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Statistics C183/C283 **Instructor: Nicolas Christou**

Constructing the optimal portfolios - Single index model
R commands

In this example we use data from 5 stocks plus the $S\&P500$ index.

Read the data:

```
data1 <- read.table("http://www.stat.ucla.edu/~nchristo/statistics_c183_c283/
         stocks_5_ret.txt", header=TRUE)
```

Read the data in matrix form:

```
b <- as.matrix(data1)
```

Initialize the vectors and matrices:

```
x <- rep(0, 30)
xx <- matrix(x, ncol=6, nrow=5)

stock <- rep(0,5)
alpha <- rep(0,5)
beta <- rep(0,5)
mse <- rep(0,5)
Rbar <- rep(0,5)
Ratio <- rep(0,5)

col1 <- rep(0,5)
col2 <- rep(0,5)
col3 <- rep(0,5)
col4 <- rep(0,5)
col5 <- rep(0,5)
```

Risk free rate: `rf <- 0.001`

Perform regression of each stock on the index and record $\alpha, \beta, \sigma^2_{\epsilon_i}$:

```
for(i in 1:5){
alpha[i] <- lm(data=data1,formula=data1[,i] ~ data1[,6])$coefficients[1]
beta[i] <- lm(data=data1,formula=data1[,i] ~ data1[,6])$coefficients[2]
Rbar[i] <- alpha[i]+beta[i]*mean(b[,6])
mse[i] <- sum(lm(data=data1, formula=data1[,i] ~ data1[,6])$residuals^2)/(nrow(b)-2)
Ratio[i] <- (Rbar[i]-rf)/beta[i]
stock[i] <- i
              }
```

So far we have this table:

```
xx <- (cbind(stock,alpha, beta, Rbar, mse, Ratio))
```

Order the table based on the excess return to beta ratio:

```
aaa <- xx[order(-Ratio),]
```

Create the last 5 columns of the table:

```
col1 <- (aaa[,4]-rf)*aaa[,3]/aaa[,5]

col3 <- aaa[,3]^2/aaa[,5]

for(i in(1:5)) {

         col2[i] <- sum(col1[1:i])
         col4[i] <- sum(col3[1:i])
              }
```

So far we have:

```
cbind(aaa, col1, col2, col3, col4)
```

Compute the Ci (col5):

```
for(i in (1:5)) {

          col5[i] <- var(data1[,6])*col2[i]/(1+var(data1[,6])*col4[i])

               }
```

SHORT SALES ALLOWED:

```
#Compute the Zi:
z_short <- (aaa[,3]/aaa[,5])*(aaa[,6]-col5[5])

#Compute the xi:
x_short <- z_short/sum(z_short)

#The final table when short sales allowed:
aaaa <- cbind(aaa, col1, col2, col3, col4, col5, z_short, x_short)
```

SHORT SALES NOT ALLOWED:

```
#First create a matrix up to the maximum of col5:
table1 <- cbind(aaa, col1, col2, col3, col4, col5)
table2 <- table1[1:which(col5==max(col5)), ]

#Compute the Zi:
z_no_short <- (table2[,3]/table2[,5])*(table2[,6]-max(col5))

#Compute the xi:
x_no_short <- z_no_short/sum(z_no_short)

#The final table when short sales are not allowed:
aaaaa <- cbind(table2, z_no_short, x_no_short)
```