

THEORY OF FINANCE (20135)

Question on the empirical part

The following code is run in R after installing and loading all necessary libraries and uploading in the environment two databases in .xts format.

- FF, which contains monthly observations from February 1992 to October 2010 on 8 variables: the returns on the 5 Fama-French Factors, the returns on the risk-free rate the return on the market and the returns of an equally weighted portfolio invested in the five factors.
- stocks_exret, which contains monthly excess returns on twenty six stocks over the sample February 1992- June 2005

```
1
2 reg_data <- cbind(stocks_exret, ff5["1992-03-01/2005-06-01",1:5])
3 install.packages("fEcofin", repos="http://R-Forge.R-project.org")
4 library(fEcofin)
5 returns_matrix=as.matrix(stocks_exret)
6 factor.mat = as.matrix(ff5["1992-03-01/2005-06-01",1:5])
7 n.obs = nrow(returns_matrix)
8 X.mat = cbind(rep(1,n.obs),factor.mat)
9 colnames(X.mat)[1] = "intercept"
10 XX.mat = crossprod(X.mat)
11 G.hat = solve(XX.mat)%%crossprod(X.mat,returns_matrix)
12 Mkt.RF.hat = G.hat[2,]
13 SMB.hat = G.hat[3,]
14 HML.hat = G.hat[4,]
15 RMW.hat = G.hat[5,]
16 CMA.hat = G.hat[6,]
17 beta.hat = G.hat[2:6,]
18 E.hat = returns_matrix - X.mat%%G.hat
19 diagD.hat = diag(crossprod(E.hat)/(n.obs-6))
20 cov1 = t(beta.hat)%%var(factor.mat)%%beta.hat + diag(diagD.hat)
21 cov2=var(returns_matrix)
22 mu = matrix(colMeans(returns_matrix), nrow = ncol(returns_matrix), ncol
23           = 1)
24 e = matrix(1, nrow = nrow(cov1), ncol = 1)
25 w1 = (solve(cov1)%%(mu))/as.numeric(t(e)%%(solve(cov1)%%(mu)))
26 w2=(solve(cov2)%%(mu))/as.numeric(t(e)%%(solve(cov2)%%(mu)))
27 barplot(t(w1), horiz=F, main="Weights", col="blue", cex.names = 0.75,
28         las=2)
29 barplot(t(w2), horiz=F, main="Weights", col="blue", cex.names = 0.75,
30         las=2)
```

Please answer to all the following questions:

1. Briefly describe the general purpose of the code and the main output produced
2. What are the dimensions of the matrices `factor.mat` and `E.hat` ?
3. How many regressions are run in this code? What is the total number of parameters estimated in these regressions?
4. (9 points) How many graphs are produced by the programme? Do you expect them to plot different results? Specify, if possible, conditions under which these graphs will be identical ?

ANSWERS

1. The purpose of the code is compare the weights of assets in the tangency portfolio derived with two different models: A Fama-French five factor model and a CER model.
2. 160x5, 160x number of columns in `returns_matrix`
3. the number of regressions is equal to the number of columns of `returns_matrix`, in each regression seven parameters are estimated: the six coefficients (constant plus the loadings on the five factors) and the variance of residuals
4. two graphs are produced by the programme; they are exactly equal in the case the idiosyncratic component is truly orthogonal across different assets' returns