Assignment-5

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1 Question A

Code for R

```r
rm(list = ls())

n = 100;
alpha = 0.05;
sig = sqrt(5);

X = rnorm(n, mean = 0, sd = sig);
sum_X2 = sum(X^2);

prior <- function(sig2) {
    return (sig2^(-7/2) * exp(-0.5/sig2));
}

likelihood <- function (sig2) {
    return (exp(-sum_X2/(2*sig2)) / sqrt(2*pi*sig2)^n)
}

posterior1 <- function(sig2) {
    y = likelihood(sig2)*prior(sig2);
    return (y);
}

coeff = 1/integrate(posterior1, 0, Inf)$value;
posterior <- function(sig2) {
    return (coeff * posterior1(sig2));
}

m = 1000;
Y = sort(rexp(m));
W = posterior(Y)/dexp(Y);
```

```
31 W = W / sum(W);
32
33 clb = 0; cub = Inf;
34
35 s = 0; k = 0;
36 for (i in 1:m) {
37     s = s + W[i];
38     if ((s > alpha/2) && (k == 0)) {
39         k = 1;
40         clb = Y[i];
41     }
42     if ((s > 1 - alpha/2) && (k == 1)) {
43         k = 2;
44         cub = Y[i];
45     }
46 }
47
48 cat(sprintf('\nThe %d%% confidence interval for sig^2 = [%f, %f]\n\n', 100*(1-alpha), clb, cub
        ));
```

The 95% confidence interval for $\hat{sig2}$ = [5.049555, 7.282538]

2 Question B (i)

Code for R

```
1 rm(list = ls())
2 d = read.table("d-csp0108.txt", header=TRUE)
3 names = c('C', 'SP')
4 n = length(d[,1]);
5
6 # Calculating log returns
7 for (k in 2:3) {
8     d[,k] = log(1 + d[,k]);
9 }
10
11 N = c(50, n);
12 alpha = 0.05;
13
14 for (k in 2:3) {
15     X = d[,k];
16     mu_total = mean(X);
17     for (n in N) {
18         mu = mean(X[1:n]);
19         sig = sd(X[1:n]);
20
```

```
21        clb = sig*qnorm(alpha/2)/sqrt(n); cub = sig*qnorm(1 - alpha/2)/sqrt(n);
22
23        cat(sprintf('\n%s Stock, %d samples\\\\\n', names[k-1], n));
24        cat(sprintf('The %d%% confidence interval for mean = [%f, %f]\\\\\n', 100*(1-alpha), clb
             , cub));
25        if ((clb <= mu) && (mu <= cub)) {
26            cat(sprintf('The mean = %f is inside the confidence interval.\\\\\n\n', mu));
27        } else {
28            cat(sprintf('The mean = %f is not inside the confidence interval.\\\\\n\n', mu));
29        }
30    }
31 }
```

C Stock, 50 samples

The 95% confidence interval for mean = [-0.007473, 0.007473]

The mean = -0.002522 is inside the confidence interval.

C Stock, 2011 samples

The 95% confidence interval for mean = [-0.001330, 0.001330]

The mean = -0.000845 is inside the confidence interval.

SP Stock, 50 samples

The 95% confidence interval for mean = [-0.004114, 0.004114]

The mean = -0.002473 is inside the confidence interval.

SP Stock, 2011 samples

The 95% confidence interval for mean = [-0.000593, 0.000593]

The mean = -0.000189 is inside the confidence interval.

3 Question B (ii)

Code for R

```
1 rm(list = ls())
2 d = read.table("d-csp0108.txt", header=TRUE)
3 names = c('C', 'SP')
4 methods = c('boot-t', 'boot percentile');
5 n = length(d[,1]);
6
7 # Calculating log returns
8 for (k in 2:3) {
```

```r
 9      d[,k] = log(1 + d[,k]);
10  }
11
12  N = c(50, n);
13  alpha = 0.05;
14  B = 1000;
15  m = 100;
16
17  for (method in methods) {
18      for (k in 2:3) {
19          X = d[,k];
20          mu_total = mean(X);
21          for (n in N) {
22              mu = mean(X[1:n]);
23              sig = sd(X[1:n]);
24
25              if (method == 'boot-t') {
26                  T = numeric(B);
27                  for (b in 1:B) {
28                      s = sample(n, m, replace = TRUE);
29                      Y = X[s];
30                      T[b] = sqrt(m)*(mean(Y) - mu)/sd(Y);
31                  }
32                  CI = quantile(T, c(alpha/2, 1- alpha/2));
33                  CI = CI*sig/sqrt(n);
34              } else {
35                  M = numeric(B);
36                  for (b in 1:B) {
37                      s = sample(n, m, replace = TRUE);
38                      Y = X[s];
39                      M[b] = mean(Y);
40                  }
41                  CI = quantile(M, c(alpha/2, 1- alpha/2));
42              }
43
44              # print(CI);
45              clb = CI[1]; cub = CI[2];
46              cat(sprintf('\n%s Stock, %d samples, Method = %s\\\\\n', names[k-1], n, method));
47              cat(sprintf('The %d%% confidence interval for mean = [%f, %f]\\\\\n', 100*(1-alpha),
                      clb, cub));
48              if ((clb <= mu) && (mu <= cub)) {
49                  cat(sprintf('The mean = %f is inside the confidence interval.\\\\\n\n', mu));
50              } else {
51                  cat(sprintf('The mean = %f is not inside the confidence interval.\\\\\n\n', mu));
52              }
53          }
54      }
55  }
```

C Stock, 50 samples, Method = boot-t

The 95% confidence interval for mean = [-0.007753, 0.007045]

The mean = -0.002522 is inside the confidence interval.

C Stock, 2011 samples, Method = boot-t

The 95% confidence interval for mean = [-0.001279, 0.001470]

The mean = -0.000845 is inside the confidence interval.

SP Stock, 50 samples, Method = boot-t

The 95% confidence interval for mean = [-0.004057, 0.004151]

The mean = -0.002473 is inside the confidence interval.

SP Stock, 2011 samples, Method = boot-t

The 95% confidence interval for mean = [-0.000572, 0.000579]

The mean = -0.000189 is inside the confidence interval.

C Stock, 50 samples, Method = boot percentile

The 95% confidence interval for mean = [-0.007709, 0.002714]

The mean = -0.002522 is inside the confidence interval.

C Stock, 2011 samples, Method = boot percentile

The 95% confidence interval for mean = [-0.006803, 0.005083]

The mean = -0.000845 is inside the confidence interval.

SP Stock, 50 samples, Method = boot percentile

The 95% confidence interval for mean = [-0.005385, 0.000361]

The mean = -0.002473 is inside the confidence interval.

SP Stock, 2011 samples, Method = boot percentile

The 95% confidence interval for mean = [-0.002946, 0.002433]

The mean = -0.000189 is inside the confidence interval.