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1. Determine whether there exists significant Jensen Alpha.

```
. regress 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


. regress 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
```

Form the regression on CAPM and FF models, Jensen Alpha is statistically insignificant since p-value of t-test is 0.505 and 0.562, respectively, which exceed the critical region at 95% confidence level of 0.05. Then, we fail to reject the null hypothes and there is no significant Jensen Alpha.

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

From the regression, we perform hypothesis testing that H0: β_{j1} = 1 in order to test that the risk of portfolio j is equal to the market or not. The result shows that for both CAPM and FF models, we cannot reject the null hypothesis since the p-value of market risk in CAPM and FF models are 0.6813 and 0.6651, respectively. Therefore, if market risk increases by 1 unit portfolio j's risk also increases by 1 unit too. The portfolio j has the same risk as to the market.

3. Determine whether there exists a significant size premium.

```
. test smb

 ( 1)  smb = 0

       F(  1, 11955) =   36.84
            Prob > F =    0.0000
```

To test the significant we perform hypothesis testing that β_{j2} = 0, the result shows that size premium is statistically significant at 95% confidence level since the p-value is 0.00, meaning that β_{j2} is not equal to 0. There is a significant size premium effects.

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

```
. test  hml

 ( 1)  hml = 0

       F(  1, 11955) =   85.42
            Prob > F =    0.0000
```

To test the significant we perform hypothesis testing that β_{j3} = 0, the result shows that size premium is statistically significant at 95% confidence level since the p-value is 0.00, meaning that we reject the null hypothesis. So, β_{j3} is not equal to 0, presenting that a significant value premium exists.

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
```

CAPM and FF models are nested models according to the same independent variable (market risk premium). We perform hypothesis testing that $\beta_{j2} = \beta_{j3} = 0$. The result of the test is statistically significant at 95% confidence level since the p-value is 0.00. We reject the null hypotheses. Therefore, we should not eliminate the size premium and value premium from the model. The FF model is more appropriate.

6. Determine whether there exist significant January effects.

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

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

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

According to the result from regression, the January effects are statistically insignificant at 95% confidence level. The p-value of γ_j (0.239) is higher than 0.05. So, we cannot reject the null hypothesis that the relationship between excess return on portfolio j and the January effects have a significant relationship.

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

All of the independent variables have positive coefficients. For the January effect, it is reasonable that it yields higher returns because the investors usually sell stocks at the end of the year due to the tax purpose and buy it again in January. As demand increases, the price goes up and raises the capital gain. For market risk premium, it implies that the excess return on portfolio j will move in the same direction with market return. Besides, a positive coefficient of size premium shows that the portfolio j has weighted toward small-capital stocks. If the variable is significant, the return should go up with the impact on small minus big effects. Lastly, the positive value premium coefficient indicates that the weight of portfolio j is slightly dependent more on value stocks which usually outperforms the growth stocks. If the significant High minus low effects exist, the return should increase.

For the overall test, the p-value of F-test is 0.00, meaning that the model is statistically significant at 95% confidence level. All explanatory variables can significantly explain the dependent variables.

The R-squared of this model is 0.3406, implying that the model can explain the dependent variable or the data is fit to the model by 34.06%.

From the individual test, market risk, size premium and growth premium are statistically significant since the p-value is only 0.00 which is less than 0.05. However, the p-value of January effect is 0.2388 which is higher than 0.05, indicating that the variable is statistically insignificant at 95% confidence level.

(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 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
```

From performing the hypotheses testing that $\gamma_j = \beta_{j1}D_{1t} = \beta_{j2}D_{1t} = \beta_{j3}D_{1t} = 0$, the results imply that all testing variables are statistically insignificant at 95% confidence level because the p-value is 0.6844 which is larger than critical region of 0.05. We cannot reject our null hypotheses. Therefore, January and other month share the same structure of the FF model.