Assignment-

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September 12, 2017

Question A

Code for R

```
rm(list = ls())
d = read.table("d-csp0108.txt", header=TRUE)
names = c('C', 'SP')
n = length(d[,1]);

# Calculating log returns
for (k in 2:3) {
   d[,k] = log(1 + d[,k]);
}

N = c(50, 100, 500, 1000, n);
alpha = 0.05;

for (k in 2:3) {
   X = d[,k];
   mu_total = mean(X);
   for (n in N) {
      mu = mean(X[1:n]);
      sig = sd(X[1:n]);

      clb = sig*qnorm(alpha/2)/sqrt(n); cub = sig*qnorm(1 - alpha/2)/sqrt(n);

      cc = exp(-qnorm(1 - alpha/2)^2/2);

      cat(sprintf('\n%s Stock, %d samples\\\\\n', names[k-1], n));
      cat(sprintf('Using Likelihood Ratio Test to find confidence interval.\\\\\nHypothesis
          rejected if ratio less than %f\\\\\n', cc));
      cat(sprintf('The %d%% confidence interval for mean = [%f, %f]\\\\\n', 100*(1-alpha), clb
          , cub));
      if ((clb <= mu) && (mu <= cub)) {
```

```
29          cat(sprintf('The mean = %f is inside the confidence interval.\\\\\n\n', mu));
30      } else {
31          cat(sprintf('The mean = %f is not inside the confidence interval.\\\\\n\n', mu));
32      }
33  }
34 }
```

C Stock, interval constructed using 50 samples

Using Likelihood Ratio Test to find confidence interval.

Hypothesis rejected if ratio less than 0.146500

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

The mean = -0.002522 is inside the confidence interval.

For 50 samples coverage probability = 1.000000

For 100 samples coverage probability = 0.920000

For 150 samples coverage probability = 0.973333

For 200 samples coverage probability = 0.930000

For 250 samples coverage probability = 0.948000

For 300 samples coverage probability = 0.970000

For 350 samples coverage probability = 0.948571

For 400 samples coverage probability = 0.945000

For 450 samples coverage probability = 0.935556

For 500 samples coverage probability = 0.946000

For 550 samples coverage probability = 0.941818

For 600 samples coverage probability = 0.956667

For 650 samples coverage probability = 0.946154

For 700 samples coverage probability = 0.965714

For 750 samples coverage probability = 0.961333

For 800 samples coverage probability = 0.960000

For 850 samples coverage probability = 0.960000

For 900 samples coverage probability = 0.954444

For 950 samples coverage probability = 0.956842

For 1000 samples coverage probability = 0.940000

For 1050 samples coverage probability = 0.957143

For 1100 samples coverage probability = 0.942727

For 1150 samples coverage probability = 0.943478

For 1200 samples coverage probability = 0.959167

For 1250 samples coverage probability = 0.956000

For 1300 samples coverage probability = 0.962308

For 1350 samples coverage probability = 0.962222

For 1400 samples coverage probability = 0.956429
For 1450 samples coverage probability = 0.964828
For 1500 samples coverage probability = 0.953333
For 1550 samples coverage probability = 0.946452
For 1600 samples coverage probability = 0.947500
For 1650 samples coverage probability = 0.950909
For 1700 samples coverage probability = 0.958824
For 1750 samples coverage probability = 0.947429
For 1800 samples coverage probability = 0.950556
For 1850 samples coverage probability = 0.950270
For 1900 samples coverage probability = 0.950000
For 1950 samples coverage probability = 0.945128
For 2000 samples coverage probability = 0.959500

C Stock, interval constructed using 100 samples
Using Likelihood Ratio Test to find confidence interval.
Hypothesis rejected if ratio less than 0.146500
The 95% confidence interval for mean = [-0.005280, 0.005280]
The mean = 0.000343 is inside the confidence interval.
For 50 samples coverage probability = 0.880000
For 100 samples coverage probability = 0.980000
For 150 samples coverage probability = 0.973333
For 200 samples coverage probability = 0.940000
For 250 samples coverage probability = 0.948000
For 300 samples coverage probability = 0.966667
For 350 samples coverage probability = 0.960000
For 400 samples coverage probability = 0.935000
For 450 samples coverage probability = 0.928889
For 500 samples coverage probability = 0.952000
For 550 samples coverage probability = 0.952727
For 600 samples coverage probability = 0.940000
For 650 samples coverage probability = 0.955385
For 700 samples coverage probability = 0.945714
For 750 samples coverage probability = 0.966667
For 800 samples coverage probability = 0.958750
For 850 samples coverage probability = 0.948235
For 900 samples coverage probability = 0.958889
For 950 samples coverage probability = 0.952632

For 1000 samples coverage probability = 0.951000
For 1050 samples coverage probability = 0.960952
For 1100 samples coverage probability = 0.951818
For 1150 samples coverage probability = 0.952174
For 1200 samples coverage probability = 0.944167
For 1250 samples coverage probability = 0.946400
For 1300 samples coverage probability = 0.942308
For 1350 samples coverage probability = 0.950370
For 1400 samples coverage probability = 0.950714
For 1450 samples coverage probability = 0.953103
For 1500 samples coverage probability = 0.956667
For 1550 samples coverage probability = 0.956129
For 1600 samples coverage probability = 0.950000
For 1650 samples coverage probability = 0.952121
For 1700 samples coverage probability = 0.952353
For 1750 samples coverage probability = 0.941143
For 1800 samples coverage probability = 0.949444
For 1850 samples coverage probability = 0.959459
For 1900 samples coverage probability = 0.958421
For 1950 samples coverage probability = 0.950256
For 2000 samples coverage probability = 0.952500

C Stock, interval constructed using 500 samples
Using Likelihood Ratio Test to find confidence interval.
Hypothesis rejected if ratio less than 0.146500
The 95% confidence interval for mean = [-0.002381, 0.002381]
The mean = -0.000557 is inside the confidence interval.
For 50 samples coverage probability = 0.960000
For 100 samples coverage probability = 0.940000
For 150 samples coverage probability = 0.960000
For 200 samples coverage probability = 0.945000
For 250 samples coverage probability = 0.928000
For 300 samples coverage probability = 0.933333
For 350 samples coverage probability = 0.945714
For 400 samples coverage probability = 0.947500
For 450 samples coverage probability = 0.962222
For 500 samples coverage probability = 0.964000
For 550 samples coverage probability = 0.945455

For 600 samples coverage probability = 0.953333
For 650 samples coverage probability = 0.950769
For 700 samples coverage probability = 0.964286
For 750 samples coverage probability = 0.952000
For 800 samples coverage probability = 0.952500
For 850 samples coverage probability = 0.951765
For 900 samples coverage probability = 0.946667
For 950 samples coverage probability = 0.940000
For 1000 samples coverage probability = 0.953000
For 1050 samples coverage probability = 0.939048
For 1100 samples coverage probability = 0.953636
For 1150 samples coverage probability = 0.952174
For 1200 samples coverage probability = 0.950833
For 1250 samples coverage probability = 0.951200
For 1300 samples coverage probability = 0.956923
For 1350 samples coverage probability = 0.951111
For 1400 samples coverage probability = 0.948571
For 1450 samples coverage probability = 0.953103
For 1500 samples coverage probability = 0.950000
For 1550 samples coverage probability = 0.949032
For 1600 samples coverage probability = 0.943125
For 1650 samples coverage probability = 0.945455
For 1700 samples coverage probability = 0.950588
For 1750 samples coverage probability = 0.950857
For 1800 samples coverage probability = 0.945556
For 1850 samples coverage probability = 0.950270
For 1900 samples coverage probability = 0.958947
For 1950 samples coverage probability = 0.956410
For 2000 samples coverage probability = 0.953000

C Stock, interval constructed using 1000 samples
Using Likelihood Ratio Test to find confidence interval.
Hypothesis rejected if ratio less than 0.146500
The 95% confidence interval for mean = [-0.001320, 0.001320]
The mean = 0.000099 is inside the confidence interval.
For 50 samples coverage probability = 0.980000
For 100 samples coverage probability = 0.910000
For 150 samples coverage probability = 0.966667

For 200 samples coverage probability = 0.965000
For 250 samples coverage probability = 0.932000
For 300 samples coverage probability = 0.960000
For 350 samples coverage probability = 0.942857
For 400 samples coverage probability = 0.932500
For 450 samples coverage probability = 0.935556
For 500 samples coverage probability = 0.948000
For 550 samples coverage probability = 0.947273
For 600 samples coverage probability = 0.945000
For 650 samples coverage probability = 0.955385
For 700 samples coverage probability = 0.945714
For 750 samples coverage probability = 0.948000
For 800 samples coverage probability = 0.958750
For 850 samples coverage probability = 0.960000
For 900 samples coverage probability = 0.960000
For 950 samples coverage probability = 0.955789
For 1000 samples coverage probability = 0.941000
For 1050 samples coverage probability = 0.951429
For 1100 samples coverage probability = 0.956364
For 1150 samples coverage probability = 0.957391
For 1200 samples coverage probability = 0.938333
For 1250 samples coverage probability = 0.942400
For 1300 samples coverage probability = 0.952308
For 1350 samples coverage probability = 0.962222
For 1400 samples coverage probability = 0.952143
For 1450 samples coverage probability = 0.954483
For 1500 samples coverage probability = 0.952667
For 1550 samples coverage probability = 0.956774
For 1600 samples coverage probability = 0.948125
For 1650 samples coverage probability = 0.951515
For 1700 samples coverage probability = 0.942353
For 1750 samples coverage probability = 0.950857
For 1800 samples coverage probability = 0.944444
For 1850 samples coverage probability = 0.956216
For 1900 samples coverage probability = 0.947895
For 1950 samples coverage probability = 0.949231
For 2000 samples coverage probability = 0.952000

C Stock, interval constructed using 2011 samples

Using Likelihood Ratio Test to find confidence interval.

Hypothesis rejected if ratio less than 0.146500

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

The mean = -0.000845 is inside the confidence interval.

For 50 samples coverage probability = 0.960000

For 100 samples coverage probability = 0.940000

For 150 samples coverage probability = 0.933333

For 200 samples coverage probability = 0.940000

For 250 samples coverage probability = 0.956000

For 300 samples coverage probability = 0.963333

For 350 samples coverage probability = 0.942857

For 400 samples coverage probability = 0.937500

For 450 samples coverage probability = 0.957778

For 500 samples coverage probability = 0.946000

For 550 samples coverage probability = 0.963636

For 600 samples coverage probability = 0.951667

For 650 samples coverage probability = 0.966154

For 700 samples coverage probability = 0.942857

For 750 samples coverage probability = 0.949333

For 800 samples coverage probability = 0.937500

For 850 samples coverage probability = 0.941176

For 900 samples coverage probability = 0.948889

For 950 samples coverage probability = 0.944211

For 1000 samples coverage probability = 0.946000

For 1050 samples coverage probability = 0.950476

For 1100 samples coverage probability = 0.942727

For 1150 samples coverage probability = 0.962609

For 1200 samples coverage probability = 0.949167

For 1250 samples coverage probability = 0.952800

For 1300 samples coverage probability = 0.950000

For 1350 samples coverage probability = 0.947407

For 1400 samples coverage probability = 0.950714

For 1450 samples coverage probability = 0.946207

For 1500 samples coverage probability = 0.942667

For 1550 samples coverage probability = 0.949032

For 1600 samples coverage probability = 0.943750

For 1650 samples coverage probability = 0.940606

For 1700 samples coverage probability = 0.945882
For 1750 samples coverage probability = 0.949143
For 1800 samples coverage probability = 0.951111
For 1850 samples coverage probability = 0.935676
For 1900 samples coverage probability = 0.943158
For 1950 samples coverage probability = 0.948205
For 2000 samples coverage probability = 0.953500

SP Stock, interval constructed using 50 samples
Using Likelihood Ratio Test to find confidence interval.
Hypothesis rejected if ratio less than 0.146500
The 95% confidence interval for mean = [-0.004114, 0.004114]
The mean = -0.002473 is inside the confidence interval.
For 50 samples coverage probability = 0.940000
For 100 samples coverage probability = 0.990000
For 150 samples coverage probability = 0.966667
For 200 samples coverage probability = 0.960000
For 250 samples coverage probability = 0.940000
For 300 samples coverage probability = 0.950000
For 350 samples coverage probability = 0.931429
For 400 samples coverage probability = 0.957500
For 450 samples coverage probability = 0.966667
For 500 samples coverage probability = 0.964000
For 550 samples coverage probability = 0.961818
For 600 samples coverage probability = 0.953333
For 650 samples coverage probability = 0.940000
For 700 samples coverage probability = 0.951429
For 750 samples coverage probability = 0.956000
For 800 samples coverage probability = 0.955000
For 850 samples coverage probability = 0.950588
For 900 samples coverage probability = 0.950000
For 950 samples coverage probability = 0.943158
For 1000 samples coverage probability = 0.953000
For 1050 samples coverage probability = 0.945714
For 1100 samples coverage probability = 0.948182
For 1150 samples coverage probability = 0.946957
For 1200 samples coverage probability = 0.950833
For 1250 samples coverage probability = 0.952800

For 1300 samples coverage probability = 0.940769
For 1350 samples coverage probability = 0.953333
For 1400 samples coverage probability = 0.948571
For 1450 samples coverage probability = 0.953103
For 1500 samples coverage probability = 0.947333
For 1550 samples coverage probability = 0.962581
For 1600 samples coverage probability = 0.945000
For 1650 samples coverage probability = 0.951515
For 1700 samples coverage probability = 0.949412
For 1750 samples coverage probability = 0.944571
For 1800 samples coverage probability = 0.955556
For 1850 samples coverage probability = 0.949189
For 1900 samples coverage probability = 0.954211
For 1950 samples coverage probability = 0.950769
For 2000 samples coverage probability = 0.956500

SP Stock, interval constructed using 100 samples
Using Likelihood Ratio Test to find confidence interval.
Hypothesis rejected if ratio less than 0.146500
The 95% confidence interval for mean = [-0.003052, 0.003052]
The mean = -0.000207 is inside the confidence interval.
For 50 samples coverage probability = 0.960000
For 100 samples coverage probability = 0.920000
For 150 samples coverage probability = 0.933333
For 200 samples coverage probability = 0.950000
For 250 samples coverage probability = 0.960000
For 300 samples coverage probability = 0.946667
For 350 samples coverage probability = 0.948571
For 400 samples coverage probability = 0.957500
For 450 samples coverage probability = 0.944444
For 500 samples coverage probability = 0.942000
For 550 samples coverage probability = 0.958182
For 600 samples coverage probability = 0.953333
For 650 samples coverage probability = 0.969231
For 700 samples coverage probability = 0.948571
For 750 samples coverage probability = 0.956000
For 800 samples coverage probability = 0.951250
For 850 samples coverage probability = 0.945882

For 900 samples coverage probability = 0.957778
For 950 samples coverage probability = 0.953684
For 1000 samples coverage probability = 0.958000
For 1050 samples coverage probability = 0.942857
For 1100 samples coverage probability = 0.957273
For 1150 samples coverage probability = 0.932174
For 1200 samples coverage probability = 0.947500
For 1250 samples coverage probability = 0.947200
For 1300 samples coverage probability = 0.947692
For 1350 samples coverage probability = 0.962963
For 1400 samples coverage probability = 0.948571
For 1450 samples coverage probability = 0.942069
For 1500 samples coverage probability = 0.939333
For 1550 samples coverage probability = 0.960000
For 1600 samples coverage probability = 0.953125
For 1650 samples coverage probability = 0.950303
For 1700 samples coverage probability = 0.958235
For 1750 samples coverage probability = 0.948000
For 1800 samples coverage probability = 0.953889
For 1850 samples coverage probability = 0.955135
For 1900 samples coverage probability = 0.955263
For 1950 samples coverage probability = 0.950769
For 2000 samples coverage probability = 0.947000

SP Stock, interval constructed using 500 samples
Using Likelihood Ratio Test to find confidence interval.
Hypothesis rejected if ratio less than 0.146500
The 95% confidence interval for mean = [-0.001317, 0.001317]
The mean = -0.000812 is inside the confidence interval.
For 50 samples coverage probability = 0.940000
For 100 samples coverage probability = 0.940000
For 150 samples coverage probability = 0.946667
For 200 samples coverage probability = 0.930000
For 250 samples coverage probability = 0.988000
For 300 samples coverage probability = 0.943333
For 350 samples coverage probability = 0.922857
For 400 samples coverage probability = 0.965000
For 450 samples coverage probability = 0.953333

For 500 samples coverage probability = 0.946000
For 550 samples coverage probability = 0.963636
For 600 samples coverage probability = 0.951667
For 650 samples coverage probability = 0.950769
For 700 samples coverage probability = 0.957143
For 750 samples coverage probability = 0.949333
For 800 samples coverage probability = 0.960000
For 850 samples coverage probability = 0.951765
For 900 samples coverage probability = 0.936667
For 950 samples coverage probability = 0.948421
For 1000 samples coverage probability = 0.940000
For 1050 samples coverage probability = 0.943810
For 1100 samples coverage probability = 0.950909
For 1150 samples coverage probability = 0.952174
For 1200 samples coverage probability = 0.954167
For 1250 samples coverage probability = 0.955200
For 1300 samples coverage probability = 0.951538
For 1350 samples coverage probability = 0.950370
For 1400 samples coverage probability = 0.953571
For 1450 samples coverage probability = 0.953103
For 1500 samples coverage probability = 0.954000
For 1550 samples coverage probability = 0.950968
For 1600 samples coverage probability = 0.950000
For 1650 samples coverage probability = 0.952727
For 1700 samples coverage probability = 0.950000
For 1750 samples coverage probability = 0.949714
For 1800 samples coverage probability = 0.953889
For 1850 samples coverage probability = 0.948649
For 1900 samples coverage probability = 0.955789
For 1950 samples coverage probability = 0.954872
For 2000 samples coverage probability = 0.947500

SP Stock, interval constructed using 1000 samples
Using Likelihood Ratio Test to find confidence interval.
Hypothesis rejected if ratio less than 0.146500
The 95% confidence interval for mean = [-0.000771, 0.000771]
The mean = -0.000091 is inside the confidence interval.
For 50 samples coverage probability = 0.880000

For 100 samples coverage probability = 0.940000
For 150 samples coverage probability = 0.940000
For 200 samples coverage probability = 0.930000
For 250 samples coverage probability = 0.964000
For 300 samples coverage probability = 0.943333
For 350 samples coverage probability = 0.942857
For 400 samples coverage probability = 0.935000
For 450 samples coverage probability = 0.933333
For 500 samples coverage probability = 0.960000
For 550 samples coverage probability = 0.965455
For 600 samples coverage probability = 0.935000
For 650 samples coverage probability = 0.952308
For 700 samples coverage probability = 0.952857
For 750 samples coverage probability = 0.952000
For 800 samples coverage probability = 0.948750
For 850 samples coverage probability = 0.930588
For 900 samples coverage probability = 0.950000
For 950 samples coverage probability = 0.943158
For 1000 samples coverage probability = 0.949000
For 1050 samples coverage probability = 0.946667
For 1100 samples coverage probability = 0.952727
For 1150 samples coverage probability = 0.949565
For 1200 samples coverage probability = 0.951667
For 1250 samples coverage probability = 0.953600
For 1300 samples coverage probability = 0.947692
For 1350 samples coverage probability = 0.954815
For 1400 samples coverage probability = 0.943571
For 1450 samples coverage probability = 0.957931
For 1500 samples coverage probability = 0.946667
For 1550 samples coverage probability = 0.948387
For 1600 samples coverage probability = 0.951250
For 1650 samples coverage probability = 0.943636
For 1700 samples coverage probability = 0.951765
For 1750 samples coverage probability = 0.954286
For 1800 samples coverage probability = 0.950556
For 1850 samples coverage probability = 0.948649
For 1900 samples coverage probability = 0.953684
For 1950 samples coverage probability = 0.957436

For 2000 samples coverage probability = 0.951500

SP Stock, interval constructed using 2011 samples
Using Likelihood Ratio Test to find confidence interval.
Hypothesis rejected if ratio less than 0.146500
The 95% confidence interval for mean = [-0.000593, 0.000593]
The mean = -0.000189 is inside the confidence interval.
For 50 samples coverage probability = 0.940000
For 100 samples coverage probability = 0.980000
For 150 samples coverage probability = 0.926667
For 200 samples coverage probability = 0.970000
For 250 samples coverage probability = 0.944000
For 300 samples coverage probability = 0.953333
For 350 samples coverage probability = 0.931429
For 400 samples coverage probability = 0.950000
For 450 samples coverage probability = 0.957778
For 500 samples coverage probability = 0.954000
For 550 samples coverage probability = 0.958182
For 600 samples coverage probability = 0.955000
For 650 samples coverage probability = 0.958462
For 700 samples coverage probability = 0.945714
For 750 samples coverage probability = 0.956000
For 800 samples coverage probability = 0.955000
For 850 samples coverage probability = 0.943529
For 900 samples coverage probability = 0.950000
For 950 samples coverage probability = 0.954737
For 1000 samples coverage probability = 0.943000
For 1050 samples coverage probability = 0.957143
For 1100 samples coverage probability = 0.961818
For 1150 samples coverage probability = 0.949565
For 1200 samples coverage probability = 0.958333
For 1250 samples coverage probability = 0.954400
For 1300 samples coverage probability = 0.943077
For 1350 samples coverage probability = 0.944444
For 1400 samples coverage probability = 0.956429
For 1450 samples coverage probability = 0.954483
For 1500 samples coverage probability = 0.952000
For 1550 samples coverage probability = 0.950323

For 1600 samples coverage probability = 0.956875

For 1650 samples coverage probability = 0.950303

For 1700 samples coverage probability = 0.958235

For 1750 samples coverage probability = 0.953714

For 1800 samples coverage probability = 0.957222

For 1850 samples coverage probability = 0.952432

For 1900 samples coverage probability = 0.948421

For 1950 samples coverage probability = 0.945128

For 2000 samples coverage probability = 0.959000

Question B

Code for R

```
rm(list = ls())
d = read.table("d-csp0108.txt", header=TRUE)
names = c('C', 'SP')
T = length(d[,1]);

# Calculating log returns
for (k in 2:3) {
   d[,k] = log(1 + d[,k]);
}

skew <- function(X) {
   T = length(X);
   mu = mean(X);
   sig = sqrt( sum((X-mu)^2)/(T-1) );
   sk = sum((X-mu)^3)/(T-1) / sig^3;
   return (sk);
}

kurt <- function(X) {
   T = length(X);
   mu = mean(X);
   sig = sqrt( sum((X-mu)^2)/(T-1) );
   kt = sum((X-mu)^4)/(T-1) / sig^4;
   return (kt);
}

alpha = 0.05;
type = c('Skewness', 'Excess Kurtosis');

for (k in 2:3) {
```

```
31    for (ty in type) {
32       X = d[,k];
33
34       if (ty == 'Skewness') {
35          theta = skew(X);
36          sig = sd(X)*sqrt(6/T);
37          clb = sig*qnorm(alpha/2); cub = sig*qnorm(1 - alpha/2);
38       } else {
39          theta = kurt(X) - 3;
40          sig = sd(X)*sqrt(24/T);
41          clb = sig*qnorm(alpha/2); cub = sig*qnorm(1 - alpha/2);
42       }
43
44
45       cat(sprintf('\n%s Stock\\\\\n', names[k-1]));
46       cat(sprintf('The %d%% confidence interval for %s = [%f, %f]\\\\\n', 100*(1-alpha), ty,
             clb, cub));
47       if ((clb <= theta) && (theta <= cub)) {
48          cat(sprintf('The %s = %f is inside the confidence interval.\\\\\n\n', ty, theta));
49       } else {
50          cat(sprintf('The %s = %f is not inside the confidence interval.\\\\\n\n', ty, theta))
                ;
51       }
52    }
53 }
```

C Stock

The 95% confidence interval for Skewness = [-0.003257, 0.003257]

The Skewness = 0.538650 is not inside the confidence interval. Hypothesis False

C Stock

The 95% confidence interval for Excess Kurtosis = [-0.006515, 0.006515]

The Excess Kurtosis = 42.760151 is not inside the confidence interval. Hypothesis False

SP Stock

The 95% confidence interval for Skewness = [-0.001452, 0.001452]

The Skewness = -0.140850 is not inside the confidence interval. Hypothesis False

SP Stock

The 95% confidence interval for Excess Kurtosis = [-0.002904, 0.002904]

The Excess Kurtosis = 9.956392 is not inside the confidence interval. Hypothesis False