ECON 490 003
Lab 1 - Portfolio Frontier and CAPM

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Question 1

R Code:

```
df <- data.frame(read.csv("490lab1.csv"))

table1 <- data.frame()
table1[1,1] <- c("Average")
table1[1,2] <- c("Standard Deviation")
for (i in 2:11) {
  c(mean(df[ ,i])) -> table1[i,1]
  c(sd(df[ ,i])) -> table1[i,2]
}
```

Output:

1	Average	Standard Deviation
2	0.0369687704918033	0.177106792817629
3	0.00773663934426229	0.0343103697881718
4	-0.0238158196721311	0.137042047055579
5	0.015187737704918	0.0911762307523004
6	-0.000795311475409836	0.0681983421840397
7	0.0232769508196721	0.057808823624203
8	0.0109065409836066	0.0590012983757063
9	-0.00581501639344262	0.0710640400398335
10	0.0147350163934426	0.0598658871516135
11	0.00585240983606557	0.0388252323909667

Question 2

R Code:

```
table2 <- data.frame()
for (i in 1:10) {
       for (j in 1:10) {
         table2[i,j] <- cor(df[ ,i+1], df[, j+1])
         }
}
```

Output:

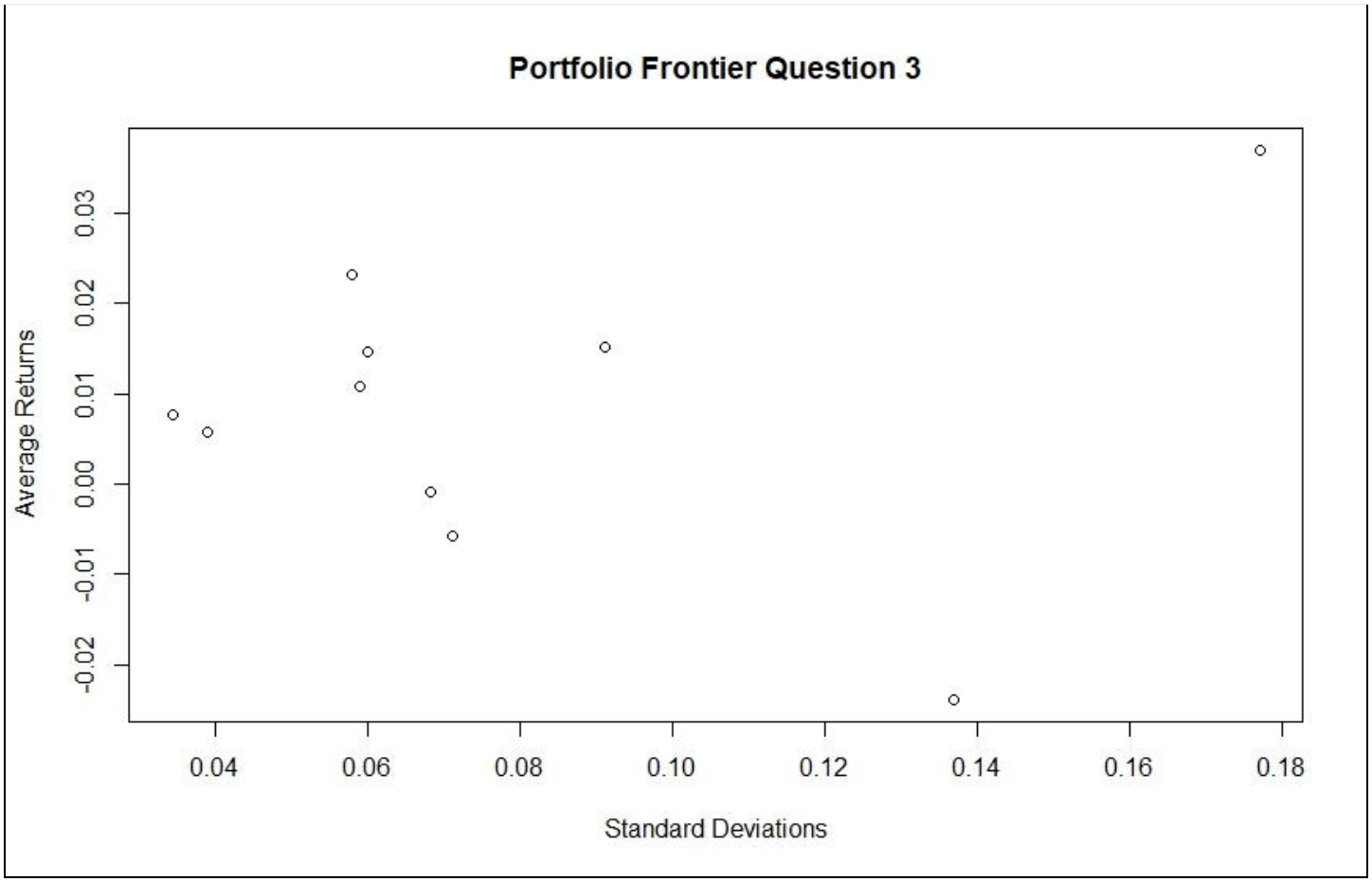
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
1	1.00000000	0.23527394	0.13951241	0.140054895	0.09559122	-0.109976204	-0.18527662	0.119587221	0.260297115	-0.02617310
2	0.23527394	1.00000000	0.28845003	0.012769575	0.29669034	0.144721915	0.01482753	-0.016390053	0.278537026	0.14944393
3	0.13951241	0.28845003	1.00000000	0.132601990	0.44094083	0.068266694	-0.08130521	0.299570034	0.111295000	0.23718047
4	0.14005490	0.01276957	0.13260199	1.000000000	0.18835666	0.001623467	-0.04052272	0.181811283	0.078401488	0.12645863
5	0.09559122	0.29669034	0.44094083	0.188356656	1.00000000	0.074306771	-0.02277204	0.208469678	0.092285878	0.18034785
6	-0.10997620	0.14472192	0.06826669	0.001623467	0.07430677	1.000000000	0.26117219	-0.008068086	0.006570366	-0.01353587
7	-0.18527662	0.01482753	-0.08130521	-0.040522715	-0.02277204	0.261172191	1.00000000	-0.039303652	0.101050694	0.20828412
8	0.11958722	-0.01639005	0.29957003	0.181811283	0.20846968	-0.008068086	-0.03930365	1.000000000	0.034242569	0.02386917
9	0.26029711	0.27853703	0.11129500	0.078401488	0.09228588	0.006570366	0.10105069	0.034242569	1.000000000	0.04943904
10	-0.02617310	0.14944393	0.23718047	0.126458634	0.18034785	-0.013535874	0.20828412	0.023869172	0.049439042	1.00000000

Question 3

R Code:

```
plot(table1[,2], table1[,1], xlab = "Standard Deviations", ylab = "Average
Returns", main = "Portfolio Frontier Question 3")
```

Output:



Question 4

The stocks with the **largest positive correlation** are r3 and r5, which are Sherrit International Corp and Canada Natural Resources Limited. From table 1 we know the expected returns and standard deviation for the stocks of these firms, and from table 2 we can find correlation. So we can make a table with different levels of alpha.

R Code:

```
table3 <- data.frame()
alpha=0
for (i in 1:21) {
  table3[i,1] = alpha
  table3[i,2] =
alpha*(-0.0238158196721311)+(1-alpha)*(-0.000795311475409836)
  table3[i,3] =
(alpha^2)*((0.137042047055579)^2)+((1-alpha)^2)*((0.0681983421840397)
^2)+2*alpha*(1-alpha)*(0.44094082538375)*(0.137042047055579)*(0.06819
83421840397)
  alpha = alpha+0.05
}
```

The stocks with the largest negative correlation are r1 and r7, which are Air Canada and Loblaw Companies Ltd. respectively. From table 1 we know the expected returns and standard deviation for the stocks of these firms, and from table 2 we can find correlation. So we can make a table with different levels of alpha.

R Code:

```
table4 <- data.frame()
alpha=0
for (i in 1:21) {
  table4[i,1] = alpha
  table4[i,2] =
alpha*(0.0369687704918033)+(1-alpha)*(0.0109065409836066)
  table4[i,3] =
(alpha^2)*((0.177106792817629)^2)+((1-alpha)^2)*((0.0590012983757063)
^2)+2*alpha*(1-alpha)*(-0.185276622851687)*(0.177106792817629)*(0.059
0012983757063)
  alpha = alpha+0.05
}
```

Output:

	V1	V2	V3
1	0.00	-0.0007953115	0.004651014
2	0.05	-0.0019463369	0.004635991
3	0.10	-0.0030973623	0.004696916
4	0.15	-0.0042483877	0.004833787
5	0.20	-0.0053994131	0.005046606
6	0.25	-0.0065504385	0.005335372
7	0.30	-0.0077014639	0.005700085
8	0.35	-0.0088524893	0.006140745
9	0.40	-0.0100035148	0.006657353
10	0.45	-0.0111545402	0.007249908
11	0.50	-0.0123055656	0.007918410
12	0.55	-0.0134565910	0.008662859
13	0.60	-0.0146076164	0.009483255
14	0.65	-0.0157586418	0.010379598
15	0.70	-0.0169096672	0.011351889
16	0.75	-0.0180606926	0.012400126
17	0.80	-0.0192117180	0.013524311
18	0.85	-0.0203627434	0.014724443
19	0.90	-0.0215137689	0.016000523
20	0.95	-0.0226647943	0.017352549
21	1.00	-0.0238158197	0.018780523

	V1	V2	V3
1	0.00	0.01090654	0.003481153
2	0.05	0.01220965	0.003036233
3	0.10	0.01351276	0.002784913
4	0.15	0.01481588	0.002727193
5	0.20	0.01611899	0.002863073
6	0.25	0.01742210	0.003192555
7	0.30	0.01872521	0.003715636
8	0.35	0.02002832	0.004432318
9	0.40	0.02133143	0.005342600
10	0.45	0.02263454	0.006446482
11	0.50	0.02393766	0.007743965
12	0.55	0.02524077	0.009235049
13	0.60	0.02654388	0.010919732
14	0.65	0.02784699	0.012798017
15	0.70	0.02915010	0.014869901
16	0.75	0.03045321	0.017135386
17	0.80	0.03175632	0.019594471
18	0.85	0.03305944	0.022247157
19	0.90	0.03436255	0.025093443
20	0.95	0.03566566	0.028133329
21	1.00	0.03696877	0.031366816

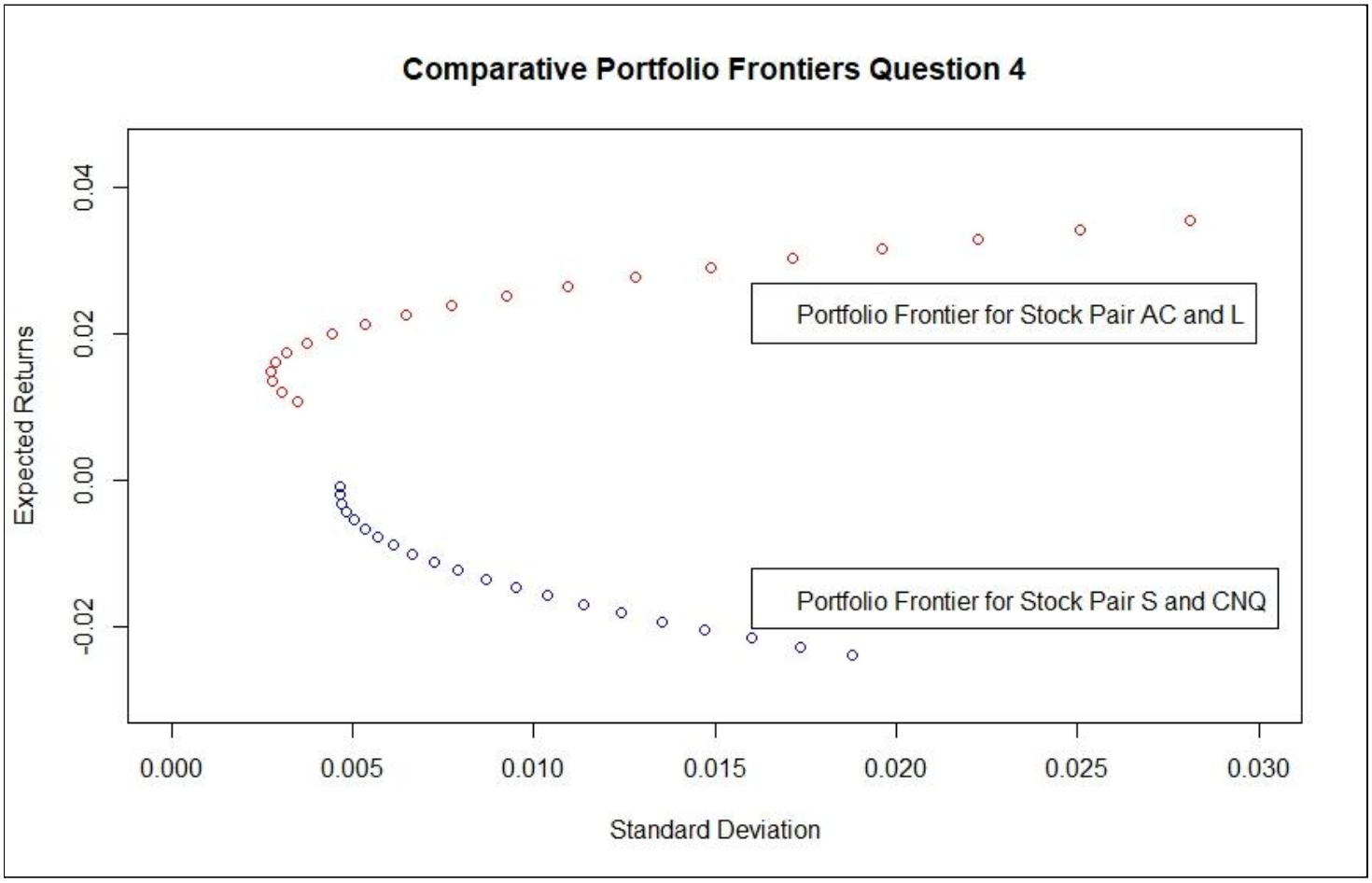
Table 3 (left); Table 4 (right)

We can make a portfolio frontier for both of these from table 3 and table 4 for each of the pairs of stocks. The portfolio frontier in **blue** is for the portfolio containing different alpha for Sherritt International Corp and Canada Natural Resources Limited (stocks with largest positive correlation). The portfolio frontier in **red** is for the portfolio containing different alpha for Air Canada and Loblaw Companies Ltd. (stocks with largest negative correlation).

R Code:

```
plot(table3[ ,3], table3[ ,2], main = "Comparative Portfolio
Frontiers Question 4", xlab = "Standard Deviation", ylab = "Expected
Returns", ylim = c(-0.030, 0.045), xlim = c(0, 0.030), col="blue")
points(table4[ ,3], table4[ ,2], col="red")
legend(x=.016 , y=0.027,legend = c("Portfolio Frontier for Stock Pair
AC and L"))
legend(x=.016 , y=-0.012,legend = c("Portfolio Frontier for Stock
Pair S and CNQ"))
```

Output:



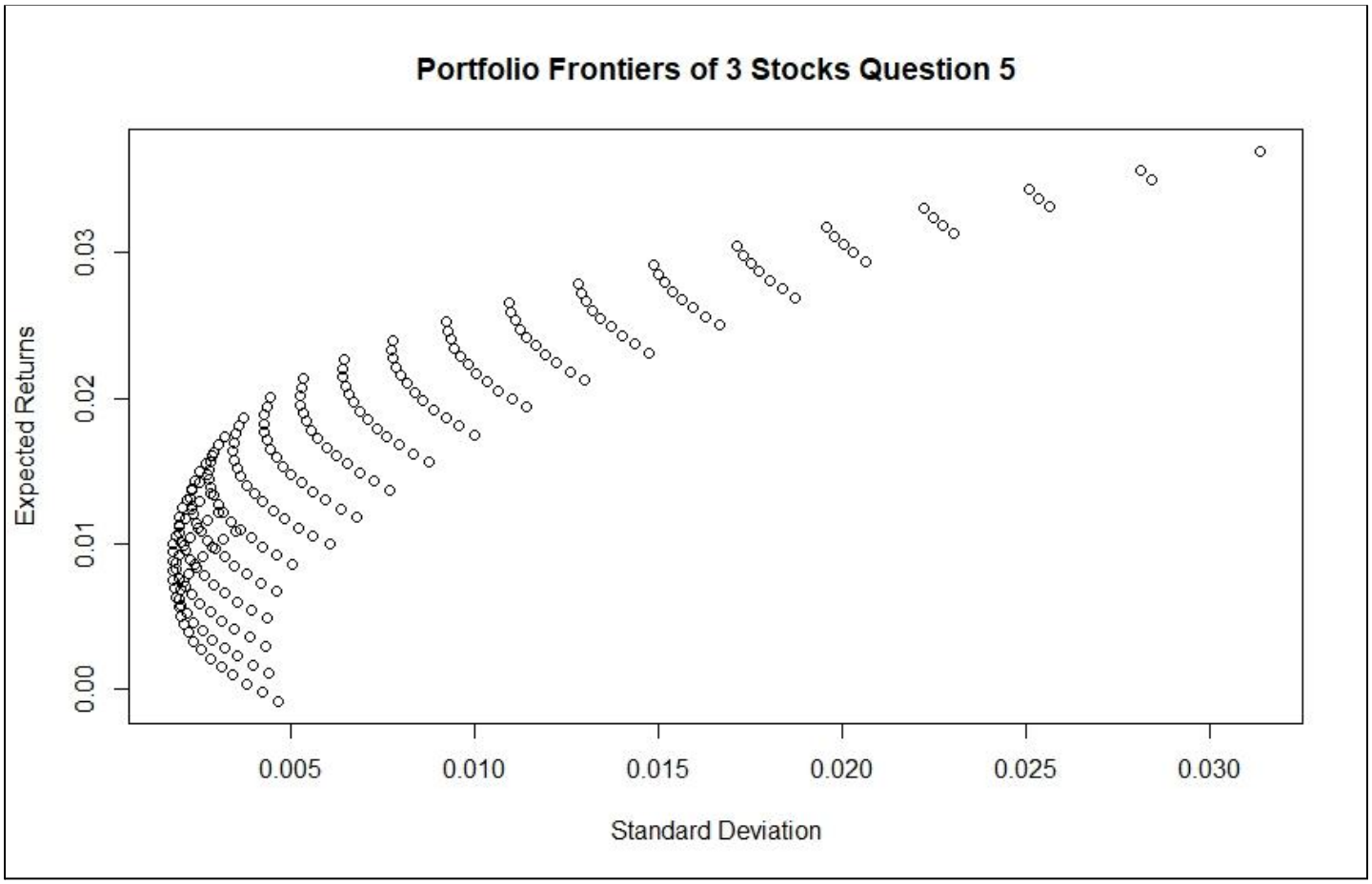
Question 5

For this question I took r1, r5 and r7, which are namely Air Canada, Canadian Natural Resources Limited, and Loblaw Companies.
From table 1 we can find expected returns and standard deviation, while finding correlation between the stocks from table 2. Thus, plugging the values into the formula given we can draw the portfolio frontier.

R Code:

```
alpha = 0
beta = 0
ret1 = 0.0369687704918033
ret2 = -0.000795311475409836
ret3 = 0.0109065409836066
std1 = 0.177106792817629
std2 = 0.0681983421840397
std3 = 0.0590012983757063
cor12 = 0.0955912173496807
cor13 = -0.185276622851687
cor23 = -0.0227720369444608
rowcount = 1
table5 <- data.frame()
for (i in 1:21) {
  beta = 0
  while (beta<1.05) {
    if ((alpha + beta) > 1.05) break
    else {
      table5[rowcount,1] = alpha
      table5[rowcount,2] = beta
      table5[rowcount,3] = alpha*ret1+beta*ret2+(1-alpha-beta)*ret3
      table5[rowcount,4] =
alpha^2*std1^2+beta^2*std2^2+(1-alpha-beta)^2*std3^2+2*alpha*beta*cor
12*std1*std2+2*alpha*(1-alpha-beta)*cor13*std1*std3+2*beta*(1-alpha-b
eta)*cor23*std2*std3
      rowcount= rowcount+1
      beta = beta + 0.05
    }
  }
  alpha = alpha + 0.05
}
plot(table5[ ,4], table5[ ,3], main = "Portfolio Frontiers of 3
Stocks Question 5", xlab = "Standard Deviation", ylab = "Expected
Returns")
```

Output:


Portfolio Frontiers of 3 Stocks Question 5
Expected Returns
0.00
0.01
0.02
0.03
0.005
0.010
0.015
0.020
0.025
0.030
Standard Deviation