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ASSIGNMENT 1

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

```
. 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
```

```
. 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
```

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1. Jensen Alpha is insignificant, p-value in CAPM model is 0.505 which is greater than 0.05 (p-value : 0.505 > 0.05), and p-value in FF model is 0.562 (p-value : 0.562 > 0.05). Therefore, there does not exist a significant Jensen Alpha in the CAPM model and FF model.
2. In order for portfolio j to have the same risk as the market, its beta has to be 1. Testing hypothesis by Ho : $\beta_1 = 1$
   Portfolio j from CAPM model has the same risk as the market since its p-value is fail to reject (p-value : 0.6813 > 0.05), and from FF model, portfolio j also has the same risk as the market since its p-value is fail to reject (p-value : 0.6651 > 0.05).

3. From the FF model shown above, there exists a significant size premium because p-value is rejected (p-value : 0.000 < 0.05).
4. There exists a significant growth premium since its p-value is rejected (p-value : 0.000 < 0.05).
5. To test whether CAPM model or FF model is more appropriate, we test hypothesis of Ho : $\beta_2 = \beta_3 = 0$.

```
. test smb hml

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

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

From the test, p-value is rejected (p-value : 0.0000 < 0.05). So, FF model is more appropriate, and size premium and growth premium should not be eliminated.

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.

```
. reg rj rm smb hml d1

      Source |       SS           df       MS      Number of obs   =    11,959
-------------+----------------------------------   F(4, 11954)     =   1543.31
       Model |  11683.8263         4  2920.95657   Prob > F        =    0.0000
    Residual |  22624.8427    11,954  1.89265875   R-squared       =    0.3406
-------------+----------------------------------   Adj R-squared   =    0.3403
       Total |   34308.669    11,958  2.86909759   Root MSE        =    1.3757

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          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
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```

6. To study calendar effects or January effects, we use the ANCOVA model because it includes quantitative independent variables (RM, SMB, HML). From the regression, we can interpret that D1 (January effects) is insignificant since p-value is failed to reject (p-value : 0.239 > 0.05).
7. According to the regression model, we can interpret that return on market portfolio is positive (1.01), and other variables including SMB, HML, D1, and interception are all positive. For the overall test, F-test suggested that the p-value for F-test is significant, H0 is rejected (p-value : 0.0000 < 0.05) which means these 4 variables are adequate to explain portfolio j. Moreover, by looking at the R-square, we can conclude that the model explains variation in rj by 34.06%. For the individual test, it is shown that both SMB and HML generate the significant variables since p-value is rejected (p-value : 0.0000 < 0.05) while D1 is failed to reject in this case where p-value is 0.239 which is greater than 0.05. Therefore, from the data, January effects do not affect the portfolio j.

8.

```
. 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==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

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          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
```

```
. 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
```

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```
. 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

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

```
. 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
```

According to the Chow Test and FF test, we observed that both Chow Test and FF models failed to reject January effects (H0 : d1 = rmd1 = smbd1 = hmld1 = 0 is failed to reject). Therefore, there is no structure change (p-value : 0.6844 > 0.05), dummy variables are not necessary in this model, and FF model is enough to interpret.

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