Penpitcha Pornjaroenwattana 6004640402

# EE435: Assignment 1

## CAPM Model

$$r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \varepsilon_{jt}$$

```
. reg rj rm

      Source |       SS           df       MS      Number of obs   =    11,959
-------------+----------------------------------   F(1, 11957)     =   5988.94
       Model |  11449.5344         1  11449.5344   Prob > F        =    0.0000
    Residual |  22859.1346    11,957  1.91177842   R-squared       =    0.3337
-------------+----------------------------------   Adj R-squared   =    0.3337
       Total |   34308.669    11,958  2.86909759   Root MSE        =    1.3827

------------------------------------------------------------------------------
          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |   .9947206   .0128536    77.39   0.000     .9695254    1.019916
       _cons |   .0084273   .0126552     0.67   0.505    -.0163789    .0332335
------------------------------------------------------------------------------

. test rm==1

 ( 1)  rm = 1

       F(  1, 11957) =    0.17
            Prob > F =    0.6813
```

## Fama & French:

$$r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \varepsilon_{jt}$$

```
. reg rj rm smb hml

      Source |       SS           df       MS      Number of obs   =    11,959
-------------+----------------------------------   F(3, 11955)     =   2057.22
       Model |  11681.1999         3  3893.73328   Prob > F        =    0.0000
    Residual |  22627.4691    11,955  1.89272013   R-squared       =    0.3405
-------------+----------------------------------   Adj R-squared   =    0.3403
       Total |   34308.669    11,958  2.86909759   Root MSE        =    1.3758

------------------------------------------------------------------------------
          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |   1.005554   .0128271    78.39   0.000     .9804104    1.030697
         smb |   .0371377   .0061189     6.07   0.000     .0251437    .0491318
         hml |   .0562866     .00609     9.24   0.000     .0443492     .068224
       _cons |   .0073088   .0125928     0.58   0.562    -.0173752    .0319928
------------------------------------------------------------------------------

. test rm=1

 ( 1)  rm = 1

       F(  1, 11955) =    0.19
            Prob > F =    0.6651
```

1) Determine whether there exists significant Jensen Alpha.

From the CAPM, Jensen Alpha is insignificant at 95% confidence interval since p-value (0.505) is higher than 0.05 with t=0.67. Thus, there is no Jensen Alpha.

According to the FF model, Jensen Alpha is insignificant at 0.05 level of confidence since p-value (0.562) is higher than 0.05 with t=0.58. Thus, there is no Jensen Alpha.

2) Determine whether portfolio j has the same risk as the market.

First, we perform $\beta_{j1}=1$ to know whether the risk of portfolio j is the same as market risk or not,

According to CAMP, portfolio j has the same risk as the market (p-value=0.6813, F=0.17)

According to FF model, portfolio j has the same risk as the market (p-value=0.6651, F=0.19)

3) Determine whether there exists a significant size premium.

From the FF model, the size premium is $\beta_{j2}$, so the significant size premium exists with p-value=0.000 and t=6.07.

4) Determine whether there exists significant growth (value) premium.

From the FF model, the growth (value) premium is $\beta_{j3}$, so the significant growth premium exists with p-value=0.000 and t=9.24.

5) Compare CAPM and FF models and determine which model is the most appropriate model. Why?

<u>Test CAPM&FF model</u>

```
. test smb hml

 ( 1)  smb = 0
 ( 2)  hml = 0

       F(  2, 11955) =   61.20
            Prob > F =    0.0000
```

We eliminate smb and hml out of the model, or hypotheses testing, H0: $\beta_{j2}=\beta_{j3}=0$. There exists a significant smb&hml which p-value (0.000) is lower than 0.05. Thus, FF model is more appropriate and should not eliminate smb&hml from the model because we can see that from 3&4 both size and growth premium are significant.

January effects

$r_{jt} = \alpha_j + \gamma_j D_{1t} + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \varepsilon_{jt}$

```
. reg rj d1 rm smb hml
```

| Source | SS | df | MS |
|---|---|---|---|
| Model | 11683.8263 | 4 | 2920.95657 |
| Residual | 22624.8427 | 11,954 | 1.89265875 |
| Total | 34308.669 | 11,958 | 2.86909759 |

| | | |
|---|---|---|
| Number of obs | = | 11,959 |
| F(4, 11954) | = | 1543.31 |
| Prob > F | = | 0.0000 |
| R-squared | = | 0.3406 |
| Adj R-squared | = | 0.3403 |
| Root MSE | = | 1.3757 |

| rj | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| d1 | .05393 | .045781 | 1.18 | 0.239 | -.0358082 | .1436682 |
| rm | 1.005405 | .0128275 | 78.38 | 0.000 | .9802607 | 1.030549 |
| smb | .0369291 | .0061214 | 6.03 | 0.000 | .0249302 | .048928 |
| hml | .0562495 | .00609 | 9.24 | 0.000 | .0443121 | .0681868 |
| _cons | .0028773 | .0131425 | 0.22 | 0.827 | -.0228842 | .0286388 |

(6) Determine whether there exist significant January effects.

From the regression model above, there is insignificant since p-value(0.239) is higher than 0.05. Therefore, there is no January effect.

(7) Make interpretation of estimated result of model (3) (including (1) sign, (2) overall test, (3) R-square, and (4) individual test).

From the regression model above, there is no Jensen Alpha ($\alpha_j$=0) and no January effect ($D_{1t}$=0). First, all coefficients are positive. If the market risk premium (rm) increased by 1%, the return on portfolio will rise by 1.005%. If the size premium (smb) increased by 1%, the return on portfolio will rise by 0.367%. If the value (hml) premium increased by 1%, the return on portfolio will rise by 0.562%.

Second, for the overall test, there is a significant at 95% confidence interval since p-value (0.000) is lower than 0.05.

Third, R-square equals 0.3406 which interprets that 34.06% of a dependent variable(rjt)is explained by the independent variables (rm, smb, hml) in this regression model.

Individual testing:

```
. test rm

 ( 1)  rm = 0

       F(  1, 11954) = 6143.24
            Prob > F =    0.0000

. test smb

 ( 1)  smb = 0

       F(  1, 11954) =   36.39
            Prob > F =    0.0000

. test hml

 ( 1)  hml = 0

       F(  1, 11954) =   85.31
            Prob > F =    0.0000
```

Lastly, from the testing, all $\boldsymbol{\beta}_{j1}$&$\boldsymbol{\beta}_{j2}$&$\boldsymbol{\beta}_{j3}$ are significant at 95% confidence interval with the same p-value (0.000).

On the other hand, $\boldsymbol{\gamma}_j$ is insignificant at 95% confidence interval as the p-value (0.2388) is higher than 0.05 level of confidence.

```
. test d1

 ( 1)  d1 = 0

       F(  1, 11954) =    1.39
            Prob > F =    0.2388
```

<u>Chow test using Intercept and slope dummy</u>

$$r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt}$$
$$+ \gamma_j D_{1t} + \beta_{j1} D_{1t} r_{mt} + \beta_{j2} D_{1t} r_{smbt} + \beta_{j3} D_{1t} r_{hmlt} + \varepsilon_{jt}$$

```
. g d1rm=d1*rm

. g d1smb=d1*smb

. g d1hml=d1*hml
```

```
. reg rj rm smb hml d1 d1rm d1smb d1hml

      Source |       SS           df       MS      Number of obs   =    11,959
-------------+----------------------------------   F(7, 11951)     =    881.86
       Model |  11685.5157         7  1669.35938   Prob > F        =    0.0000
    Residual |  22623.1533    11,951  1.89299249   R-squared       =    0.3406
-------------+----------------------------------   Adj R-squared   =    0.3402
       Total |   34308.669    11,958  2.86909759   Root MSE        =    1.3759

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          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |   1.008159   .0133675    75.42   0.000     .9819563    1.034361
         smb |   .0364768   .0064084     5.69   0.000     .0239153    .0490383
         hml |   .0553364   .0063695     8.69   0.000     .0428511    .0678216
          d1 |   .0552912   .0461135     1.20   0.231    -.0350988    .1456811
        d1rm |   -.035594   .0475853    -0.75   0.454    -.1288689    .0576808
       d1smb |   .0037628   .0217997     0.17   0.863    -.0389682    .0464937
       d1hml |   .0106311   .0218876     0.49   0.627    -.0322721    .0535344
       _cons |   .0027652   .0131445     0.21   0.833    -.0230002    .0285307
------------------------------------------------------------------------------

. test d1 d1rm d1smb d1hml

 ( 1)  d1 = 0
 ( 2)  d1rm = 0
 ( 3)  d1smb = 0
 ( 4)  d1hml = 0

       F(  4, 11951) =    0.57
            Prob > F =    0.6844
```

(8) Perform Chow-test (using Intercept and Slope Dummy) whether January and other month share the same structure of the Fama-French model (Model (2) vs Model (4))

From the hypothesis testing, $\gamma_j = \boldsymbol{\beta}_{j1}D_{1t}=\boldsymbol{\beta}_{j2}D_{1t}=\boldsymbol{\beta}_{j3}D_{1t}=0$, it implies that there are statistically insignificant at 95% confidence interval since p-value (0.6844) is higher than 0.05. Therefore, the January and other month share the same structure of the FF model.