FamaFrench3factors

2023-04-20

```
stocks=read.csv("/Users/helbarmi/Documents/FinancialStatistics/PCA-NEW/Stock_Bond_2004_to_2006.csv", hea
stocks<-stocks[-(505:674),]
attach(stocks)
stocks_subset= as.data.frame(cbind(GM_AC, F_AC, UTX_AC, MRK_AC))
FF_data<-read.table("/Users/helbarmi/Documents/FinancialStatistics/PCA-NEW/FF_data.txt", header=TRUE )
stocks_diff=as.data.frame(100*apply(log(stocks_subset)-FF_data$RF, 2, diff))
names(stocks_diff)=c("GM", "Ford", "UTX", "Merk")
FF_data=FF_data[-1,]
```

CAPM

```
CAPM<-lm(as.matrix(stocks_diff)~FF_data$Mkt.RF)
CAPM
```

```
##
## Call:
## lm(formula = as.matrix(stocks_diff) ~ FF_data$Mkt.RF)
##
## Coefficients:
##                   GM        Ford       UTX       Merk
## (Intercept)    -0.21781   -0.17201   0.01182   -0.08114
## FF_data$Mkt.RF  1.22790    1.29803   0.90806    0.64255
```

```
summary(CAPM)
```

```
## Response GM :
##
## Call:
## lm(formula = GM ~ FF_data$Mkt.RF)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.7764  -0.7171   0.0108   0.8088  15.2886
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.21781    0.08639  -2.521    0.012 *
## FF_data$Mkt.RF   1.22790    0.12481   9.838   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.936 on 501 degrees of freedom
## Multiple R-squared:  0.1619, Adjusted R-squared:  0.1602
## F-statistic: 96.79 on 1 and 501 DF,  p-value: < 2.2e-16
##
```

```
##
## Response Ford :
##
## Call:
## lm(formula = Ford ~ FF_data$Mkt.RF)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.3034 -0.8626  0.0182  0.7955  9.1081
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.17201    0.06747   -2.55   0.0111 *
## FF_data$Mkt.RF   1.29803    0.09748   13.32   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.512 on 501 degrees of freedom
## Multiple R-squared:  0.2614, Adjusted R-squared:  0.2599
## F-statistic: 177.3 on 1 and 501 DF,  p-value: < 2.2e-16
##
##
## Response UTX :
##
## Call:
## lm(formula = UTX ~ FF_data$Mkt.RF)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4071 -0.5196 -0.0012  0.5099  3.6282
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.01182    0.03873   0.305     0.76
## FF_data$Mkt.RF   0.90806    0.05595  16.230   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8678 on 501 degrees of freedom
## Multiple R-squared:  0.3446, Adjusted R-squared:  0.3433
## F-statistic: 263.4 on 1 and 501 DF,  p-value: < 2.2e-16
##
##
## Response Merk :
##
## Call:
## lm(formula = Merk ~ FF_data$Mkt.RF)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -31.1217  -0.4808   0.0726   0.7080  12.3075
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)    -0.08114    0.09191  -0.883    0.378
## FF_data$Mkt.RF  0.64255    0.13279   4.839 1.74e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.06 on 501 degrees of freedom
## Multiple R-squared:  0.04465,    Adjusted R-squared:  0.04274
## F-statistic: 23.42 on 1 and 501 DF,  p-value: 1.741e-06
```

Three factor model

```
FF3<- lm(as.matrix(stocks_diff)~FF_data$Mkt.RF+FF_data$SMB+ FF_data$HML)
summary(FF3)
```

```
## Response GM :
##
## Call:
## lm(formula = GM ~ FF_data$Mkt.RF + FF_data$SMB + FF_data$HML)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.7393  -0.7650  -0.0074   0.7755  14.8383
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -0.24559    0.08623  -2.848  0.00458 **
## FF_data$Mkt.RF  1.38721    0.14825   9.357  < 2e-16 ***
## FF_data$SMB    -0.24343    0.21493  -1.133  0.25792
## FF_data$HML     0.83140    0.29674   2.802  0.00528 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.921 on 499 degrees of freedom
## Multiple R-squared:  0.178,  Adjusted R-squared:  0.1731
## F-statistic: 36.03 on 3 and 499 DF,  p-value: < 2.2e-16
##
##
## Response Ford :
##
## Call:
## lm(formula = Ford ~ FF_data$Mkt.RF + FF_data$SMB + FF_data$HML)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.2886 -0.8565 -0.0177  0.8115  9.0854
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -0.18274    0.06785  -2.693  0.00731 **
## FF_data$Mkt.RF  1.30979    0.11665  11.228  < 2e-16 ***
## FF_data$SMB     0.04614    0.16912   0.273  0.78508
## FF_data$HML     0.34978    0.23349   1.498  0.13475
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.511 on 499 degrees of freedom
## Multiple R-squared:  0.2648, Adjusted R-squared:  0.2603
## F-statistic: 59.89 on 3 and 499 DF,  p-value: < 2.2e-16
##
##
## Response UTX :
##
## Call:
## lm(formula = UTX ~ FF_data$Mkt.RF + FF_data$SMB + FF_data$HML)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.3176 -0.5314  0.0105  0.5311  3.4567
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     0.009946   0.038762   0.257   0.7976
## FF_data$Mkt.RF  1.003065   0.066642  15.052   <2e-16 ***
## FF_data$SMB    -0.253718   0.096616  -2.626   0.0089 **
## FF_data$HML     0.007639   0.133393   0.057   0.9544
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8635 on 499 degrees of freedom
## Multiple R-squared:  0.3536, Adjusted R-squared:  0.3498
## F-statistic: 91.01 on 3 and 499 DF,  p-value: < 2.2e-16
##
##
## Response Merk :
##
## Call:
## lm(formula = Merk ~ FF_data$Mkt.RF + FF_data$SMB + FF_data$HML)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -30.3838  -0.5185   0.0890   0.6913  12.1337
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.04453    0.09107  -0.489   0.6251
## FF_data$Mkt.RF   0.68034    0.15658   4.345 1.69e-05 ***
## FF_data$SMB     -0.37685    0.22700  -1.660   0.0975 .
## FF_data$HML     -1.23812    0.31341  -3.951 8.92e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.029 on 499 degrees of freedom
## Multiple R-squared:  0.0767, Adjusted R-squared:  0.07115
## F-statistic: 13.82 on 3 and 499 DF,  p-value: 1.142e-08
```

GM

```
CAPM_GM<- lm(stocks_diff[,1]~FF_data$Mkt.RF)
summary(CAPM_GM)
```

```
##
## Call:
## lm(formula = stocks_diff[, 1] ~ FF_data$Mkt.RF)
##
## Residuals:
##      Min      1Q   Median      3Q      Max
## -13.7764  -0.7171   0.0108   0.8088  15.2886
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.21781    0.08639  -2.521    0.012 *
## FF_data$Mkt.RF   1.22790    0.12481   9.838   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.936 on 501 degrees of freedom
## Multiple R-squared:  0.1619, Adjusted R-squared:  0.1602
## F-statistic: 96.79 on 1 and 501 DF,  p-value: < 2.2e-16
```

```
FF3_GM <- lm(stocks_diff[,1]~FF_data$Mkt.RF++FF_data$SMB+ FF_data$HML )
summary(FF3_GM)
```

```
##
## Call:
## lm(formula = stocks_diff[, 1] ~ FF_data$Mkt.RF + +FF_data$SMB +
##     FF_data$HML)
##
## Residuals:
##      Min      1Q   Median      3Q      Max
## -13.7393  -0.7650  -0.0074   0.7755  14.8383
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.24559    0.08623  -2.848  0.00458 **
## FF_data$Mkt.RF   1.38721    0.14825   9.357  < 2e-16 ***
## FF_data$SMB     -0.24343    0.21493  -1.133  0.25792
## FF_data$HML      0.83140    0.29674   2.802  0.00528 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.921 on 499 degrees of freedom
## Multiple R-squared:  0.178,  Adjusted R-squared:  0.1731
## F-statistic: 36.03 on 3 and 499 DF,  p-value: < 2.2e-16
```

```
anova(CAPM_GM, FF3_GM)
```

```
## Analysis of Variance Table
##
## Model 1: stocks_diff[, 1] ~ FF_data$Mkt.RF
## Model 2: stocks_diff[, 1] ~ FF_data$Mkt.RF + +FF_data$SMB + FF_data$HML
```

```
##   Res.Df     RSS Df Sum of Sq      F   Pr(>F)
## 1    501 1877.4
## 2    499 1841.3  2    36.107 4.8926 0.007865 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Ford

```
CAPM_Ford<- lm(stocks_diff[,2]~FF_data$Mkt.RF)
summary(CAPM_Ford)
```

```
##
## Call:
## lm(formula = stocks_diff[, 2] ~ FF_data$Mkt.RF)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.3034 -0.8626  0.0182  0.7955  9.1081
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.17201    0.06747   -2.55   0.0111 *
## FF_data$Mkt.RF   1.29803    0.09748   13.32   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.512 on 501 degrees of freedom
## Multiple R-squared:  0.2614, Adjusted R-squared:  0.2599
## F-statistic: 177.3 on 1 and 501 DF,  p-value: < 2.2e-16
```

```
FF3_Ford <- lm(stocks_diff[,2]~FF_data$Mkt.RF++FF_data$SMB+ FF_data$HML )
summary(FF3_Ford)
```

```
##
## Call:
## lm(formula = stocks_diff[, 2] ~ FF_data$Mkt.RF + +FF_data$SMB +
##     FF_data$HML)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.2886 -0.8565 -0.0177  0.8115  9.0854
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.18274    0.06785   -2.693  0.00731 **
## FF_data$Mkt.RF   1.30979    0.11665   11.228  < 2e-16 ***
## FF_data$SMB      0.04614    0.16912    0.273  0.78508
## FF_data$HML      0.34978    0.23349    1.498  0.13475
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.511 on 499 degrees of freedom
## Multiple R-squared:  0.2648, Adjusted R-squared:  0.2603
## F-statistic: 59.89 on 3 and 499 DF,  p-value: < 2.2e-16
```

```
anova(CAPM_Ford, FF3_Ford)
```

```
## Analysis of Variance Table
##
## Model 1: stocks_diff[, 2] ~ FF_data$Mkt.RF
## Model 2: stocks_diff[, 2] ~ FF_data$Mkt.RF + +FF_data$SMB + FF_data$HML
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1    501 1145.1
## 2    499 1140.0  2    5.1703 1.1316 0.3233
```

UTX

```
CAPM_UTX<- lm(stocks_diff[,3]~FF_data$Mkt.RF)
summary(CAPM_UTX)
```

```
##
## Call:
## lm(formula = stocks_diff[, 3] ~ FF_data$Mkt.RF)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4071 -0.5196 -0.0012  0.5099  3.6282
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     0.01182    0.03873   0.305     0.76
## FF_data$Mkt.RF  0.90806    0.05595  16.230   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8678 on 501 degrees of freedom
## Multiple R-squared:  0.3446, Adjusted R-squared:  0.3433
## F-statistic: 263.4 on 1 and 501 DF,  p-value: < 2.2e-16
```

```
FF3_UTX <- lm(stocks_diff[,3]~FF_data$Mkt.RF++FF_data$SMB+ FF_data$HML )
summary(FF3_UTX)
```

```
##
## Call:
## lm(formula = stocks_diff[, 3] ~ FF_data$Mkt.RF + +FF_data$SMB +
##     FF_data$HML)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.3176 -0.5314  0.0105  0.5311  3.4567
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     0.009946   0.038762   0.257   0.7976
## FF_data$Mkt.RF  1.003065   0.066642  15.052   <2e-16 ***
## FF_data$SMB    -0.253718   0.096616  -2.626   0.0089 **
## FF_data$HML     0.007639   0.133393   0.057   0.9544
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 0.8635 on 499 degrees of freedom
## Multiple R-squared:  0.3536, Adjusted R-squared:  0.3498
## F-statistic: 91.01 on 3 and 499 DF,  p-value: < 2.2e-16
```

```
anova(CAPM_UTX, FF3_UTX)
```

```
## Analysis of Variance Table
##
## Model 1: stocks_diff[, 3] ~ FF_data$Mkt.RF
## Model 2: stocks_diff[, 3] ~ FF_data$Mkt.RF + +FF_data$SMB + FF_data$HML
##   Res.Df    RSS Df Sum of Sq      F  Pr(>F)
## 1    501 377.27
## 2    499 372.06  2     5.207 3.4918 0.03119 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Merk

```
CAPM_Merk<- lm(stocks_diff[,4]~FF_data$Mkt.RF)
summary(CAPM_Merk)
```

```
##
## Call:
## lm(formula = stocks_diff[, 4] ~ FF_data$Mkt.RF)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -31.1217  -0.4808   0.0726   0.7080  12.3075
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -0.08114    0.09191  -0.883    0.378
## FF_data$Mkt.RF   0.64255    0.13279   4.839 1.74e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.06 on 501 degrees of freedom
## Multiple R-squared:  0.04465,    Adjusted R-squared:  0.04274
## F-statistic: 23.42 on 1 and 501 DF,  p-value: 1.741e-06
```

```
FF3_Merk <- lm(stocks_diff[,4]~FF_data$Mkt.RF++FF_data$SMB+ FF_data$HML )
summary(FF3_Merk)
```

```
##
## Call:
## lm(formula = stocks_diff[, 4] ~ FF_data$Mkt.RF + +FF_data$SMB +
##     FF_data$HML)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -30.3838  -0.5185   0.0890   0.6913  12.1337
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)    -0.04453    0.09107  -0.489   0.6251
## FF_data$Mkt.RF  0.68034    0.15658   4.345 1.69e-05 ***
## FF_data$SMB    -0.37685    0.22700  -1.660   0.0975 .
## FF_data$HML    -1.23812    0.31341  -3.951 8.92e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.029 on 499 degrees of freedom
## Multiple R-squared:  0.0767, Adjusted R-squared:  0.07115
## F-statistic: 13.82 on 3 and 499 DF,  p-value: 1.142e-08
```

```
anova(CAPM_Merk, FF3_Merk)
```

```
## Analysis of Variance Table
##
## Model 1: stocks_diff[, 4] ~ FF_data$Mkt.RF
## Model 2: stocks_diff[, 4] ~ FF_data$Mkt.RF + +FF_data$SMB + FF_data$HML
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    501 2125.1
## 2    499 2053.8  2    71.286 8.6597 0.0002009 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```