

# 2016 R MFE Programming Workshop Lab 3

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## 1 CAPM Failures

In this lab we are going to replicate some of basic results from Fama and French's 1993 paper *Common Risk Factors in the Returns of Stocks and Bonds*. Kenneth French provides a phenomenal data library on his website. The dataset for this week contains two files:

- *FFfactors.csv* contains returns of the famous Fama-French risk factors *mkt.RF* (the excess return on the market), *HML*, and *SMB* along with the risk free rate *RF*.
- *FFports.csv* contains the returns of the 25 Fama-French portfolios. I will denote the returns of these portfolios as  $R_{it}$  for  $i = 1, \dots, 25$ .

Read in both of these datasets. First we will estimate the CAPM  $\beta$  for each of these 25 portfolios. You will likely need to clean up the dates. Also, limit the data to be from January 1963 through the end of 2013. The  $\beta$  is estimated from the following time series regression for each portfolio:

$$R_{it}^e = \alpha_i + \beta_i mkt_t + \epsilon_{it} \quad t = 1, \dots, T$$

$R_{it}^e = R_{it} - RF_t$  is the excess return on portfolio  $i$ . Now calculate the average return for each portfolio over the sample period. Plot the average return versus  $\beta_i$  for all 25 portfolios. If the CAPM holds, then average return should linearly increase in the  $\beta_i$ . Does this appear to be true?

**Note** doing the above will require a number of steps. To get you started, here are some hints:

- Use `fread` from `data.table` to create data.tables from the .csv files.
- You'll need to clean up the dates so that you can subset. Use `lubridate`.
- You'll need to use a join or a merge. Before you merge, you will need to use `melt` from the package `reshape2` to create a long table from *FFfactors.csv*
- You'll need to run regressions on groups. Recall that you can put anything into `j`!

## 2 Fama-French Model

Now we will look at the famous Fama-French 3 factor model. Instead of estimating just  $\beta_i$ , estimate  $\beta_i$ ,  $h_i$ , and  $s_i$  for each portfolio using the following time series regression:

$$R_{it}^e = \alpha_i + \beta_i mkt.RF_t + h_i HML_t + s_i SMB_t + \epsilon_{it} \quad t = 1, \dots, T$$

Calculate the average returns for the 3 Fama-French factors  $E[mkt.RF_t]$ ,  $E[HML_t]$ , and  $E[SMB_t]$ . Now for each portfolio, calculate the predicted value:

$$pred_i = \beta_i E[mkt.RF_t] + h_i E[HML_t] + s_i E[SMB_t]$$

Plot this predicted value versus the average excess return for each portfolio. Do things look a little better?