Assignment 1
Review OLS

Mutual Fund

$H_0 : \beta_j = 1$

β : Systematic Risk α = Risk Adjusted Return (Jensen Alpha)

Due 28/1/2021

From the given data set, `assign1.dta`, estimate the following models:

Capital Asset Pricing Model (CAPM)

$r_j = \frac{NAV_t - NAV_{t-1}}{NAV_{t-1}}$ $r_{mt} = \frac{SET_t - SET_{t-1}}{SET_{t-1}}$

$$\text{CAPM:} \quad r_{jt} = \alpha_j + \beta_j r_{mt} + \varepsilon_{jt} \tag{1}$$

Fama & French three-factor Model (FF)

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

Carhart four-factor Model

$$\text{Carhart:} \quad r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \beta_{j4} r_{wmlt} + \varepsilon_{jt} \tag{3}$$

Where: r_{jt} = excess return on mutual fund j at time t and j = 1, 2, …, 20.

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.

r_{wmlt} = return on a winners portfolio minus the return on a losers portfolio (Winners Minus Losers) at time t – representing momentum premium.

(a) From CAPM, determine top 3 mutual fund in term of their performance based on Jensen Alpha.

(b) From FF, determine top 3 mutual fund in term of their performance based on Jensen Alpha.

(c) From Carhart, determine top 3 mutual fund in term of their performance based on Jensen Alpha.

(d) From the estimated result of Carhart four-factor model (3) of mutual fund #1, evaluate whether there exist Autocorrelation and Multicollinearity problem or not? Which model between Carhart or FF should be employed in this case? Why? Also, make evaluation of the estimated results of Carhart model in term of (i) sign and meaning of the estimated coefficients; (ii) overall test; (iii) coefficient of determination; and (iv) individual test.

(e) Based on (a), (b), and (c), which result is the most appropriated one? Why?

* If you run manually, you have to run for 20 times. Very time consuming.

Hint: In order to speed up your analysis, you can employ the loop command by using `forvalue` *command, as follows:*

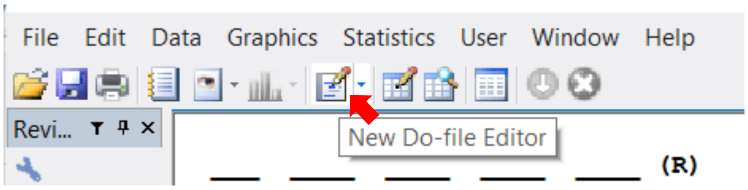
2) Create matrix (mat list : to show the matrix)

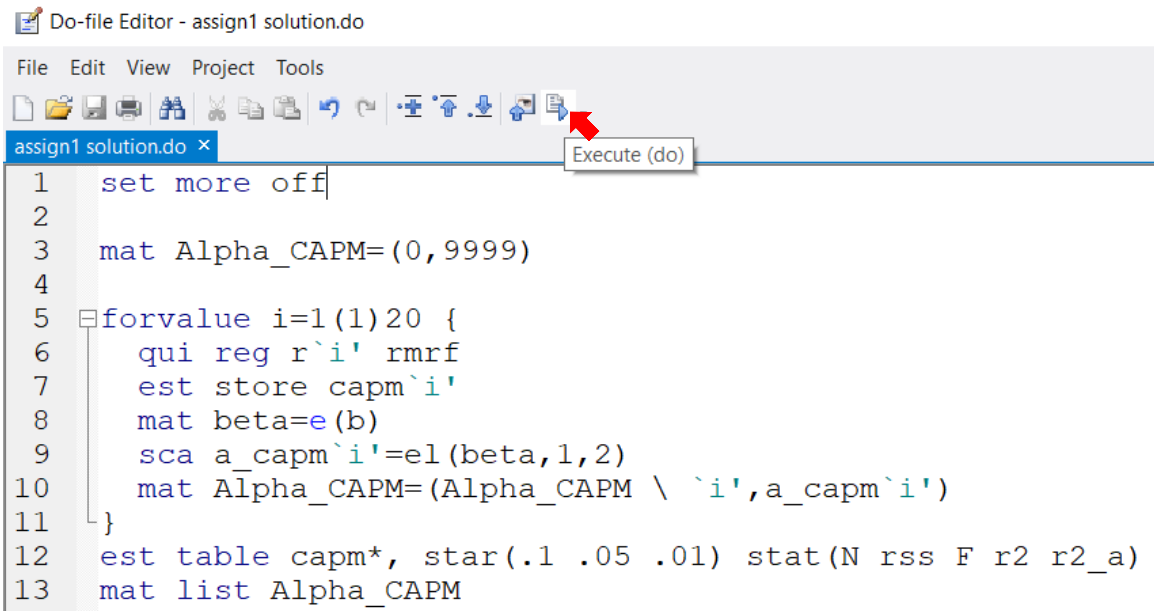
Example do-file command

1)
```
set more off
```

2)
```
mat Alpha_CAPM=(0,9999)
```
mat: matrix

```
forvalue i=1(1)20 {
  qui reg r`i' rmrf
  est store capm`i'
  mat beta=e(b)
  sca a_capm`i'=el(beta,1,2)
  mat Alpha_CAPM=(Alpha_CAPM \ `i',a_capm`i')
}
est table capm*, star(.1 .05 .01) stat(N rss F r2 r2_a)
mat list Alpha_CAPM
```
qui : quietly





Thanakrit 6204640087.

ANSWER

(a) From CAPM, determine top 3 mutual fund in term of their performance based on Jensen Alpha.

Using CAPM model, the Jensen Alpha from 20 mutual funds are as follows.

```
. mat list Alpha_CAPM

Alpha_CAPM[21,2]
            c1          c2
 r1          0        9999
 r2          1  -.28045261
 r3          2   .02705237
 r4          3   .04241345
 r5          4   .41910739
 r6          5    .1533913
 r7          6    .2460271
 r8          7   .06639442
 r9          8   .22738701
r10          9   .03444878
r11         10   .15557323
r12         11   .19464246
r13         12   .03145185
r14         13   .13681104
r15         14   .17849533
r16         15   .09946436
r17         16   .02742681
r18         17   .03352088
r19         18   .09933407
r20         19   .00020766
r21         20   .04748425
```

Since, Jensen Alpha implies the return, in this case, of the mutual fund regardless the level of risk, called "Risk-Adjusted Return". Therefore, in term of performance, the higher Jensen Alpha [as shown in the column c2] is better.

Based on Jensen Alpha, top three mutual funds are

1) Mutual fund # 4 2) Mutual fund # 6 3) Mutual fund # 8.

(b) From FF, determine top 3 mutual fund in term of their performance based on Jensen Alpha.

From Fama & French model, top three mutual funds based on Jensen Alpha are

```
. mat list Alpha_FF

Alpha_FF[21,2]
            c1          c2
 r1          0        9999
 r2          1  -.30036799
 r3          2   .02917021
 r4          3   .09651371
 r5          4   .54137257
 r6          5   .24517545
 r7          6   .28268096
 r8          7   .06469084
 r9          8   .24142393
r10          9   .01544377
r11         10   .24200303
r12         11   .24259989
r13         12  -.00860432
r14         13   .13495997
r15         14   .17933912
r16         15   .13446597
r17         16   .08765823
r18         17   .11427555
r19         18   .15543046
r20         19   .07292389
r21         20   .12042667
```

1) Mutual fund # 4

2) Mutual fund # 6

3) Mutual fund # 5.

(c) From Carhart, determine top 3 mutual fund in term of their performance based on Jensen Alpha.

From Carhart four-factor model, top three mutual funds based on Jensen Alpha are

```
. mat list Alpha_CH

Alpha_CH[21,2]
            c1          c2
 r1          0        9999
 r2          1   .71766532
 r3          2  -.16464281
 r4          3   .85962846
 r5          4  -1.0030189
 r6          5   1.1058157
 r7          6  -.00363444
 r8          7   .25590768
 r9          8  -.03462485
r10          9   -.2831535
r11         10   -.6508953
r12         11  -.94625889
r13         12  -.33194474
r14         13   -.3349251
r15         14  -.25458186
r16         15  -.57509829
r17         16   .79030403
r18         17   .88918966
r19         18  -.14240538
r20         19   .72254197
r21         20   .71246294
```

1) Mutual fund #5

2) Mutual fund #17

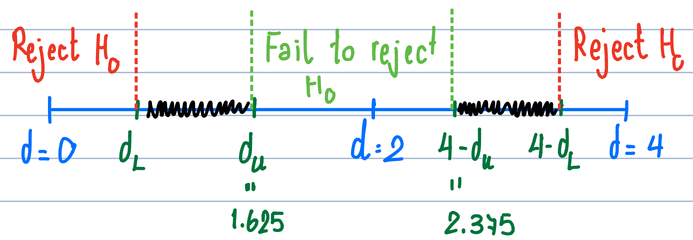
3) Mutual fund #3

(d) From the estimated result of Carhart four-factor model (3) of mutual fund #1, evaluate whether there exist Autocorrelation and Multicollinearity problem or not? Which model between Carhart or FF should be employed in this case? Why? Also, make evaluation of the estimated results of Carhart model in term of (i) sign and meaning of the estimated coefficients; (ii) overall test; (iii) coefficient of determination; and (iv) individual test.

=> To test whether autocorrelation exists in this model, Durbin-Watson test is performed.

d-statistic (5, 120) = 2.349188 computed by STATA. From the table, critical values ($k = 4$, $n = 120$) at 2% level are $d_L = 1.461$, $d_u = 1.625$.

$H_0: \rho = 0$ ($d = 2$) VS H_1: H_0 is not true



Since d_{stat} falls into Fail-to-reject region ($d_u < d_{stat} < 4 - d_u$), there is enough evidence to conclude that $\rho = 0$ or there is no autocorrelation problem.

Since we know that the autocorrelation does not exist, the $Var(\hat{\beta}_{OLS})$ is secured and t-test is reliable. Thus, we can look further whether we have multicollinearity or not.

=> From the observation on the Cahart-four-factor model, I would say that multicolinearity problem occurs because r_{smbt} and r_{hmlt} is highly correlated, and also shows high VIF. However, these two independent variables are significant (individually)

```
4 . corr rmrf smb hml wml
(obs=120)

             |     rmrf      smb      hml      wml
-------------+------------------------------------
        rmrf |   1.0000
         smb |   0.3499   1.0000
         hml |  -0.2829  -0.9514   1.0000
         wml |  -0.0237  -0.0314   0.0305   1.0000
```

```
3 . vif

    Variable |       VIF       1/VIF
-------------+----------------------
         smb |     11.39    0.087771
         hml |     10.87    0.092012
        rmrf |      1.18    0.851025
         wml |      1.00    0.998808
-------------+----------------------
    Mean VIF |      6.11
```

=> From my point of view, Fama & French model should be employed instead of Cahart-4-factor model, because ...

```
1 . reg r1 rmrf smb hml wml

      Source |       SS           df       MS      Number of obs   =       120
-------------+----------------------------------   F(4, 115)       =    130.81
       Model |    1763.719         4  440.92975   Prob > F        =    0.0000
    Residual |  387.652185       115  3.37088857   R-squared       =    0.8198
-------------+----------------------------------   Adj R-squared   =    0.8135
       Total |  2151.37118       119  18.0787494   Root MSE        =     1.836

------------------------------------------------------------------------------
          r1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        rmrf |   88.37442   4.132204    21.39   0.000     80.18932    96.55952
         smb |  -30.55523   15.20777    -2.01   0.047     -60.6789   -.4315607
         hml |  -29.55418   14.55813    -2.03   0.045    -58.39103   -.7173227
         wml |  -16.89643    11.8509    -1.43   0.157    -40.37078     6.57791
       _cons |   .7176653   .7344903     0.98   0.331    -.7372186    2.172549
------------------------------------------------------------------------------
```

From the print out, it reveals that r_{wmlt} (wml) has very low t-statistic and, thus, high p-value. As a result, this explanatory variable is insignicant at any reasonable levels. Furthermore, the low t-statistic is not because of multicolinearity problem.

```
3 . vif

    Variable |       VIF       1/VIF
-------------+----------------------
         smb |     11.39    0.087771
         hml |     10.87    0.092012
        rmrf |      1.18    0.851025
         wml |      1.00    0.998808
-------------+----------------------
    Mean VIF |      6.11
```

(VIF(wml) = 1 showing that wml does not correlate with another regressors). Hence, r_{wmlt} itself is insignificant because it cannot explain the dependent variable. This variable, therefore, should be droped. Then, what are left in the model are r_{smbt}, r_{hmlt}, and r_{mt} only which is Fama & French model.

=> Estimated result of Carhart model of mutual fund #1 is

$$\hat{r}_{1t} = \underset{(0.73)}{0.72} + \underset{(4.13)}{88.37}\, r_{mt} - \underset{(15.21)}{30.56}\, r_{smbt} - \underset{(14.56)}{29.55}\, r_{hmlt} - \underset{(11.85)}{16.90}\, r_{wmlt}$$

(i) • r_{mt} : $\hat{\beta}_{rmt} > 0$, it indicates that the market risk premium (r_{mt}) positively affects the (estimated) excess return on mutual fund #1. ($\hat{r}_{1t}$)

$\hat{\beta}_{rmt} = 88.37$ means that if r_{mt} increases by 1 percentage point then $\hat{r}_{1t}$ will increase by 88.37 percentage point holding other things fixed. (Vice versa)

• r_{smbt} : $\hat{\beta}_{rsmbt} < 0$, it indicates that size premium (r_{smbt}) negatively affects the (estimated) excess return on mutual fund #1. ($\hat{r}_{1t}$)

$\hat{\beta}_{smbt} = -30.56$ means that if r_{smbt} increases by 1 percentage point then $\hat{r}_{1t}$ will decrease by 30.56 percentage point holding other things fixed. (Vice versa)

• r_{hmlt} : $\hat{\beta}_{rhmlt} < 0$, it indicates that value premium (r_{hmlt}) negatively affects the (estimated) excess return on mutual fund #1. ($\hat{r}_{1t}$)

$\hat{\beta}_{hmlt} = -29.55$ means that if r_{hmlt} increases by 1 percentage point then $\hat{r}_{1t}$ will decrease by 29.55 percentage point holding other things fixed. (Vice versa)

• r_{wmlt} : $\hat{\beta}_{r_{wmlt}} < 0$, it indicates that momentum premium (r_{wmlt}) negatively affects the (estimated) excess return on mutual fund #1. ($\hat{r}_{1t}$)

$\hat{\beta}_{wmlt} = -16.89$ means that if r_{wmlt} increases by 1 percentage point then $\hat{r}_{1t}$ will decrease by 16.89 percentage point holding other things fixed. (Vice versa).

• $\alpha = 0.72$ means that the (estimated) excess return on mutual fund #1. ($\hat{r}_{1t}$) will be equal to 0.72 percentage point when $r_{mt} = r_{smbt} = r_{hmlt} = r_{wmlt} = 0$.

(ii) Overall Test : looking at p-value from F-test (Prob > F = 0.00), it means that all explanatory variables are all significant.

(iii) Coefficient of Determination

$R^2 = 0.8198$ It means that variation in the regressand can be explained by variation in the regressors by 81.98 % .

(iv) Individual Test

```
1 . reg r1 rmrf smb hml wml
```

Source	SS	df	MS
Model	1763.719	4	440.92975
Residual	387.652185	115	3.37088857
Total	2151.37118	119	18.0787494

Number of obs	=	120
F(4, 115)	=	130.81
Prob > F	=	0.0000
R-squared	=	0.8198
Adj R-squared	=	0.8135
Root MSE	=	1.836

r1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rmrf	88.37442	4.132204	21.39	0.000	80.18932	96.55952
smb	-30.55523	15.20777	-2.01	0.047	-60.6789	-.4315607
hml	-29.55418	14.55813	-2.03	0.045	-58.39103	-.7173227
wml	-16.89643	11.8509	-1.43	0.157	-40.37078	6.57791
_cons	.7176653	.7344903	0.98	0.331	-.7372186	2.172549

rmrf : $P>|t| = 0.00$ => It is statistically significant for any reasonable levels.

smb : $P>|t| = 0.047$ => It is statistically significant at 5% level.

hml : $P>|t| = 0.045$ => It is statistically significant at 5% level.

wml : $P>|t| = 0.157$ => It is statistically insignificant for any reasonable levels.

(e) Based on (a), (b), and (c), which result is the most appropriated one? Why?

In my opinion, the result from (b) - Fama & French - is the most appropriated, because

1) CAPM model has only explanatory variable. It is highly likely that there are omitted variables in which we will have a biased model. So, I decide not to choose this model.

2) Although Carhart model has higher adjusted R^2 than Fama & French, Cahart model contains insignificant variable (wml, to specify) which should be dropped.

```
  ___  ____  ____  ____  ____(R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/
  Statistics/Data Analysis
```

```
      rmrf |   86.67481***    .33259034      79.458292***    71.566194***    89.883716***    68.863747***    99.202503***    101.10416***     10.99266***    95.818659***
      name:  <unnamed>
       log:  C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 1\AS1 (a-c).smcl
  log type:  smcl
 opened on:  24 Jan 2021, 21:42:33

. do "C:\Users\CHAIYA~1\AppData\Local\Temp\STD1850_000000.tmp"

. set more off

. mat Alpha_CAPM=(0,9999)

. forvalue i=1(1)20 {
  2.  qui reg r`i' rmrf
  3.  est store capm`i'
  4.  mat beta=e(b)
  5.  sca a_capm`i'=el(beta,1,2)
  6.  mat Alpha_CAPM=(Alpha_CAPM \ `i',a_capm`i')
  7. }

. est table capm*, star(.1 .05 .01) stat(N rss F r2 r2_a)
```

Variable	capm1	capm2	capm3	capm4	capm5	capm6	capm7	capm8	capm9	capm10
rmrf	86.67481***	.33259034	79.458292***	71.566194***	89.883716***	68.863747***	99.202503***	101.10416***	10.99266***	95.818659***
_cons	-.28045261	.02705237	.04241345	.41910739*	.1533913	.2460271*	.06639442	.22738701	.03444878	.15557323
N	120	120	120	120	120	120	120	120	120	120
rss	408.66469	17.49366	608.13953	723.83913	444.17823	259.81331	347.73031	406.34169	95.443848	1155.1959
F	503.19828	.17308485	284.18142	193.68422	497.88063	499.62062	774.68148	688.60011	34.655976	217.55296
r2	.81004455	.00146467	.70660007	.6214117	.80840443	.8089442	.86781399	.85370694	.22702011	.64834165
r2_a	.80843476	-.00699749	.70411363	.61820332	.80678074	.80732509	.86669377	.85246717	.22046943	.64536149

legend: * p<.1; ** p<.05; *** p<.01

Variable	capm11	capm12	capm13	capm14	capm15	capm16	capm17	capm18	capm19	capm20
rmrf	92.431281***	103.15122***	95.215162***	95.059925***	99.733614***	96.735158***	103.90009***	91.703867***	91.012912***	90.702947***
_cons	.19464246	.03145185	.13681104	.17849533	.09946436	.02742681	.03352088	.09933407	.00020766	.04748425
N	120	120	120	120	120	120	120	120	120	120
rss	425.2018	298.82029	273.31705	271.52934	1344.5332	431.54133	2003.3903	368.5193	513.53595	501.25227
F	550.00079	974.67347	907.9584	910.95859	202.50328	593.56291	147.49821	624.64823	441.52533	449.26947
r2	.8233535	.89200799	.88498559	.88532094	.63182904	.83416786	.55555256	.84110916	.78910696	.79198598
r2_a	.8218565	.89109281	.88401089	.88434909	.62870894	.8327625	.55178605	.83976263	.78731973	.79022315

legend: * p<.1; ** p<.05; *** p<.01

```
. mat list Alpha_CAPM

Alpha_CAPM[21,2]
            c1          c2
 r1          0        9999
 r2          1  -.28045261
 r3          2   .02705237
 r4          3   .04241345
 r5          4   .41910739
 r6          5    .1533913
 r7          6    .2460271
 r8          7   .06639442
 r9          8   .22738701
r10          9   .03444878
r11         10   .15557323
r12         11   .19464246
r13         12   .03145185
r14         13   .13681104
r15         14   .17849533
r16         15   .09946436
r17         16   .02742681
r18         17   .03352088
r19         18   .09933407
r20         19   .00020766
r21         20   .04748425
```

```
.
end of do-file

. do "C:\Users\CHAIYA~1\AppData\Local\Temp\STD1850_000000.tmp"

. set more off

. mat Alpha_FF=(0,9999)

. forvalue i=1(1)20 {
  2.  qui reg r`i' rmrf smb hml
  3.  est store ff`i'
  4.  mat beta=e(b)
  5.  sca a_ff`i'=el(beta,1,4)
  6.  mat Alpha_FF=(Alpha_FF \ `i',a_ff`i')
  7. }

. est table ff*, star(.1 .05 .01) stat(N rss F r2 r2_a)
```

Variable	ff1	ff2	ff3	ff4	ff5	ff6	ff7	ff8	ff9	ff10
rmrf	88.458388***	.15618323	75.024622***	61.286991***	82.28291***	65.828077***	99.363511***	99.933834***	12.587241***	88.602574***
smb	-30.483305**	.60757858	1.092207	53.954532***	17.510869	7.0524714	-4.2836123	4.2470385	-7.7456739	28.144644
hml	-29.652027**	.01421362	-16.831267	23.318083	-9.8956295	-3.8808586	-4.5338083	.35644319	-2.8606204	4.5713118
_cons	-.30036799*	.02917021	.09651371	.54137257**	.24517545	.28268096**	.06469084	.24142393	.01544377	.24200303
N	120	120	120	120	120	120	120	120	120	120
rss	394.50442	17.442327	557.60582	576.53565	333.87253	242.26493	347.39698	404.13022	91.799415	1073.6006
F	172.19625	.17068035	105.06507	89.562091	229.82317	178.37712	254.1311	227.08932	13.342101	79.645306
r2	.81662652	.00439475	.73098031	.69845558	.85598462	.82184855	.86794071	.85450312	.25653561	.67318044
r2_a	.8118841	-.02135366	.7240229	.69065701	.85226008	.81724118	.86452538	.85074027	.23730809	.66472821

legend: * p<.1; ** p<.05; *** p<.01

Variable	ff11	ff12	ff13	ff14	ff15	ff16	ff17	ff18	ff19	ff20
rmrf	88.395815***	106.51349***	95.41369***	95.023693***	96.70656***	91.734718***	97.066451***	87.040137***	84.999799***	84.673247***
smb	21.866246	-16.608141	-9.3380346	-6.5211564	32.201686	13.987945	44.444846	14.334871	12.156005	11.773332
hml	9.9841502	-6.3663201	-10.507753	-8.0541036	26.643361	-3.5183434	25.898477	-1.7189686	-9.886029	-10.417874
_cons	.24259989	-.00860432	.13495997	.17933912	.13446597	.08765823	.11427555	.15543046	.07292389	.12042667
N	120	120	120	120	120	120	120	120	120	120
rss	402.73013	282.71843	271.3924	270.18671	1328.344	386.84485	1941.3309	330.98711	441.74976	428.36742
F	192.44011	339.77687	299.90727	300.1817	67.63698	221.44127	51.113897	232.28201	174.47532	178.84575
r2	.83268917	.89782712	.8857955	.885888	.63626209	.85134377	.56932029	.85729155	.81858729	.82223237
r2_a	.82836216	.89518472	.88284194	.88293682	.62685507	.84749921	.55818203	.85360081	.81389558	.81763493

legend: * p<.1; ** p<.05; *** p<.01

```
. mat list Alpha_FF

Alpha_FF[21,2]
            c1          c2
 r1          0        9999
 r2          1  -.30036799
 r3          2   .02917021
 r4          3   .09651371
 r5          4   .54137257
 r6          5   .24517545
 r7          6   .28268096
 r8          7   .06469084
 r9          8   .24142393
r10          9   .01544377
r11         10   .24200303
r12         11   .24259989
r13         12  -.00860432
r14         13   .13495997
r15         14   .17933912
r16         15   .13446597
r17         16   .08765823
r18         17   .11427555
r19         18   .15543046
r20         19   .07292389
r21         20   .12042667
```

```
.
end of do-file

. do "C:\Users\CHAIYA~1\AppData\Local\Temp\STD1850_000000.tmp"

. set more off

. mat Alpha_CH=(0,9999)

. forvalue i=1(1)20 {
  2.  qui reg r`i' rmrf smb hml wml
  3.  est store ch`i'
  4.  mat beta=e(b)
  5.  sca a_ch`i'=el(beta,1,5)
  6.  mat Alpha_CH=(Alpha_CH \ `i',a_ch`i')
  7. }

. est table ch*, star(.1 .05 .01) stat(N rss F r2 r2_a)
```

Variable	ch1	ch2	ch3	ch4	ch5	ch6	ch7	ch8	ch9	ch10
rmrf	88.37442***	.17216893	74.961681***	61.414372***	82.211925***	65.851692***	99.347739***	99.956602***	12.61187***	88.67622***
smb	-30.555228**	.62127126	1.0382938	54.063641***	17.450066	7.0726993	-4.2971215	4.266541	-7.7245783	28.207726
hml	-29.554175**	-.00441541	-16.757917	23.169639	-9.8129059	-3.9083788	-4.5154288	.32990977	-2.8893211	4.4854877
wml	-16.896434	3.2167406	-12.665517	25.632471*	-14.28416	4.7520146	-3.1736513	4.5816182	4.9558586	14.819552
_cons	.71766532	-.16464281	.85962846	-1.0030189	1.1058157	-.00363444	.25590768	-.03462485	-.2831535	-.6508953
N	120	120	120	120	120	120	120	120	120	120
rss	387.65219	17.193972	553.75558	560.76597	328.97529	241.72293	347.15523	403.62639	91.20992	1068.3294
F	130.8052	.54401476	78.862559	69.273695	173.85324	132.99139	189.10684	169.0954	10.170241	59.653079
r2	.81981157	.01857085	.73283787	.70670357	.85809703	.82224711	.8680326	.85468451	.26130981	.67478508
r2_a	.81354415	-.01556582	.72354528	.69650195	.85316128	.8160644	.86344243	.84963006	.23561624	.66347326

legend: * p<.1; ** p<.05; *** p<.01

Variable	ch11	ch12	ch13	ch14	ch15	ch16	ch17	ch18	ch19	ch20
rmrf	88.493872***	106.54016***	95.452446***	95.059483***	96.765085***	91.676764***	97.002536***	87.064702***	84.946218***	84.624416***
smb	21.950238	-16.585297	-9.3048377	-6.4905003	32.251816	13.938304	44.390099	14.355913	12.11011	11.731505
hml	9.8698788	-6.3973991	-10.552918	-8.0958114	26.575159	-3.4508061	25.97296	-1.7475961	-9.8235887	-10.360968
wml	19.731647	5.3665241	7.7987449	7.2018442	11.776732	-11.661906	-12.861352	4.943221	-10.781798	-9.8261046
_cons	-.94625889	-.33194474	-.3349251	-.25458186	-.57509829	.79030403	.88918966	-.14240538	.72254197	.71246294
N	120	120	120	120	120	120	120	120	120	120
rss	393.38536	282.02719	269.93261	268.94182	1325.0152	383.58062	1937.3606	330.40062	438.95963	426.05
F	147.16777	253.32549	224.35281	224.36166	50.489	166.29503	38.141745	173.06729	130.73574	133.85767
r2	.83657138	.89807693	.88640979	.88641377	.63717361	.85259814	.57020108	.85754442	.8197331	.82319408
r2_a	.8308869	.89453178	.88245883	.88246294	.62455357	.84747112	.55525155	.85258944	.81346295	.8170443

legend: * p<.1; ** p<.05; *** p<.01

```
. mat list Alpha_CH

Alpha_CH[21,2]
            c1          c2
 r1          0        9999
 r2          1   .71766532
 r3          2  -.16464281
 r4          3   .85962846
 r5          4  -1.0030189
 r6          5   1.1058157
 r7          6  -.00363444
 r8          7   .25590768
 r9          8  -.03462485
r10          9   -.2831535
r11         10   -.6508953
r12         11  -.94625889
r13         12  -.33194474
r14         13   -.3349251
r15         14  -.25458186
r16         15  -.57509829
r17         16   .79030403
r18         17   .88918966
r19         18  -.14240538
r20         19   .72254197
r21         20   .71246294
```

```
.
end of do-file

. log off
      name:  <unnamed>
       log:  C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 1\AS1 (a-c).smcl
  log type:  smcl
 paused on:  24 Jan 2021, 21:46:38
```

```
  ___  ____  ____  ____  ____(R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/
  Statistics/Data Analysis
```

name:	**<unnamed>**
log:	**C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 1\AS1 (d).smcl**
log type:	**smcl**
opened on:	**27 Jan 2021, 09:50:09**

1 . reg r1 rmrf smb hml wml

Source	SS	df	MS			
Model	1763.719	4	440.92975	Number of obs	=	120
Residual	387.652185	115	3.37088857	F(4, 115)	=	130.81
				Prob > F	=	0.0000
				R-squared	=	0.8198
				Adj R-squared	=	0.8135
Total	2151.37118	119	18.0787494	Root MSE	=	1.836

r1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rmrf	88.37442	4.132204	21.39	0.000	80.18932	96.55952
smb	-30.55523	15.20777	-2.01	0.047	-60.6789	-.4315607
hml	-29.55418	14.55813	-2.03	0.045	-58.39103	-.7173227
wml	-16.89643	11.8509	-1.43	0.157	-40.37078	6.57791
_cons	.7176653	.7344903	0.98	0.331	-.7372186	2.172549

2 . estat dwatson

Durbin-Watson d-statistic(5,   120) = 2.349188

3 . vif

Variable	VIF	1/VIF
smb	11.39	0.087771
hml	10.87	0.092012
rmrf	1.18	0.851025
wml	1.00	0.998808
Mean VIF	6.11	

```
4 . corr rmrf smb hml wml
  (obs=120)

             |     rmrf      smb      hml      wml
-------------+------------------------------------
        rmrf |   1.0000
         smb |   0.3499   1.0000
         hml |  -0.2829  -0.9514   1.0000
         wml |  -0.0237  -0.0314   0.0305   1.0000


5 . log close
      name:  <unnamed>
       log:  C:\Users\Chaiyapong M\Desktop\BE\EE426\Assignment 1\AS1 (d).smcl
  log type:  smcl
 closed on:  27 Jan 2021, 10:09:01
```