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.

(1) Determine whether there exists significant Jensen Alpha.
(2) Determine whether portfolio j has the same risk as the market.
(3) Determine whether there exists significant size premium.
(4) Determine whether there exists significant growth (value) premium.
(5) Compare CAPM and FF models and determine which model is the most appropriated model. why?

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

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

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

(6) Determine whether there exist significant January effects.
(7) Make interpretation of estimated result of model (3) (including (1) sign, (2) overall test, (3) R-square, and (4) individual test).

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

(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)).

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

CAPM Model

```
. reg rj rm

      Source |       SS       df       MS              Number of obs =   11959
-------------+------------------------------           F(  1, 11957) = 5988.94
       Model |  11449.5344     1  11449.5344            Prob > F      =  0.0000
    Residual |  22859.1346 11957  1.91177842           R-squared     =  0.3337
-------------+------------------------------           Adj R-squared =  0.3337
       Total |   34308.669 11958  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: $$r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \varepsilon_{jt} \quad (2)$$

Fama & French (FF) Model

```
. reg rj rm smb hml

      Source |       SS       df       MS              Number of obs =   11959
-------------+------------------------------           F(  3, 11955) = 2057.22
       Model |  11681.1999     3  3893.73328            Prob > F      =  0.0000
    Residual |  22627.4691 11955  1.89272013           R-squared     =  0.3405
-------------+------------------------------           Adj R-squared =  0.3403
       Total |   34308.669 11958  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.
According to CAPM, Jensen Alpha is insignificant (t=0.67 & p-value=0.505).
Also, based on FF, there is no Jensen Alpha (t=0.58 & p-value=0.562).

(2) Determine whether portfolio *j* has the same risk as the market.
According to CAPM, portfolio *j* has the same risk as the market since β_j=1. (F=0.17 & p-value=0.6813).
Also, based on FF, portfolio *j* has the same risk as the market since β_j=1. (F=0.19 & p-value=0.6651).

(3) Determine whether there exists significant size premium.
According to FF, there exists significant size premium (t=6.07 & p-value=0.000).

(4) Determine whether there exists significant growth (value) premium.
According to FF, there exists significant growth premium (t=9.24 & p-value=0.000).

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

Test FF model vs CAPM

```
. test smb hml

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

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

According to the above test, the FF model is more appropriate since both size and growth premium coefficients are significant.

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

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

January Effect

```
. reg rj rm smb hml d1

      Source |       SS       df       MS              Number of obs =   11959
-------------+------------------------------           F(  4, 11954) = 1543.31
       Model |  11683.8263     4  2920.95657            Prob > F      =  0.0000
    Residual |  22624.8427 11954  1.89265875            R-squared     =  0.3406
-------------+------------------------------           Adj R-squared =  0.3403
       Total |   34308.669 11958  2.86909759            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.
According to the above estimated result, there is no January effects (t=1.18 & p-value=0.239).

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

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

Chow test using dummy variables technique

```
. g drm=d1*rm

. g dsmb=d1*smb

. g dhml=d1*hml
```

```
. reg rj rm drm smb dsmb hml dhml d1
      Source |       SS       df       MS              Number of obs =   11959
-------------+------------------------------           F(  7, 11951) =  881.86
       Model |  11685.5157     7  1669.35938            Prob > F      =  0.0000
    Residual |  22623.1533 11951  1.89299249            R-squared     =  0.3406
-------------+------------------------------           Adj R-squared =  0.3402
       Total |   34308.669 11958  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
         drm |   -.035594   .0475853    -0.75   0.454    -.1288689    .0576808
         smb |   .0364768   .0064084     5.69   0.000     .0239153    .0490383
        dsmb |   .0037628   .0217997     0.17   0.863    -.0389682    .0464937
         hml |   .0553364   .0063695     8.69   0.000     .0428511    .0678216
        dhml |   .0106311   .0218876     0.49   0.627    -.0322721    .0535344
          d1 |   .0552912   .0461135     1.20   0.231    -.0350988    .1456811
       _cons |   .0027652   .0131445     0.21   0.833    -.0230002    .0285307
------------------------------------------------------------------------------

. test drm dsmb dhml d1
 ( 1)  drm = 0
 ( 2)  dsmb = 0
 ( 3)  dhml = 0
 ( 4)  d1 = 0
       F(  4, 11951) =    0.57
            Prob > F =    0.6844
```

1. Sign and Meaning:
   For Dummy variable=0 or other months, the estimated model is:

   $$\hat{r}_{jt} = 0.0027 + 1.0082 r_{mt} + 0.0365 r_{smbt} + 0.0553 r_{hmlt}$$

   For Dummy variable=1 or January, the estimated model is:

   $$\hat{r}_{jt} = (0.0028 + 0.0553) + (1.0082 - 0.0356) r_{mt} + (0.0365 + 0.0038) r_{smbt} + (0.0553 + 0.0106) r_{hmlt}$$

2. Overall Test F-test=881.86 with p-value of 0.000 < 0.05, the null hypothesis of all coefficients of independent variables are equals to zero is rejected. Thus, all independent variables (including intercept and slope dummy variables) can be used together in explaining the dependent variables significantly.
3. R-squared=0.3406 means that variation in the dependent variable can be explained by the variation in the estimated model by 34.06%.
4. However, individual t-tests of intercept dummy and all slope dummy variables are all insignificant, only main variables (rm, smb, and hml) are significant. This might imply that January model should not be separate from other months model.

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

According to the above Chow-test (using dummy variable technique) F-test=0.57 with p-value of 0.6844>0.05, the null hypothesis cannot be rejected. Thus, January and other months share the same structure of the FF model. Therefore, the models of January and other months should be estimated as one model (should not be separated).