ECON 432 Homework 4 R Excercises

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Contents

1A

```
set.seed(432)
```

```
options(digits=4, width=70)
# Round off a number to 4 decimal places
# The width option says how many characters R should put on a line.

library(tseries)
```

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

```r
# look at help on get.hist.quote
# ?get.hist.quote

# get the adjusted closing prices from Yahoo!
AAPL.prices = get.hist.quote(instrument="AAPL", start="2010-01-01",
                             end="2021-01-31", quote="AdjClose",
                             provider="yahoo",
                             compression="w", retclass="zoo")
```

```
## ’getSymbols’ currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## ’loadSymbols’ to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.
```

```
## time series ends   2021-01-29
```

```r
AAPL.return = diff(log(AAPL.prices))
T = length(AAPL.return)

mu.hat = mean(AAPL.return)
sigma.hat = sd(AAPL.return)
variance = sigma.hat^2
SE = sigma.hat/sqrt(T-1)
cbind(mu.hat,variance,SE)
```

```
##        mu.hat variance       SE
## [1,] 0.005212 0.001375 0.001544
```

1B

```r
library(bootstrap)
nboot = 1000
sam_m = function(x){mean(x)}
Ret <- as.numeric(AAPL.return)
results = bootstrap(Ret, nboot, sam_m)
B_SE = sd(results$thetastar)
IQR_SE = IQR(results$thetastar)/(qnorm(0.75)-qnorm(0.25))
cbind(SE, B_SE, IQR_SE)
```

```
##            SE     B_SE   IQR_SE
## [1,] 0.001544 0.001522 0.001519
```

The SE, bootstrap SE, and IQR SE are all fairly close to eachother with the SE and IQR SE being the closest.

1C

```r
library(bootstrap)
nboot = 1000
sam_m = function(x){mean(x)}
Ret <- as.numeric(AAPL.return)
results = bootstrap(Ret, nboot, sam_m)
B_SE = sd(results$thetastar)
B_SE
```

```
## [1] 0.001484
```

```r
IQR_SE = IQR(results$thetastar)/(qnorm(0.75)-qnorm(0.25))
IQR_SE
```

```
## [1] 0.001472
```

1D

```r
B_bias = mean(results$thetastar)-mu.hat
MSE = mean((results$thetastar-mu.hat)^2)
cbind(B_bias,MSE)
```

```
##         B_bias       MSE
## [1,] 5.686e-05 2.205e-06
```

1E

```r
alpha = 0.05
q_sym = quantile(abs(results$thetastar-mu.hat),1-alpha)
q_et_1 = quantile(mu.hat-results$thetastar,alpha/2)
q_et_2 = quantile(mu.hat-results$thetastar,1-alpha/2)

CI_et = c(mu.hat+q_et_1, mu.hat+q_et_2)
CI_sym = c(mu.hat-q_sym, mu.hat+q_sym)
cbind(CI_et,CI_sym)
```

```
##          CI_et   CI_sym
## 2.5%  0.002450 0.002359
## 97.5% 0.008075 0.008065
```

1F

```r
W0 <- 1000
alpha <- 0.1
L1 <- W0*(exp(AAPL.return)-1)
VaR_Para_Est <- W0*(exp(qnorm(alpha,mu.hat,sigma.hat))-1)

VaR_NonP_Est <- W0*(exp(quantile(AAPL.return,alpha))-1)

library(cvar)
L1_qf <- function(x){ W0*(exp(qnorm(x, mu.hat, sigma.hat)) - 1)}
para_ES <- -1*ES(L1_qf, x = alpha, dist.type = "qf")

ind <- as.numeric(L1 <= VaR_NonP_Est)
nonp_ES <- mean(L1*ind)/mean(ind)

cbind(VaR_Para_Est, para_ES,VaR_NonP_Est,nonp_ES)
```

```
##     VaR_Para_Est para_ES VaR_NonP_Est nonp_ES
## 10%       -41.42  -57.99        -38.2  -62.54
```

1G

```r
set.seed(123)
nboot <-  1000
VaR_Est  <- function(x, p = alpha){ W0*(exp(quantile(x, p)) - 1) }

Ret <- as.numeric(AAPL.return)
results_VaR <- bootstrap(Ret, nboot, VaR_Est)

B_SE_VaR <- sd(results_VaR$thetastar)

Q_VaR <- quantile(results_VaR$thetastar, c(0.25, 0.75))
B_IQRSE_VaR <- (Q_VaR[2] - Q_VaR[1])/(qnorm(0.75) - qnorm(0.25))

ES_Est   <- function(x, p=alpha){
var_est  = W0*(exp(quantile(x, p)) - 1)
L1       = W0*(exp(x) - 1)
ind      = as.numeric(L1 <= var_est)
f_val    = mean(L1*ind)/mean(ind)
return(f_val)
}

set.seed(123)
results_ES <- bootstrap(Ret,nboot,ES_Est)

Q_ES <- quantile(results_ES$thetastar, c(0.25, 0.75))
B_SE_ES <- sd(results_ES$thetastar)
B_IQRSE_ES <- (Q_ES[2] - Q_ES[1])/(qnorm(0.75) - qnorm(0.25))

cbind(B_SE_VaR,B_IQRSE_VaR,B_SE_ES,B_IQRSE_ES)
```

```
##     B_SE_VaR B_IQRSE_VaR B_SE_ES B_IQRSE_ES
## 75%    2.531        2.73   4.482      4.384
```

1H

```
CI_B_SE1.ES <- c(nonp_ES - B_SE_ES*1.96,    nonp_ES + B_SE_ES*1.96)
CI_B_SE1.VaR <- c(VaR_NonP_Est - B_SE_VaR*1.96,    VaR_NonP_Est + B_SE_VaR*1.96)
cbind(CI_B_SE1.ES,CI_B_SE1.VaR)
```

```
##     CI_B_SE1.ES CI_B_SE1.VaR
## 10%      -71.32       -43.16
## 10%      -53.75       -33.23
```