Assignment 1

From the given data set, estimate the following models:

Capital Asset Pricing Model (CAPM)

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

Fama & French three-factor Model (FF)

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

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:

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

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

(6) Determine whether there exist significant January effects.
(7) Perform Chow-test whether January and other month share the same structure of the Fama-French model (2).

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) = 5984.04
       Model |  11441.6298     1  11441.6298           Prob > F      =  0.0000
    Residual |  22862.0841 11957  1.91202509           R-squared     =  0.3335
-------------+------------------------------           Adj R-squared =  0.3335
       Total |  34303.7139 11958  2.86868321           Root MSE      =  1.3828

------------------------------------------------------------------------------
          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |   .9943772   .0128545    77.36   0.000     .9691804    1.019574
       _cons |    .021087    .012656     1.67   0.096    -.0037207    .0458948
------------------------------------------------------------------------------

. test rm==1

 ( 1)  rm = 1

       F(  1, 11957) =    0.19
            Prob > F =    0.6618
```

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) = 2054.82
       Model |  11670.5367     3   3890.1789           Prob > F      =  0.0000
    Residual |  22633.1772 11955  1.89319759           R-squared     =  0.3402
-------------+------------------------------           Adj R-squared =  0.3400
       Total |  34303.7139 11958  2.86868321           Root MSE      =  1.3759

------------------------------------------------------------------------------
          rj |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          rm |    1.00514   .0128287    78.35   0.000     .9799932    1.030286
         smb |   .0365574   .0061197     5.97   0.000     .0245618     .048553
         hml |   .0561834   .0060908     9.22   0.000     .0442445    .0681223
       _cons |   .0199832   .0125944     1.59   0.113     -.004704    .0446703
------------------------------------------------------------------------------

. test rm==1

 ( 1)  rm = 1

       F(  1, 11955) =    0.16
            Prob > F =    0.6887
```

(1) Determine whether there exists significant Jensen Alpha.
According to CAPM, Jensen Alpha is insignificant (t=1.67 & p-value=0.096).
Also, based on FF, there is no Jensen Alpha (t=1.59 & p-value=0.113).

(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=0.19 & p-value=0.6618).
Also, based on FF, portfolio *j* has the same risk as the market since β_j=1. (F=0.16 & p-value=0.6887).

(3) Determine whether there exists significant size premium.
According to FF, there exists significant size premium (t=5.97 & p-value=0.000).

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

According to FF, there exists significant growth premium (t=9.22 & 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) =   60.46
            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:

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

January Effect

```
. reg rj rm smb hml d1

      Source |       SS       df       MS              Number of obs =   11959
-------------+------------------------------           F(  4, 11954) = 1542.65
       Model |  11678.8711     4  2919.71779           Prob > F      =  0.0000
    Residual |  22624.8427 11954  1.89265875           R-squared     =  0.3405
-------------+------------------------------           Adj R-squared =  0.3402
       Total |  34303.7139 11958  2.86868321           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 |    -.09607    .045781    -2.10   0.036    -.1858082   -.0063318
       _cons |   .0278773   .0131425     2.12   0.034     .0021158    .0536388
------------------------------------------------------------------------------
```

(6) Determine whether there exist significant January effects.
According to the above estimated result, there is significant January effects (t=-2.05 & p-value=0.040).

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) =  881.49
       Model |  11680.5605     7  1668.65151           Prob > F      =  0.0000
    Residual |  22623.1533 11951   1.8929925           R-squared     =  0.3405
-------------+------------------------------           Adj R-squared =  0.3401
       Total |  34303.7139 11958  2.86868321           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     .0428512    .0678216
```

```
        dhml |   .0106311   .0218876     0.49   0.627    -.0322721    .0535344
          d1 |  -.0947088   .0461135    -2.05   0.040    -.1850988   -.0043189
       _cons |   .0277652   .0131445     2.11   0.035     .0019998    .0535306
------------------------------------------------------------------------------

. test drm dsmb dhml d1

 ( 1)  drm = 0
 ( 2)  dsmb = 0
 ( 3)  dhml = 0
 ( 4)  d1 = 0

       F(  4, 11951) =    1.32
            Prob > F =    0.2584
```

(7) Perform Chow-test whether January and other month share the same structure of the Fama-French model (2).

According to the above Chow-test (using dummy variable technique), 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).