MA 471: Lab Assignment 05

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Contents

Problem 1

R Code :

```
library(coda)

N = 100
y = rnorm(N, 0, sqrt(5))

a = (N+5)/2
b = (1+sum(y^2))/2

Theta = rgamma(N, shape = a, scale = 1/b)
Theta = 1/Theta
Theta = sort(Theta)

alpha = 1-0.95

Min_interval_length = 9999999

theta_a = 0
theta_b = 0

for(j in 1:(N - as.integer(N*(1-alpha))))
{
  temp = Theta[j+as.integer(N*(1-alpha))] - Theta[j]
  if(temp < Min_interval_length)
  {
    Min_interval_length = temp
    theta_a = Theta[j]
    theta_b = Theta[j+as.integer(N*(1-alpha))]
  }
}

cat("95% Credible Interval for sigma^2 :\n")
cat("Confidence Interval =
    [ ",theta_a, ", ", theta_b, " ]\n\n")
```

Output :

```
95% Credible Interval for sigma^2 :
Confidence Interval = [ 3.546708, 5.800625 ]
```

Problem 2

R Code :

```
# data
data = read.table(file = "d-csp0108.txt", header = TRUE);

C_rtn = data[,2]
SP_rtn = data[,3]

# Log returns calculated
log_C = log(1+C_rtn)
log_SP = log(1+SP_rtn)

alpha = 1-0.95

z = qnorm(1-alpha/2, mean=0, sd=1)

# -------------------------- PART (a) ----------------------

cat("95% Confidence Inervals Assuming
    data follows normal\n\n")

# ---------------For log returns for Citi Group----------------
# (i) Based on first 50 samples

cat("For mean of daily log return
    of CitiGroup Stock:\n\n")

sample1_50 = log_C[1:50]
x1_50 = mean(sample1_50)
s1_50 = sd(sample1_50)

a1_50 = x1_50 - s1_50*z/sqrt(50);
b1_50 = x1_50 + s1_50*z/sqrt(50);

cat("Based on first 50 sample points:\n")
cat("Confidence Interval:
    [ ", a1_50, ", ",b1_50," ]\n")

# (ii) Based on Complete sample

X1 = mean(log_C)
s1 = sd(log_C)

a1 = X1 - s1*z/sqrt(length(log_C))
b1 = X1 + s1*z/sqrt(length(log_C))

cat("Based on the Complete sample points:\n")
cat("Confidence Interval:
    [ ", a1, ", ",b1," ]\n")
```

```
# ----------------For log returns for S&P-----------------
# (i) Based on first 50 samples

cat("For mean of daily log
    return of S&P Stock:\n\n")

sample2_50 = log_SP[1:50]
x2_50 = mean(sample2_50)
s2_50 = sd(sample2_50)

a2_50 = x2_50 - s2_50*z/sqrt(50);
b2_50 = x2_50 + s2_50*z/sqrt(50);

cat("Based on first 50 sample points:\n")
cat("Confidence Interval:
    [ ", a2_50, ", ",b2_50," ]\n")

# (ii) Based on Complete sample

X2 = mean(log_SP)
s2 = sd(log_SP)

a2 = X2 - s2*z/sqrt(length(log_SP))
b2 = X2 + s2*z/sqrt(length(log_SP))

cat("Based on the Complete sample points:\n")
cat("Confidence Interval:
    [ ", a2, ", ",b2," ]\n")


# ---------------------- PART (b) ------------------------


# ================= PERCENTILE BOOTSTRAP =================

GenReSample <- function(X)
{
  n = length(X)
  K = sample.int(n, n, replace = TRUE)
  Y = X[K]
  return(Y)
}

cat("95% Percentile Bootstrap Confidence Inervals\n\n")

# --------------For log returns for Citi Group---------------
# (i) Based on first 50 samples

cat("For mean of daily log return
    of CitiGroup Stock:\n\n")

sample1_50 = log_C[1:50]
n = length(sample1_50)
```

```
x1_50 = mean(sample1_50)
s1_50 = sd(sample1_50)

Y1_50 = GenReSample(sample1_50)
Y1_50 = sort(Y1_50)

ay1_50 = Y1_50[as.integer(n*alpha/2)+1]
by1_50 = Y1_50[as.integer(n*(1-alpha/2))+1]

cat("Based on first 50 sample points:\n")
cat("Confidence Interval:
    [ ", ay1_50, ", ",by1_50," ]\n")


# (ii) Based on Complete sample

n = length(log_C)
X1 = mean(log_C)
s1 = sd(log_C)

Y1 = GenReSample(log_C)
Y1 = sort(Y1)

ay1 = Y1[as.integer(n*alpha/2)+1]
by1 = Y1[as.integer(n*(1-alpha/2))+1]

cat("Based on Complete sample points:\n")
cat("Confidence Interval:
    [ ", ay1, ", ",by1," ]\n")

# ---------------- For log returns for S&P-----------------
# (i) Based on first 50 samples

cat("For mean of daily log
    return of S&P Stock:\n\n")

sample2_50 = log_SP[1:50]
n = length(sample2_50)
x2_50 = mean(sample2_50)
s2_50 = sd(sample2_50)

Y2_50 = GenReSample(sample2_50)
Y2_50 = sort(Y2_50)

ay2_50 = Y2_50[as.integer(n*alpha/2)+1]
by2_50 = Y2_50[as.integer(n*(1-alpha/2))+1]

cat("Based on first 50 sample points:\n")
cat("Confidence Interval:
    [ ", ay2_50, ", ",by2_50," ]\n")


# (ii) Based on Complete sample
```

```
n = length(log_SP)
X2 = mean(log_SP)
s2 = sd(log_SP)

Y2 = GenReSample(log_SP)
Y2 = sort(Y2)

ay2 = Y2[as.integer(n*alpha/2)+1]
by2 = Y2[as.integer(n*(1-alpha/2))+1]

cat("Based on Complete sample points:\n")
cat("Confidence Interval:
    [ ", ay2, ", ",by2," ]\n")


# ==================== BOOT-t ====================

GenerateBootstrapSamples <- function(X, B)
{
  n = length(X)

  muX = vector(,B)
  sdX = vector(,B)
  for(i in 1:B)
  {
    K = sample.int(n, n, replace = TRUE)
    xB = X[K]
    muX[i] = mean(xB)
    sdX[i] = sd(xB)
  }

  params <- list("mu"=muX, "sd"=sdX)
  return(params)
}


cat("95% Boot-t Confidence Inervals\n\n")

# --------------For log returns for Citi Group--------------
# (i) Based on first 50 samples

cat("For mean of daily log return
    of CitiGroup Stock:\n\n")

sample1_50 = log_C[1:50]
n = length(sample1_50)
x1_50 = mean(sample1_50)
s1_50 = sd(sample1_50)

B = 100
params = GenerateBootstrapSamples(sample1_50, B)
muxb1_50 = params$mu
```

```
sdxb1_50 = params$sd

tb1_50 = (x1_50 - muxb1_50)/(sdxb1_50/sqrt(length(n)))
tb1_50 = sort(tb1_50)

L = as.integer(B*alpha/2)+1
U = as.integer(B*(1-alpha/2))+1

ab1_50 = x1_50 + s1_50*tb1_50[L]/sqrt(n)
bb1_50 = x1_50 + s1_50*tb1_50[U]/sqrt(n)

cat("Based on first 50 sample points:\n")
cat("Confidence Interval: [ ", ab1_50, ", ",bb1_50," ]\n")


# (ii) Based on Complete sample

n = length(log_C)
X1 = mean(log_C)
s1 = sd(log_C)

B = 100
params = GenerateBootstrapSamples(log_C, B)
muXb1 = params$mu
sdXb1 = params$sd

tb1 = (X1 - muXb1)/(sdXb1/sqrt(length(n)))
tb1 = sort(tb1)

L = as.integer(B*alpha/2)+1
U = as.integer(B*(1-alpha/2))+1

ab1 = X1 + s1*tb1[L]/sqrt(n)
bb1 = X1 + s1*tb1[U]/sqrt(n)

cat("Based on Complete sample points:\n")
cat("Confidence Interval: [ ", ab1, ", ",bb1," ]\n")


# ----------------For log returns for S&P-----------------
# (i) Based on first 50 samples

cat("For mean of daily log return of S&P Stock:\n\n")

sample2_50 = log_SP[1:50]
n = length(sample2_50)
x2_50 = mean(sample2_50)
s2_50 = sd(sample2_50)

B = 100
params = GenerateBootstrapSamples(sample2_50, B)
muxb2_50 = params$mu
sdxb2_50 = params$sd
```

```
tb2_50 = (x2_50 - muxb2_50)/(sdxb2_50/sqrt(length(n)))
tb2_50 = sort(tb2_50)

L = as.integer(B*alpha/2)+1
U = as.integer(B*(1-alpha/2))+1

ab2_50 = x2_50 + s2_50*tb2_50[L]/sqrt(n)
bb2_50 = x2_50 + s2_50*tb2_50[U]/sqrt(n)

cat("Based on first 50 sample points:\n")
cat("Confidence Interval: [ ", ab2_50, ", ",bb2_50," ]\n")


# (ii) Based on Complete sample

n = length(log_SP)
X2 = mean(log_SP)
s2 = sd(log_SP)

B = 100
params = GenerateBootstrapSamples(log_SP, B)
muXb2 = params$mu
sdXb2 = params$sd

tb2 = (X2 - muXb2)/(sdXb2/sqrt(length(n)))
tb2 = sort(tb2)

L = as.integer(B*alpha/2)+1
U = as.integer(B*(1-alpha/2))+1

ab2 = X2 + s2*tb2[L]/sqrt(n)
bb2 = X2 + s2*tb2[U]/sqrt(n)

cat("Based on Complete sample points:\n")
cat("Confidence Interval: [ ", ab2, ", ",bb2," ]\n")
```

Output :

```
95% Confidence Inervals Assuming data follows Normal

For mean of daily log return of CitiGroup Stock:
Based on first 50 sample points:
Confidence Interval: [ -0.009995073, 0.004950207 ]

Based on the Complete sample points:
Confidence Interval: [ -0.002174664, 0.0004850667 ]

For mean of daily log return of S&P Stock:
Based on first 50 sample points:
Confidence Interval: [ -0.006587152, 0.001640952 ]
```

```
Based on the Complete sample points:
Confidence Interval: [ -0.0007814516, 0.0004039273 ]


95% Percentile Bootstrap Confidence Inervals

For mean of daily log return of CitiGroup Stock:
Based on first 50 sample points:
Confidence Interval: [ -0.05830837, 0.03298303 ]

Based on Complete sample points:
Confidence Interval: [ -0.05129329, 0.05320232 ]

For mean of daily log return of S&P Stock:
Based on first 50 sample points:
Confidence Interval: [ -0.0284324, 0.01733881 ]

Based on Complete sample points:
Confidence Interval: [ -0.02677836, 0.02361203 ]


95% Boot-t Confidence Inervals

For mean of daily log return of CitiGroup Stock:
Based on first 50 sample points:
Confidence Interval: [ -0.003784931, -0.001433817 ]

Based on Complete sample points:
Confidence Interval: [ -0.0008718505, -0.0008159373 ]

For mean of daily log return of S&P Stock:
Based on first 50 sample points:
Confidence Interval: [ -0.003031185, -0.001797106 ]

Based on Complete sample points:
Confidence Interval: [ -0.0002011453, -0.0001764316 ]
```