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Assignment 1

From the given data set, estimate the following models:

Capital Asset Pricing Model (CAPM)

CAPM: $$r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \varepsilon_{jt} \quad (1)$$

Fama & French three-factor Model (FF)

Fama & French: $$r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \varepsilon_{jt} \quad (2)$$

Where: r_{jt} = excess return on portfolio j at time t and
r_{mt} = excess return on market portfolio at time t – representing market risk premium.
r_{smbt} = return on a small-stock portfolio minus the return on a large-stock portfolio (Small Minus Big) at time t – representing size premium.
r_{hmlt} = return on a value-stock portfolio minus the return on a growth-stock portfolio (High Minus Low) at time t – representing value premium.

Figure 1

```
. 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
```

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Figure 2

```
. 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.

Jensen Alpha is not significant in CAPM model and FF model since the p-value in CAPM model is greater than 0.05 (0.505>0.05) *showing in* *Figure 1* and p-value in FF model is also greater than 0.05 as well (0.562>0.05) *showing in* *Figure 2*.

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

In order to find that portfolio j has the same risk as the market, the beta of portfolio j has to be “1” ($\beta_{j1} = 1$)

CAPM model :
Testing the hypothesis : Ho : $\beta_{j1} = 1$
The p-value is greater than 0.05 (0.6812>0.05) *showing in* *Figure 1* which means that we fail to reject Ho, portfolio j has the same risk as the market.

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FF model :

Testing the hypothesis : Ho : $\beta_{j1} = 1$

The p-value is also greater than 0.05 (0.6651>0.05) *showing in Figure 2* which means that we fail to reject Ho, portfolio j also has the same risk as the market.

(3) Determine whether there exists significant size premium.

From *Figure 2*, the p-value of r_{smbt} is less than 0.05 (0.000<0.05), there exists a significant size premium.

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

From *Figure 2*, The p-value of r_{hmlt} is less than 0.05 (0.000<0.05), there exists significant growth (value) premium.

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

```
. test smb hml

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

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

Testing the hypothesis : Ho : $\beta 2 = \beta 3 = 0$

The p-value is less than 0.05 (0.0000<0.05), we reject Ho.

FF model is more appropriate and we should not eliminate r_{smbt} and r_{hmlt} out of the model.

To study calendar effect (January effects) from the data set, estimate the following models:

$$r_{jt} = \alpha_j + \gamma_j D_{1t} + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \varepsilon_{jt} \qquad (3)$$

where: $D_{1t} = 1$ on January and $= 0$ otherwise.

Figure 3

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

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]
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
d1	.05393	.045781	1.18	0.239	-.0358082	.1436682
_cons	.0028773	.0131425	0.22	0.827	-.0228842	.0286388

(6) Determine whether there exist significant January effects.

From the ANCOVA model *shown in Figure3*, D1 which is January effects is not significant since the p-value of D1 is greater than 0.05 (0.239>0.05), we failed to reject Ho.

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

From the estimated result of model 3, we can interpret that rm, smb, hml, d1 and the interception are all positive signs. From the overall F-test, its p-value is less than 0.05 (0.0000<0.05), we reject Ho, meaning that rm, smb, hml, d1 have significance to explain the portfolio j. The R-square is equal to 0.3406 implied that this model can explain the variation in rjt by 34.06%. In terms of individual test, we fail to reject for d1 since its p-value is greater than 0.05 (0.239>0.05) while we reject for rm, smb and hml since they have their p-value less than 0.05 (0.000<0.05). We can conclude that d1 or the January effects is not significant, in other words, January effects do not have an impact on the portfolio j.

$$\begin{aligned} r_{jt} &= \alpha_j + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} \\ &\quad + \gamma_j D_{1t} + \beta_{j1} D_{1t} r_{mt} + \beta_{j2} D_{1t} r_{smbt} + \beta_{j3} D_{1t} r_{hmlt} + \varepsilon_{jt} \end{aligned} \tag{4}$$

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(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)).

```
. 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
------------------------------------------------------------------------------

. sca rss1=e(rss)

. sca n1=e(N)


. reg rj rm smb hml if d1==0

      Source |       SS           df       MS      Number of obs   =    10,974
-------------+----------------------------------   F(3, 10970)     =   1887.21
       Model |  10805.6192         3  3601.87308   Prob > F        =    0.0000
    Residual |   20936.975    10,970  1.90856654   R-squared       =    0.3404
-------------+----------------------------------   Adj R-squared   =    0.3402
       Total |  31742.5942    10,973  2.89279087   Root MSE        =    1.3815

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          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |   1.008159   .0134224    75.11   0.000     .9818484    1.034469
         smb |   .0364768   .0064347     5.67   0.000     .0238636      .04909
         hml |   .0553364   .0063956     8.65   0.000     .0427998    .0678729
       _cons |   .0027652   .0131985     0.21   0.834    -.0231062    .0286367
------------------------------------------------------------------------------

. sca rss2=e(rss)

. sca n2=e(N)
```

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```
. reg rj rm smb hml if d1==1

      Source |       SS           df       MS      Number of obs   =       985
-------------+----------------------------------   F(3, 981)       =    169.11
       Model |  872.032797         3  290.677599   Prob > F        =    0.0000
    Residual |  1686.17832       981  1.71883621   R-squared       =    0.3409
-------------+----------------------------------   Adj R-squared   =    0.3389
       Total |  2558.21111       984  2.59980804   Root MSE        =     1.311

------------------------------------------------------------------------------
          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |   .9725647   .0435176    22.35   0.000     .8871664    1.057963
         smb |   .0402395   .0198549     2.03   0.043     .0012766    .0792024
         hml |   .0659675   .0199538     3.31   0.001     .0268104    .1051246
       _cons |   .0580564   .0421181     1.38   0.168    -.0245956    .1407084
------------------------------------------------------------------------------

. sca rss3=e(rss)

. sca n3=e(N)

. sca ChowTest=((rss1-rss2-rss3)/4)/((rss2+rss3)/(n2+n3-2*4))


. sca list ChowTest
  ChowTest =  .56997206


. g rmd1 = rm*d1

. g smbd1 = smb*d1

. g hmld1 = hml*d1


. reg rj rm smb hml d1 rmd1 smbd1 hmld1

      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
        rmd1 |   -.035594   .0475853    -0.75   0.454    -.1288689    .0576808
       smbd1 |   .0037628   .0217997     0.17   0.863    -.0389682    .0464937
       hmld1 |   .0106311   .0218876     0.49   0.627    -.0322721    .0535344
       _cons |   .0027652   .0131445     0.21   0.833    -.0230002    .0285307
------------------------------------------------------------------------------
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```
. test d1 rmd1 smbd1 hmld1

 ( 1)  d1 = 0
 ( 2)  rmd1 = 0
 ( 3)  smbd1 = 0
 ( 4)  hmld1 = 0

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

From testing Ho : d1= rmd1 = smbd1 = hmld1 = 0, the p-value is greater than 0.05 (0.6844>0.05), we failed to reject Ho. Hence, there is no structure change in this case.