

Assignment 1 Review OLS

 $\beta_j = 1$
 γ_1
 < 1

Due 28/1/2021

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

Capital Asset Pricing Model (CAPM) (SLR)

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

Systematic risk
Intercept alpha, risk adjusted return $\Rightarrow$ Return without considering on the risk

Fama & French three-factor Model (FF) (MLR)

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

Carhart four-factor Model (

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

Momentum

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

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. *20 models*
- (b) From FF, determine top 3 mutual fund in term of their performance based on Jensen Alpha. *20 models*
- (c) From Carhart, determine top 3 mutual fund in term of their performance based on Jensen Alpha. *20 models*
- (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?

r_j : excess return on mutual fund j

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

Example do-file command

Loop Command

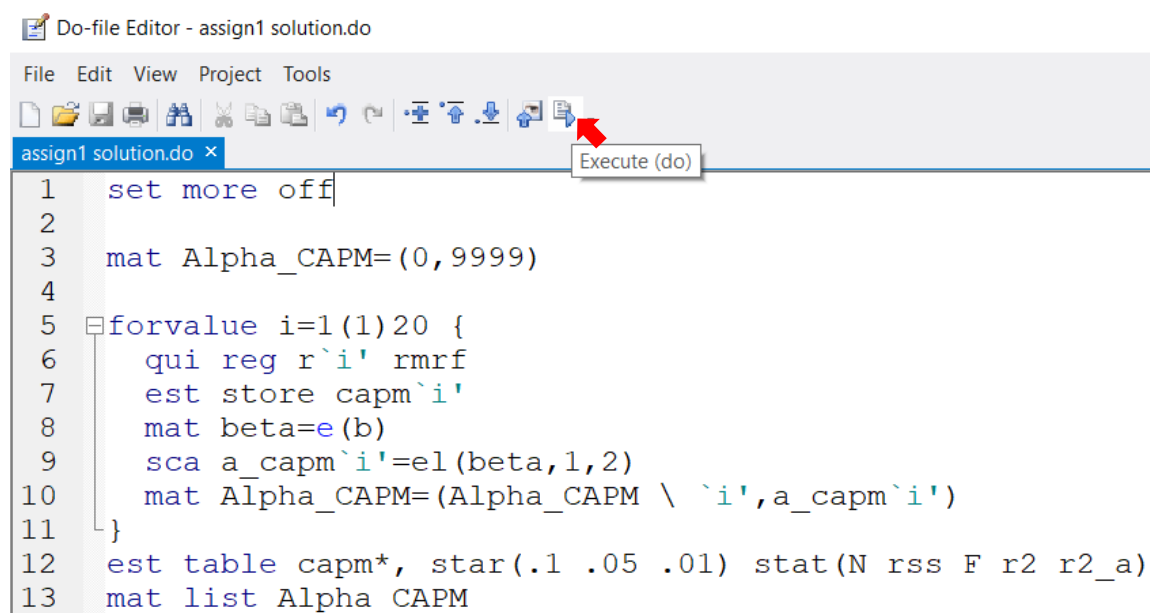
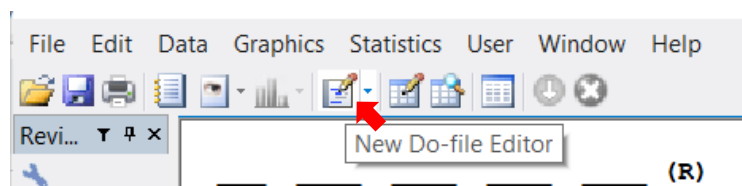
```

set more off
matrix
mat Alpha_CAPM=(0,9999)

forvalue i=1(1)20 {
  quietly qui reg r`i' rmrf
  est store capm`i'
  mat beta=e(b) element
  sca a_capm`i'=e1(beta,1,2)
  scalar 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

```



- (a) From CAPM, determine top 3 mutual fund in term of their performance based on Jensen Alpha. *20 marks*
- (b) From FF, determine top 3 mutual fund in term of their performance based on Jensen Alpha. *20 marks*
- (c) From Carhart, determine top 3 mutual fund in term of their performance based on Jensen Alpha. *20 marks*

(a)
Ans, Top 3
1. mutual fund 4
2. mutual fund 6
3. mutual fund 8

Alpha_CAPM[21,2]		
	c1	c2
r1	0	.9999
r2	1	-.28045261
r3	2	.02705237
r4	3	.04241345
r5	4	.41910739 ¹
r6	5	.1533913
r7	6	.2460271 ²
r8	7	.06639442
r9	8	.22738701
r10	9	.03444878 ³
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

(b)

Alpha_FF[21,2]		
	c1	c2
r1	0	.9999
r2	1	-.30036799
r3	2	.02917021
r4	3	.09651371
r5	4	.54137257 ¹
r6	5	.24517545 ³
r7	6	.28268096 ²
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

Ans,
Top 3
1. mutual fund 4
2. mutual fund 6
3. mutual fund 5

(c)

Alpha_CH[21,2]		
	c1	c2
r1	0	.9999
r2	1	.71766532
r3	2	-.16464281
r4	3	.85962846 ³
r5	4	-1.0030189
r6	5	1.1058157 ¹
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 ²
r19	18	-.14240538
r20	19	.72254197
r21	20	.71246294

Ans,
Top 3
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.

Ans,

2 Multi
95% arts

Carhart

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

Source	SS	df	MS	Number of obs	=	120
Model	1763.719	4	440.92975	F(4, 115)	=	130.81
Residual	387.652185	115	3.37088057	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 -43.15607
hml		-29.55418	14.55813	-2.03	0.045	-58.39103 -71.73227
wml		-16.89643	11.8509	-1.43	0.157	-40.37078 6.57791
_cons		.7176653	.7344903	0.98	0.331	-.7372186 2.172549

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

Multicollinearity exists by looking at the VIF of smb and hml.
(VIF is high)

Autocorrelation does not exist by Durbin-Watson.

By taking adj-R², VIF, durbin watson, and P-values into consideration, Since Carhart has a little higher adj-R² and both has multicollinearity and no autocorrelation, but for the individual significant test, WML seems to be irrelevant in predicting mutual fund 1, Therefore, I choose FF model for mutual fund #1.

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	

FF

```
. reg r1 rmrf smb hml
```

Source	SS	df	MS	Number of obs	=	120
Model	1756.86676	3	585.622255	F(3, 116)	=	172.20
Residual	394.504419	116	3.40090016	Prob > F	=	0.0000
				R-squared	=	0.8166
				Adj R-squared	=	0.8119
Total	2151.37118	119	18.0787494	Root MSE	=	1.8442

	r1	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
rmrf		88.45839	4.150136	21.31	0.000	80.23852 96.67826
smb		-30.48331	15.27524	-2.00	0.048	-60.73783 -43.28763
hml		-29.65263	14.62263	-2.03	0.045	-58.61399 -40.69168
_cons		-.380368	.1729078	-1.74	0.085	-.6428337 .8821577

- (i) r_{1t} has a positive sign with 88.37 as a coefficient.
So, it means that if r_{1t} increase by 1, r_1 should increase by 88.37.
Smb has a negative sign with 30.56 as a coefficient.
So, it means that if Smb increase by 1, r_1 should decrease by 30.56.
hml has a negative sign with 29.55 as a coefficient.
So, it means that if hml increase by 1, r_1 should decrease by 29.55.
wml has a negative sign with 16.90 as a coefficient.
So, it means that if wml increase by 1, r_1 should decrease by 16.90.
 r_1 = excess return on mutual fund 1.
 r_{1t} = excess return on market port folio.
Smb = return on a small-stock portfolio minus the return on a large stock portfolio representing size premium.
hml = return on a value-stock portfolio minus the return on a growth-stock portfolio representing value premium.
wml = return on a winners portfolio minus the return on a losers portfolio representing momentum premium.

(ii) Overall test, with P value = 0, we can say that the Xs are significant and important to predict Y (r₁).

(iii) $R^2 = 0.8198 = 81.98\%$.

(iv) By looking at the P-values individually, with 95% confidence level, only WML proves to be insignificant, while the rest is significant.

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

Ans, In my opinion, Carhart, or (c), is the most appropriated one b/c it also takes r_{wmt} into account. Even if r_{wmt} is insignificant to the equation, having excess variable is better than omitted variable. Because I'm not sure whether r_{wmt} is significant in all of them or not, so I would say keeping it in the equation is the best course of action.