

# FINAL ASSIGNMENT

*by* Student User

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***Assignment-FIN501***

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1

**Part I**

(a) The prices of S&P500 index, the four company stocks are given with rate of return of Treasury bill, in the data sheets. Therefore, firstly, rates of return were calculated in excel sheet itself. then excess return was calculated in Gretl.

(b)

1

1 Summary Statistics, using the observations 2004:04 - 2018:12

Variable	Mean	Median	S.D.	Min	Max
excess_Market	-0.712	-0.456	4.28	-17.4	10.8
excess_Target	-0.796	-0.855	7.03	-19.8	21.3
excess_Cisco	-0.627	-0.258	7.48	-21.7	19.5
excess_BestBuy	-0.395	-1.07	11.2	-41.0	37.2
excess_AMGEN	-0.323	-0.0630	7.35	-19.1	31.2

1

Correlation coefficients, using the observations 2004:04 - 2018:12

5% critical value (two-tailed) = 0.1476 for n = 177

excess_Market	excess_Target	excess_Cisco	excess_BestBuy	excess_AMGEN	
1.0000	0.5315	0.6640	0.5050	0.4610	excess_Market
	1.0000	0.4334	0.4504	0.2050	excess_Target
		1.0000	0.3977	0.2374	excess_Cisco
			1.0000	0.1433	excess_BestBuy
				1.0000	excess_AMGEN

Mean is negative for all three assets and S&P500 index. Rate of return is, usually, below risk free rate in this economy. SD is much higher. This is a dynamic market. So the risk in this economy is also become high. Correlation coefficients shows a positive relation as expected. All excess returns shown to be positively affected on each other.

(c) There are outliers in the graph. To find the outliers a Scatter graph was used. In 2014 there is an outlier in excess\_AMGEN. Other assets and price indices show no outliers. AMGEN has had a huge depreciation in its stock there. But there are two other points which AMGEN gets their stock price increase suddenly. So, AMGEN stock price has lost their price stability. Other assets or Market price index does not show such issue. Therefore, AMGEN has a instability which only affect themselves.

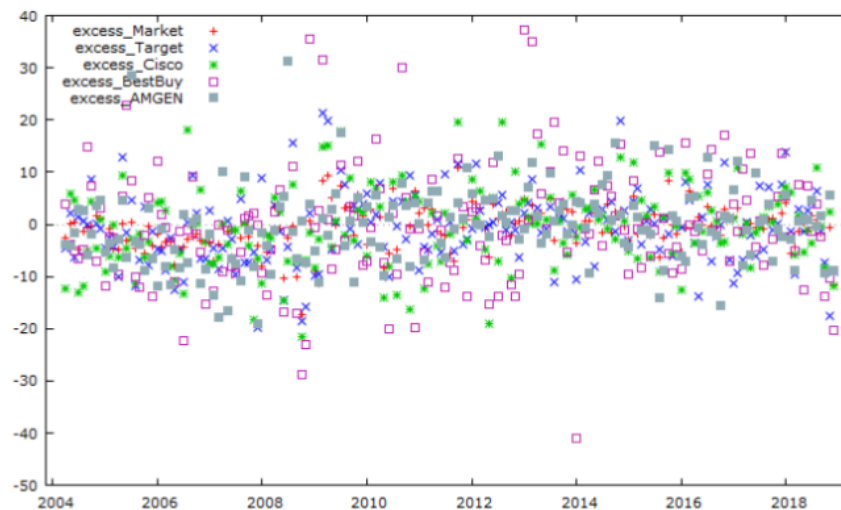


Figure 1 Excess Returns against Time

(d) KPSS test was carried out to determine the stationarity of each excess return. results were as follows.

KPSS test for excess\_Market

$T = 177$   
Lag truncation parameter = 4  
Test statistic = 0.888627

Critical values: 10% 0.349 5% 0.462 1% 0.738  
P-value < .01

KPSS test for excess\_Target

$T = 177$   
Lag truncation parameter = 4  
Test statistic = 0.35069

Critical values: 10% 0.349 5% 0.462 1% 0.738  
Interpolated p-value 0.099

KPSS test for excess\_Cisco

$T = 177$   
Lag truncation parameter = 4  
Test statistic = 0.738465

Critical values are lower than test statistic.

P-value < .01

Null hypothesis is rejected.

Therefore, series is non-stationary.

Two critical values are higher than test statistic.

P-value > .01

Null hypothesis is not rejected.

Therefore, series is stationary.

Critical values are lower than test statistic.

P-value < .01

Null hypothesis is rejected.

Therefore, series is non-stationary.

<sup>2</sup>  
 10%      5%      1%  
 Critical values: 0.349   0.462   0.738  
 P-value < .01  
 -----

KPSS test for excess\_BestBuy

T = 177  
 Lag truncation parameter = 4  
 Test statistic = 0.27386

10%      5%      1%  
 Critical values: 0.349   0.462   0.738  
 P-value > .10  
 -----

KPSS test for excess\_AMGEN

T = 177  
 Lag truncation parameter = 4  
 Test statistic = 0.695217

10%      5%      1%  
 Critical values: 0.349   0.462   0.738  
 Interpolated p-value 0.016

Critical values are higher than test statistic.

P-value > .01

5  
 Null hypothesis is not rejected.

Therefore, series is stationary.

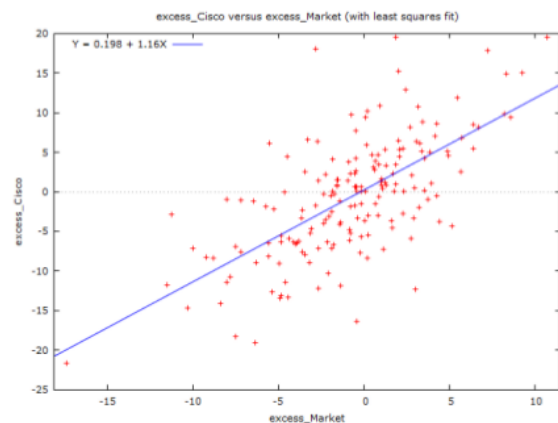
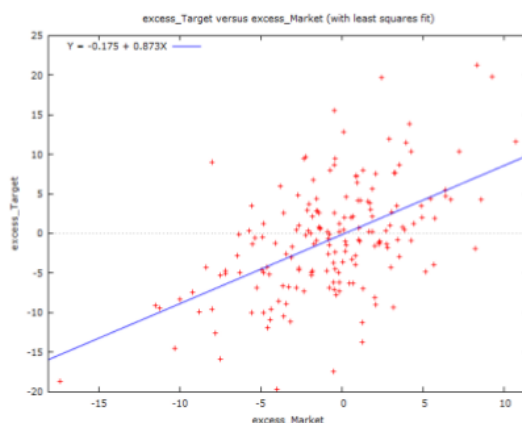
Critical values are lower than test statistic.

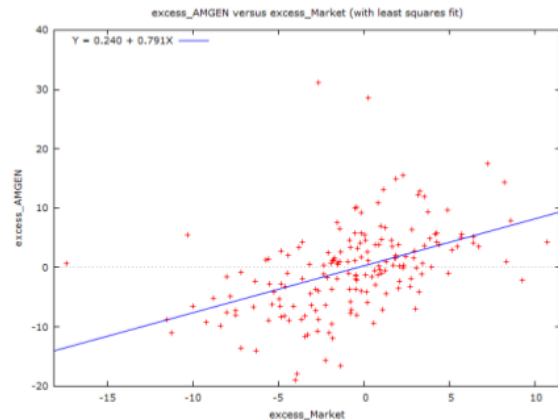
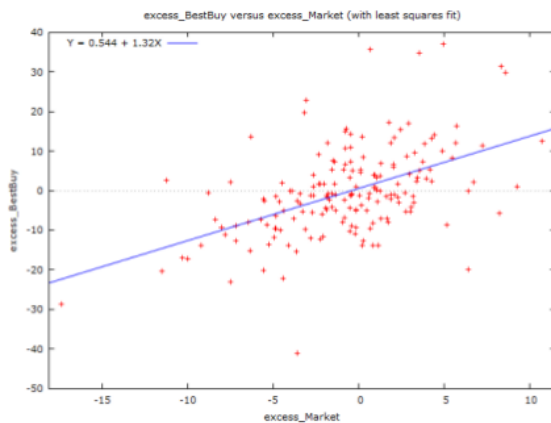
P-value > .01

5  
 Null hypothesis is not rejected.

Therefore, series is stationary.

(e) Scatter plots were implemented by Gretl as follows:





The excess\_Cisco plot, excess\_AMGEN and excess\_BestBuy plots are closely linier. The values are distributed equally in both sides of the line. Other plots has non-linier characters. It seem to be deviate from the line with time at the end.

- (f) Betas were estimated by regressing each asset's excess return on excess return of the market.

Model 3: OLS, using observations 2004:04-2018:12 (T = 177)  
Dependent variable: excess\_Target

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.175044	0.454895	-0.3848	0.7009	
excess_Market	0.872529	0.105104	8.302	<0.0001	***
Mean dependent var	-0.795870	S.D. dependent var		7.027690	
Sum squared resid	6236.417	S.E. of regression		5.969645	
R-squared	0.282541	Adjusted R-squared		0.278441	
F(1, 175)	68.91628	P-value(F)		2.69e-14	
Log-likelihood	-566.3901	Akaike criterion		1136.780	
Schwarz criterion	1143.133	Hannan-Quinn		1139.356	
rho	-0.051544	Durbin-Watson		2.102134	

beta = 0.872529

Model 5: OLS, using observations 2004:04-2018:12 (T = 177)  
Dependent variable: excess\_Cisco

	Coefficient	Std. Error	t-ratio	p-value	
const	0.197820	0.427348	0.4629	0.6440	
excess_Market	1.15991	0.0987390	11.75	<0.0001	***

Mean dependent var	-0.627488	S.D. dependent var	7.478822
Sum squared resid	5503.958	S.E. of regression	5.608136
R-squared	0.440892	Adjusted R-squared	0.437697
F(1, 175)	137.9983	P-value(F)	7.25e-24
Log-likelihood	-555.3331	Akaike criterion	1114.666
Schwarz criterion	1121.018	Hannan-Quinn	1117.242
rho	-0.014877	Durbin-Watson	2.013425

beta = 1.15991

Model 6: OLS, using observations 2004:04-2018:12 (T = 177)

Dependent variable: excess\_BestBuy

	Coefficient	Std. Error	t-ratio	p-value
const	0.543748	0.737882	0.7369	0.4622
excess_Market	1.31950	0.170488	7.740	<0.0001 ***
Mean dependent var	-0.395107	S.D. dependent var	11.18688	
Sum squared resid	16409.13	S.E. of regression	9.683307	
R-squared	0.255003	Adjusted R-squared	0.250746	
F(1, 175)	59.90016	P-value(F)	7.64e-13	
Log-likelihood	-652.0078	Akaike criterion	1308.016	
Schwarz criterion	1314.368	Hannan-Quinn	1310.592	
rho	0.069238	Durbin-Watson	1.856942	

beta = 1.31950

Model 7: OLS, using observations 2004:04-2018:12 (T = 177)

Dependent variable: excess\_AMGEN

	Coefficient	Std. Error	t-ratio	p-value
const	0.240252	0.498090	0.4823	0.6302
excess_Market	0.790937	0.115084	6.873	<0.0001 ***
Mean dependent var	-0.322520	S.D. dependent var	7.345036	
Sum squared resid	7477.018	S.E. of regression	6.536499	
R-squared	0.212541	Adjusted R-squared	0.208041	
F(1, 175)	47.23382	P-value(F)	1.07e-10	
Log-likelihood	-582.4465	Akaike criterion	1168.893	
Schwarz criterion	1175.245	Hannan-Quinn	1171.469	
rho	0.012165	Durbin-Watson	1.975077	

beta = 0.790937

Alpha coefficient(const) are much different from zero. Therefore, Capital Asset Pricing Model is rejected.

- (g) First, the mean of risk free rate should be calculated using summary statistics. It is considered as the risk free rate today.

1

Summary Statistics, using the observations 2004:04 - 2018:12

Variable	Mean	Median	S.D.	Min	Max
RiskFreeRate	1.24	0.248	1.61	0.00300	5.00

1

Summary Statistics, using the observations 2004:04 - 2018:12

Variable	Mean	Median	S.D.	Min	Max
excess_Market	-0.712	-0.456	4.28	-17.4	10.8

1 Hence, risk free rate today is 1.24.

Mean of excess\_Market is -0.71153.

Expected return = Mean rate of returns of the T-bill +  $\beta$  \* Mean excess\_Market

$$\begin{aligned} \text{Eret\_Target} &= 1.24 + 0.872529 * -0.71153 \\ &= 0.619169441 \end{aligned}$$

$$\begin{aligned} \text{Eret\_Cisco} &= 1.24 + 1.15991 * -0.71153 \\ &= 0.414689238 \end{aligned}$$

$$\begin{aligned} \text{Eret\_BestBuy} &= 1.24 + 1.3195 * -0.71153 \\ &= 0.301136165 \end{aligned}$$

$$\begin{aligned} \text{Eret\_AMGEN} &= 1.24 + 0.790937 * -0.71153 \\ &= 0.677224596 \end{aligned}$$

- 1 (h) BestBuy has the greatest firm-specific risk because it has the highest beta value.  
AMGEN has the highest market risk because it has the greatest beta value.

- (i) Here is the R-squared

1  
Model 8: OLS, using observations 2004:04-2018:12 (T = 177)  
Dependent variable: excess\_Market

	9 Coefficient	Std. Error	t-ratio	3 p-value	
const	-0.377861	0.200738	-1.882	0.0615	*
excess_Target	0.117801	0.0336763	3.498	0.0006	***
excess_Cisco	0.245951	0.0310208	7.929	<0.0001	***
excess_BestBuy	0.0786391	0.0206688	3.805	0.0002	***
excess_AMGEN	0.169006	0.0281947	5.994	<0.0001	***
4 Mean dependent var	-0.711525	S.D. dependent var		4.281278	
Sum squared resid	1208.110	S.E. of regression		2.650264	
R-squared	0.625504	Adjusted R-squared		0.616795	



F(4, 172)	71.82101	P-value(F)	1.14e-35
Log-likelihood	-421.1308	Akaike criterion	852.2616
Schwarz criterion	868.1423	Hannan-Quinn	858.7022
rho	0.261843	Durbin-Watson	1.467609

- (j) Regression is linear. The mean of residuals is zero. Homoscedasticity of residuals or equal variance. Residual plot has equal values.

## Part II

Following codes were used for Gretl analysis:

String code table for variable 1 (FundType):

```
1 = 'DE'
2 = 'IE'
3 = 'FI'
```

String code table for variable 5 (MorningstarRank):

```
1 = '2-Star'
2 = '3-Star'
3 = '4-Star'
4 = '5-Star'
```

- (a) Regression between YearAverageReturn and Fund type was used for this purpose.

Model 8: OLS, using observations 1-45  
Dependent variable: YearAverageReturn

	Coefficient	Std. Error	t-ratio	p-value	
const	20.8946	2.75549	7.583	<0.0001	***
FundType	-3.60710	1.51430	-2.382	0.0217	**
Mean dependent var	15.04311	S.D. dependent var	8.807185		
Sum squared resid	3015.073	S.E. of regression	8.373648		
R-squared	0.116572	Adjusted R-squared	0.096028		
F(1, 43)	5.674047	P-value(F)	0.021712		
Log-likelihood	-158.4584	Akaike criterion	320.9167		
Schwarz criterion	324.5301	Hannan-Quinn	322.2637		

$$\text{AveRet} = 21 - 3.6 * \text{FundType}$$

- (b) Aproxymately, yes. But, since there are many differences between 3 types when 2 types get the correct value the other get wrong.
- (c)

Model 11: OLS, using observations 1-45  
Dependent variable: YearAverageReturn

	Coefficient	Std. Error	t-ratio	p-value	
const	-0.701327	5.83724	-0.1201	0.9050	
FundType	0.307721	1.64457	0.1871	0.8525	
NetAssetValue	0.159983	0.0846303	1.890	0.0658	*
ExpenseRatio	11.9192	3.48855	3.417	0.0014	***
Mean dependent var	15.04311	S.D. dependent var		8.807185	
Sum squared resid	2137.720	S.E. of regression		7.220770	
R-squared	0.373640	Adjusted R-squared		0.327809	
F(3, 41)	8.152523	P-value(F)		0.000226	
Log-likelihood	-150.7210	Akaike criterion		309.4419	
Schwarz criterion	316.6686	Hannan-Quinn		312.1360	

FundType should be deleted. It has the heist p-value. The NetAssetValue and ExpenseRatio effects heavily on the 5Year Average Return.

(d)

Model 12: OLS, using observations 1-45  
Dependent variable: YearAverageReturn

	Coefficient	Std. Error	t-ratio	p-value	
const	-2.18298	6.54383	-0.3336	0.7404	
FundType	0.232678	1.66568	0.1397	0.8896	
NetAssetValue	0.156021	0.0857337	1.820	0.0763	*
ExpenseRatio	11.9582	3.52083	3.396	0.0016	***
MorningstarRank	0.645839	1.24291	0.5196	0.6062	
Mean dependent var	15.04311	S.D. dependent var		8.807185	
Sum squared resid	2123.387	S.E. of regression		7.285923	
R-squared	0.377840	Adjusted R-squared		0.315624	
F(4, 40)	6.073028	P-value(F)		0.000646	
Log-likelihood	-150.5696	Akaike criterion		311.1392	
Schwarz criterion	320.1725	Hannan-Quinn		314.5067	

Fund type should be deleted. Secondly, variable MorningStarRank also has a high p-value. It also should be limited. Perfect match is given by ExpenseRatio.

Model 15: OLS, using observations 1-45  
Dependent variable: YearAverageReturn

	Coefficient	Std. Error	t-ratio	p-value	
const	3.16157	6.01040	0.5260	0.6017	
FundType	-1.07846	1.54357	-0.6987	0.4887	
ExpenseRatio	12.6550	3.59727	3.518	0.0011	***
MorningstarRank	0.847002	1.27241	0.6657	0.5094	
Mean dependent var	15.04311	S.D. dependent var		8.807185	
Sum squared resid	2299.194	S.E. of regression		7.488517	
R-squared	0.326328	Adjusted R-squared		0.277035	
F(3, 41)	6.620152	P-value(F)		0.000946	
Log-likelihood	-152.3594	Akaike criterion		312.7188	
Schwarz criterion	319.9454	Hannan-Quinn		315.4128	

New equation will be as follows:

$$\text{YearAverageReturn} = 3.16 - 1.08 * \text{FundType} + 12.66 * \text{ExpenseRatio} + 0.85 * \text{MorningStarRank}$$

$$\begin{aligned} \text{(e) } 5\text{YearAverageReturn} &= 3.16 - 1.08 * 1 + 12.66 * 1.05 + 0.85 * 2 \\ &= 17.073\% \end{aligned}$$

### Part III

- (a) In a data set which has a binary output, such as in this scenario, the Logit model is useful. In the Logit model, it is a function of probability of occurrence of an event. Here, the Logit model gives the natural logarithm of the ratio between the probability of occurrence of the event and the probability of not occurring that event.

$$y = \ln\left(\frac{p}{1-p}\right)$$

Moreover, for the purpose of this analysis, we should develop a relation between two variables of the scenario, namely, "Balance" and "Deposit". For that purpose we can use the output of Logit regression of these variables. By that analysis, a function of below pattern could be implemented.

$$y = \beta_0 + \beta * \text{Balance}$$

- (b) Results of logistic regression are as follows:

Model 8: Logit, using observations 1-50					
Dependent variable: Deposit					
Standard errors based on Hessian					
	Coefficient	Std. Error	z	p-value	
const	-2.63348	0.798549	-3.298	0.0010	***
Balance	0.220181	0.0900181	2.446	0.0144	**

1	Mean dependent var	0.300000	1	S.D. dependent var	0.462910
	McFadden R-squared	0.154867		Adjusted R-squared	0.089386
	Log-likelihood	-25.81307		Akaike criterion	55.62613
	Schwarz criterion	59.45018		Hannan-Quinn	57.08235

Number of cases 'correctly predicted' = 38 (76.0%)  
 f(beta'x) at mean of independent vars = 0.463  
 Likelihood ratio test: Chi-square(1) = 9.4603 [0.0021]

Above results were implemented by logit regression of Balance and Deposit. Success percentage of prediction of values is 76%. It shows a moderately good prediction score. Therefore, we can declare the model is sufficiently fit to data provided. p-value for variable Balance is nearly 0.01. It is lower than 0.05. The balance is sufficiently affected on the Deposit. On these evidence, it is possible to conclude that the model sufficiently fits to the data of variables.

Coefficient and constant of the second function above can be drawn from above regression results. The values in the above red box are the constant and the coefficient of the function between Logit function and Balance, respectively. Therefore, the value of  $\beta_0$  is -2.63. The value of  $\beta$  is 0.220. By using these values, the following formula can be derived.

$$Y = -2.63 + 0.220 * \text{Balance}$$

- (c) The Chi Square statistic is used to test the relationship<sup>10</sup> between categorical variables. Here the Deposit and Balance. In this Chi-Square test, a null hypothesis is that there is no relationship between above variables. Which means they are independent and the Balance is not significant in the variable Deposit. p-value of the Chi-Square statistic can be obtained from the above regression output. p-value of Chi-Square is 0.0021. 5% is the alpha value given. It is less than 0.05. Therefore, the model is significant. There is a statistical relationship between both of these variables. Therefore, they are not independent. Since the p-value of the chi-square statistic is less than 0.05 the relationship is 95% correct.

- (d) Now we have formed a tested equation for "y" as a function of Balance. So, if a value for Balance is given we can easily calculate the value for y.

$$y = -2.63 + 0.220 * \text{Balance}$$

$$y = -2.63 + 0.220 * 10$$

$$y = -0.43$$

Now, The legit equation is transformed as follows:

$$y = \ln\left(\frac{p}{1-p}\right)$$

$$p = \frac{e^y}{1 + e^y}$$

Finally, the value of “y” will be substituted.

$$p = \frac{e^{-0.43}}{1 + e^{-0.43}}$$

$$p = 0.39$$

Therefore, Probability of sign up for promotion is 39% if the average monthly balance is \$1000.

(e)

$$p = 0.50$$

$$y = \ln\left(\frac{p}{1-p}\right)$$

$$y = \ln\left(\frac{0.5}{1-0.5}\right)$$

$$y = \ln(1)$$

$$y = 0$$

$$y = -2.63 + 0.220 * \text{Balance}$$

$$0 = -2.63 + 0.220 * \text{Balance}$$

$$2.63 = 0.220 * \text{Balance}$$

$$\text{Balance} = \frac{2.63}{0.220}$$

$$\text{Balance} = 11.9546$$

Probability of 0.50 can be achieved at an average monthly balance of \$1195.46.

(f)

$$\text{Odds ratio} = \frac{p}{1-p}$$

In scenario of question (g):  $\text{Odds ratio} = 1$

Odds ratio represent the ration between possibilities of occurrence of an event and possibility of not occurring that event. If odds ratio is one, there is an equal possibility of happening and not happening an event.

$$y = \ln\left(\frac{p}{1-p}\right)$$

$$e^y = \frac{p}{1-p}$$

$$\text{Odds ratio} = e^y$$

$$\text{Odds ratio} = e^{-2.63 + 0.220 * \text{Balance}}$$

# FINAL ASSIGNMENT

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