and the second column of the result is the signalline data. Then I compare series MACD and series Signalline to generate the trading signals along with the date.

```
> SignalSet
        Date  Open  High   Low Close Adj.Close    Volume xomsignal
52  2018-02-26 77.74 78.93 77.56 78.84  76.47682 16940400      buy
97  2018-05-01 77.26 77.26 75.98 76.95  74.64348 16231000     sell
104 2018-05-10 80.64 81.79 80.50 81.72  79.27050 17710300      buy
114 2018-05-24 81.35 81.36 79.95 80.27  78.65318 13360500     sell
123 2018-06-07 82.73 83.29 82.56 82.88  81.21062 13502500      buy
127 2018-06-13 82.44 82.60 81.47 81.51  79.86821 12049300     sell
139 2018-06-29 82.45 83.54 82.29 82.73  81.06364 17323200      buy
151 2018-07-18 81.80 82.32 81.49 82.22  80.56391  8711900     sell
157 2018-07-26 83.83 84.40 83.37 84.24  82.54322 13210100      buy
158 2018-07-27 80.97 82.38 80.81 81.92  80.26995 18220800     sell
177 2018-08-23 79.56 79.63 78.90 79.08  78.28639  7203900      buy
206 2018-10-04 85.50 86.08 85.25 85.58  84.72116 10204600     sell
227 2018-11-02 81.76 82.45 80.23 81.95  81.12759 19350400      buy
235 2018-11-14 78.86 79.09 76.75 77.39  77.39000 18552100     sell
245 2018-11-29 78.22 79.53 78.19 79.06  79.06000 10255200      buy
```

Noticed that the last signal can not be a pair itself, so I ignore this data to continue the next part. Assuming we have $10000, we can calculate the shares for each transaction.

```
> profit
        Date  Open  High   Low Close Adj.Close    Volume xomsignal shares
52  2018-02-26 77.74 78.93 77.56 78.84  76.47682 16940400      buy    126
97  2018-05-01 77.26 77.26 75.98 76.95  74.64348 16231000     sell      0
104 2018-05-10 80.64 81.79 80.50 81.72  79.27050 17710300      buy    122
114 2018-05-24 81.35 81.36 79.95 80.27  78.65318 13360500     sell      0
123 2018-06-07 82.73 83.29 82.56 82.88  81.21062 13502500      buy    120
127 2018-06-13 82.44 82.60 81.47 81.51  79.86821 12049300     sell      0
139 2018-06-29 82.45 83.54 82.29 82.73  81.06364 17323200      buy    120
151 2018-07-18 81.80 82.32 81.49 82.22  80.56391  8711900     sell      0
157 2018-07-26 83.83 84.40 83.37 84.24  82.54322 13210100      buy    118
158 2018-07-27 80.97 82.38 80.81 81.92  80.26995 18220800     sell      0
177 2018-08-23 79.56 79.63 78.90 79.08  78.28639  7203900      buy    126
206 2018-10-04 85.50 86.08 85.25 85.58  84.72116 10204600     sell      0
227 2018-11-02 81.76 82.45 80.23 81.95  81.12759 19350400      buy    122
235 2018-11-14 78.86 79.09 76.75 77.39  77.39000 18552100     sell      0
```

Then, I calculate the return for each trade, and I take the transaction cost into consideration here.

```
> profit
        Date  Open  High   Low Close Adj.Close    Volume xomsignal shares     return
52  2018-02-26 77.74 78.93 77.56 78.84  76.47682 16940400      buy    126    0.00000
97  2018-05-01 77.26 77.26 75.98 76.95  74.64348 16231000     sell      0 -243.13987
104 2018-05-10 80.64 81.79 80.50 81.72  79.27050 17710300      buy    122    0.00000
114 2018-05-24 81.35 81.36 79.95 80.27  78.65318 13360500     sell      0 -181.90049
123 2018-06-07 82.73 83.29 82.56 82.88  81.21062 13502500      buy    120    0.00000
127 2018-06-13 82.44 82.60 81.47 81.51  79.86821 12049300     sell      0 -169.39940
139 2018-06-29 82.45 83.54 82.29 82.73  81.06364 17323200      buy    120    0.00000
151 2018-07-18 81.80 82.32 81.49 82.22  80.56391  8711900     sell      0  -66.20024
157 2018-07-26 83.83 84.40 83.37 84.24  82.54322 13210100      buy    118    0.00000
158 2018-07-27 80.97 82.38 80.81 81.92  80.26995 18220800     sell      0 -278.76000
177 2018-08-23 79.56 79.63 78.90 79.08  78.28639  7203900      buy    126    0.00000
206 2018-10-04 85.50 86.08 85.25 85.58  84.72116 10204600     sell      0  814.00000
227 2018-11-02 81.76 82.45 80.23 81.95  81.12759 19350400      buy    122    0.00000
235 2018-11-14 78.86 79.09 76.75 77.39  77.39000 18552100     sell      0 -561.31976
> mean(profit$return)
```

Therefore, the pnl of the strategies can be calculated as the average of total return.
Which is:

```
> mean(profit$return)
[1] -49.05141
> var(profit$return)
[1] 88229.37
> sd(profit$return)
[1] 297.0343
```

(2)

For this part, I first calculate the log return of each trade. Then, using the Sharpe ratio formula, I can get the Sharpe ratio for the last question which is -1.444312

(3)

For this part, I mainly repeat the work for what have done above by changing the parameters for generating the signalline. When m=7, the Sharpe ration is -1.631563. When m=11, the Sharpe ratio is -1.589318 Since the bigger the ratio is, the better the strategy is. So use m=9 is the best parameter.

Code:

```
library("TTR")
xom<-read.table(file.choose(),sep=",",header=TRUE)
head(xom)
#9
macd <- MACD(xom[, "Close"], 12, 26, 9, maType = "EMA")
plot(macd[, 1], type = "l", col = "blue")
lines(macd[, 2], type = "l", col = "red")
Cp <- c()
Cp <- rep(0, 33)
macd
for(i in 34 : nrow(macd))
{
   if(macd[i, 1] > macd[i, 2]){Cp[i] <- 1}
   else{Cp[i] <- -1}
}
xomsignal <- rep(0,length(macd))
for(i in 34 : nrow(macd))
{
   if((Cp[i] - Cp[i - 1]) == 2)
   {xomsignal[i] <- 'buy'}
   else if((Cp[i] - Cp[i - 1]) == -2)
   {xomsignal[i] <- 'sell'}
}
xom2<- cbind(xom, xomsignal)
```

```r
SignalSet <- subset(xom2, xomsignal != 0)
SignalSet
total<-10000
shares<-rep(0,14)
for(i in 1:7)
{
    shares[2*i-1]=10000/(SignalSet$Close[2*i-1])
}
shares<-floor(shares)
profit<-cbind(SignalSet[-15,],shares)
profit
return<-rep(0,14)
for(i in 1:7)
{
    return[2*i]<-shares[2*i-1]*(profit$Close[2*i]-profit$Close[2*i-1])-5
}
profit<-cbind(profit,return)
profit
mean(profit$return)
var(profit$return)
sd(profit$return)
rf<-5.11/100
ri<-rep(0,14)
for(i in 1:7)
{
    ri[2*i]<-log(profit$Close[2*i]/profit$Close[2*i-1])
}
ri<-ri[ri!=0]
ri
sharpe1<-(mean(ri)-rf)/sd(ri-rf)
sharpe1




#7
macd <- MACD(xom[, "Close"], 12, 26, 7, maType = "EMA")
plot(macd[, 1], type = "l", col = "blue")
lines(macd[, 2], type = "l", col = "red")
Cp <- c()
Cp <- rep(0,31 )
```

```r
macd
for(i in 32 : nrow(macd))
{
   if(macd[i, 1] > macd[i, 2]){Cp[i] <- 1}
   else{Cp[i] <- -1}
}
xomsignal <- rep(0,length(macd))
for(i in 32 : nrow(macd))
{
   if((Cp[i] - Cp[i - 1]) == 2)
   {xomsignal[i] <- 'buy'}
   else if((Cp[i] - Cp[i - 1]) == -2)
   {xomsignal[i] <- 'sell'}
}
xom2<- cbind(xom, xomsignal)
SignalSet <- subset(xom2, xomsignal != 0)
SignalSet
total<-10000
shares<-rep(0,14)
for(i in 1:7)
{
   shares[2*i-1]=10000/(SignalSet$Close[2*i-1])
}
shares<-floor(shares)
profit<-cbind(SignalSet[-15,],shares)
profit
return<-rep(0,14)
for(i in 1:7)
{
   return[2*i]<-shares[2*i-1]*(profit$Close[2*i]-profit$Close[2*i-1])-5
}
profit<-cbind(profit,return)
profit
mean(profit$return)
var(profit$return)
rf<-5.11/100
ri<-rep(0,14)
for(i in 1:7)
{
   ri[2*i]<-log(profit$Close[2*i]/profit$Close[2*i-1])
}
ri<-ri[ri!=0]
sharpe2<-(mean(ri)-rf)/sd(ri-rf)
sharpe2
```

```
#11
macd <- MACD(xom[, "Close"], 12, 26, 11, maType = "EMA")
plot(macd[, 1], type = "l", col = "blue")
lines(macd[, 2], type = "l", col = "red")
Cp <- c()
Cp <- rep(0, 35)
macd
for(i in 36 : nrow(macd))
{
   if(macd[i, 1] > macd[i, 2]){Cp[i] <- 1}
   else{Cp[i] <- -1}
}
xomsignal <- rep(0,length(macd))
for(i in 36 : nrow(macd))
{
   if((Cp[i] - Cp[i - 1]) == 2)
   {xomsignal[i] <- 'buy'}
   else if((Cp[i] - Cp[i - 1]) == -2)
   {xomsignal[i] <- 'sell'}
}
xom2<- cbind(xom, xomsignal)
SignalSet <- subset(xom2, xomsignal != 0)
SignalSet
total<-10000
shares<-rep(0,14)
for(i in 1:7)
{
   shares[2*i-1]=10000/(SignalSet$Close[2*i-1])
}
shares<-floor(shares)
profit<-cbind(SignalSet[-15,],shares)
profit
return<-rep(0,14)
for(i in 1:7)
{
   return[2*i]<-shares[2*i-1]*(profit$Close[2*i]-profit$Close[2*i-1])-5
}
```

```r
profit<-cbind(profit,return)
profit
mean(profit$return)
var(profit$return)
rf<-5.11/100
ri<-rep(0,14)
for(i in 1:7)
{
    ri[2*i]<-log(profit$Close[2*i]/profit$Close[2*i-1])
}
ri<-ri[ri!=0]
sharpe3<-(mean(ri)-rf)/sd(ri-rf)
sharpe3
```