

Problem Background

In this lab we are going to start with a one-factor CAPM model, and then extend it to the three-factor Fama-French model.

We will use the data set for Stocks, FX and Bonds from 2004-2005.

Data for the Fama-French factors are available Prof. Kenneth French's website.

Where RF is the risk-free rate and Mkt.RF, SMB and HML are the Fama-French factors.

```
# Stock/Bond/FX data.
stocks <- as.data.table(read.csv(paste0(data.dir, "Stock_FX_Bond_2004_to_2005.csv"),
                                   header=T))
stocks$Date <- as.Date(stocks$Date, format = "%d-%b-%y")
stocks_subset <- stocks[, .(Date, GM_AC, F_AC, UTX_AC, MRK_AC)]
stocks_diff <- data.table(Date = stocks_subset[-1]$Date,
                          apply(log(stocks_subset[, .(GM_AC, F_AC, UTX_AC, MRK_AC)]), 2, diff))

# French-Farma data.
FF_data <- as.data.table(read.table(paste0(data.dir, "FamaFrenchDaily.txt"),
                                   header=T))
FF_data$Date <- as.Date(as.character(FF_data$date), format = "%Y%m%d")
FF_data$date <- NULL

# Combine into one data.table.
consolidated.data <- merge(stocks_diff, FF_data, on = c("Date"))
capm.data <- consolidated.data[, .(Date,
                                   GM = GM_AC - RF,
                                   Ford = F_AC - RF,
                                   UTX = UTX_AC - RF,
                                   Merck = MRK_AC - RF,
                                   Mkt.RF, SMB, HML, RF)]

summary(fit <- lm(as.matrix(cbind(GM, Ford, UTX, Merck))
                  ~ Mkt.RF + SMB + HML, data = capm.data))
```

Response GM :

Call:

```
lm(formula = GM ~ Mkt.RF + SMB + HML, data = capm.data)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.139498	-0.007662	0.000968	0.010022	0.147197

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.0106077	0.0008924	-11.887	<2e-16 ***
Mkt.RF	0.0138621	0.0015652	8.856	<2e-16 ***
SMB	-0.0024251	0.0023081	-1.051	0.2939
HML	0.0063736	0.0027274	2.337	0.0198 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01989 on 499 degrees of freedom

Multiple R-squared: 0.1647, Adjusted R-squared: 0.1597

F-statistic: 32.8 on 3 and 499 DF, p-value: < 2.2e-16

Response Ford :

Call:

lm(formula = Ford ~ Mkt.RF + SMB + HML, data = capm.data)

Residuals:

Min	1Q	Median	3Q	Max
-0.058213	-0.009663	0.000516	0.009240	0.096103

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-1.005e-02	7.083e-04	-14.185	<2e-16 ***
Mkt.RF	1.348e-02	1.242e-03	10.854	<2e-16 ***
SMB	-7.779e-05	1.832e-03	-0.042	0.9661
HML	3.780e-03	2.165e-03	1.746	0.0814 .

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01578 on 499 degrees of freedom

Multiple R-squared: 0.2477, Adjusted R-squared: 0.2431

F-statistic: 54.76 on 3 and 499 DF, p-value: < 2.2e-16

Response UTX :

Call:

lm(formula = UTX ~ Mkt.RF + SMB + HML, data = capm.data)

Residuals:

Min	1Q	Median	3Q	Max
-0.028567	-0.006099	-0.000599	0.005712	0.037245

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.0080963	0.0004199	-19.282	< 2e-16 ***
Mkt.RF	0.0102592	0.0007365	13.929	< 2e-16 ***
SMB	-0.0028475	0.0010861	-2.622	0.00901 **
HML	0.0003584	0.0012834	0.279	0.78013

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.009357 on 499 degrees of freedom

Multiple R-squared: 0.315, Adjusted R-squared: 0.3109

F-statistic: 76.48 on 3 and 499 DF, p-value: < 2.2e-16

Response Merck :

Call:

lm(formula = Merck ~ Mkt.RF + SMB + HML, data = capm.data)

Residuals:

Min	1Q	Median	3Q	Max
-0.303331	-0.005931	0.001621	0.007577	0.123256

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.008695	0.000926	-9.389	< 2e-16 ***
Mkt.RF	0.007066	0.001624	4.350	1.65e-05 ***
SMB	-0.004095	0.002395	-1.710	0.08795 .
HML	-0.009191	0.002830	-3.247	0.00124 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.02064 on 499 degrees of freedom

Multiple R-squared: 0.06266, Adjusted R-squared: 0.05702

F-statistic: 11.12 on 3 and 499 DF, p-value: 4.479e-07

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