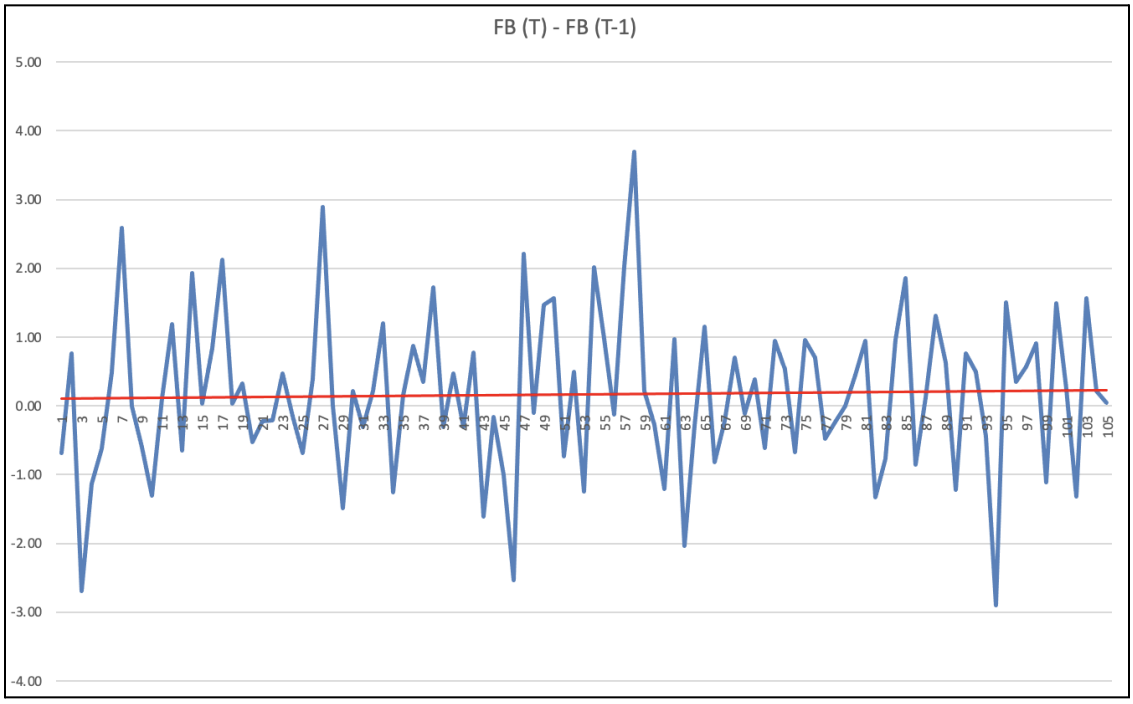
STA380 Time Series Analytics | Homework on Random Walks

Submitted by: Ruchi Sharma [rs58898]

Stan Statman has a $20,000 windfall that he wants to invest in stocks. He has decided to invest part of his windfall in Facebook (symbol: FB) and part in the utility Florida Power and Light (symbol: NEE). The Excel workbook "Stan's stocks.xlsx" on Canvas has the daily closing prices of FB, NEE, and the Standard and Poors 500 Index for a historical time period.

Ques 01: Test whether FB is a RW. Use an appropriate qualitative test for the "L" and "E" conditions and a quantitative test for "I". You must clearly state Yes or No for each condition and explain why you think so.



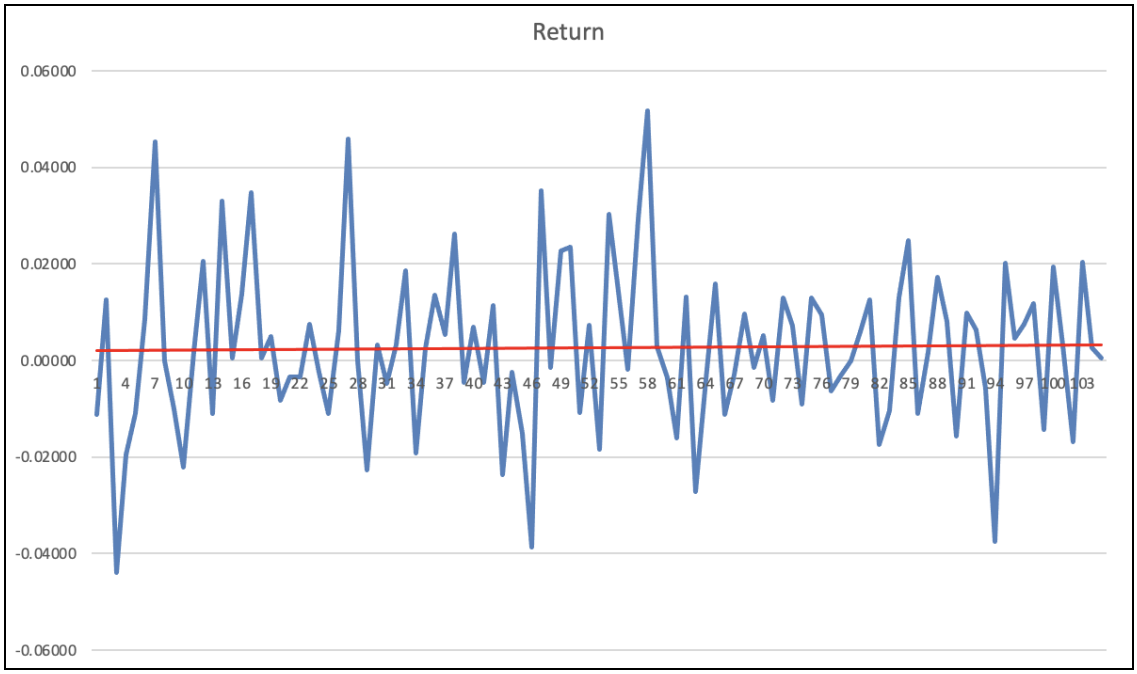
Yes, FB is RW.

To test whether FB is a random walk, we need to check for conditions of random sample, i.e. LIE in FB(T) - FB(T-1). We can see the above plot of differenced time series appears to be leveled and has uniform variations from left to right. So, L & E are satisfied. Further, to verify for I, we run the T Test (table on right), and find that we fail to reject the null hypothesis. Thus, the I condition is also verified. Since, all L, I, and E are satisfied, we can conclude FB is a Random Walk.

Ques 01	
Mean	0.170380952
Std Dev	1.148944268
AutoCorr	-0.072808762
Expected AutoCorr	0.097590007
T-Stat	0.746067797
P-Value	0.455626461

Ques 02: Test whether FB is a GRW. Use an appropriate qualitative test for the "L" and "E" conditions and a quantitative test for "I". You must clearly state Yes or No for each condition and explain why you think so.

Yes, FB is a GRW.



To test whether FB is geometric random walk, we verify log(FB) as a random walk implying that we need to verify the differences in log(FB) as a random sample. For verifying changes in log price, we can simply look at the %age changes or return. Thus, we the plot above we can verify that L & E are satisfied because the data look linear & evenly spread out going from left to right. Further, to check for I we run the T-test as shown on the right. The p-value tells that we fail to reject the null hypothesis which implies that I is satisfied. Thus, we can conclude that FB is a Geometric Random Walk.

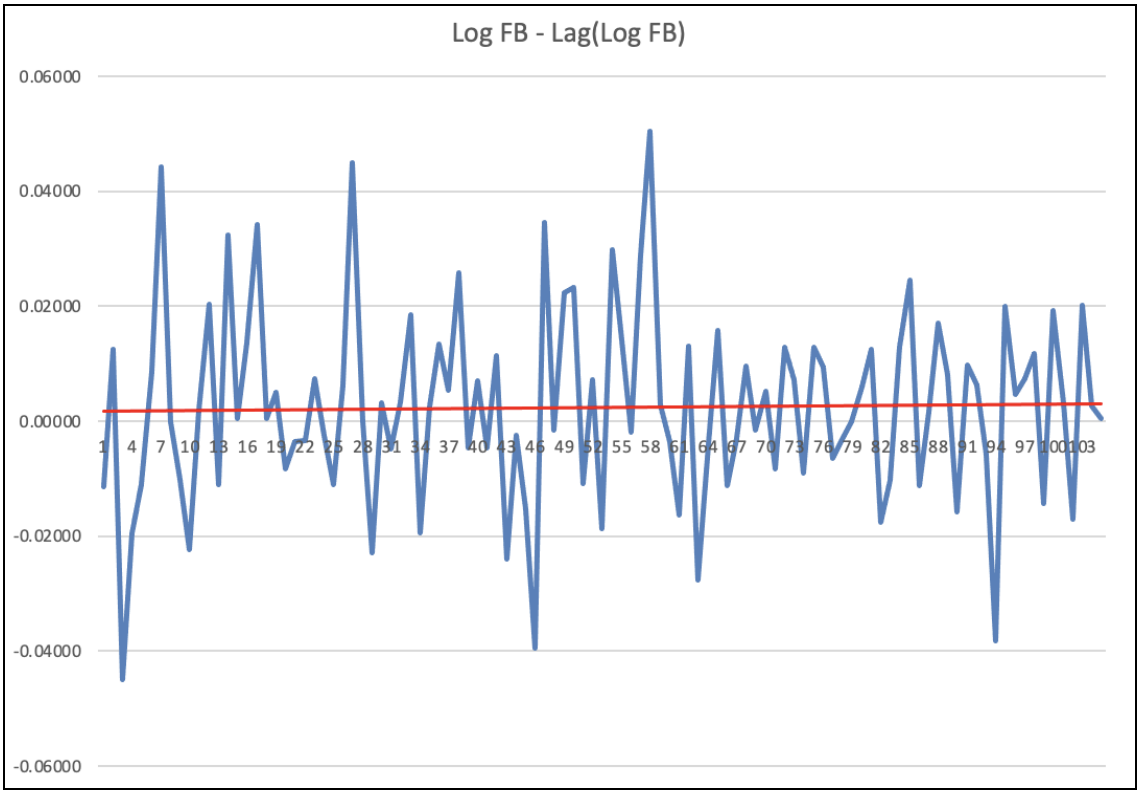
Ques 02	
Mean	0.00259
Std Dev	0.01708735
AutoCorr	-0.0572719
Expected AutoCorr	0.097590007
T-Stat	0.586862343
P-Value	0.557296163

Ques 03: Test whether log(FB) [natural logarithm] is a RW. Use an appropriate qualitative test for the “L” and ”E” conditions and a quantitative test for “I”. You must clearly state Yes or No for each condition and explain why you think so.

Yes, log(FB) is a RW.

To verify whether log(FB) is a random walk, we check if the difference in log(FB) is random sample. From the plot below we can verify the L, E conditions as the plot looks leveled and the also evenly spread out on going left to right. To check for the I condition, we look at the T-Test on the right. The p-value suggests that we fail to reject the null hypothesis, thus I condition is satisfied.

Ques 03	
Mean	0.00244
Std Dev	0.01702546
AutoCorr	-0.057712469
Expected AutoCorr	0.097590007
T-Stat	0.591376829
P-Value	0.554267962



The next three questions explore alternative models for forecasting the price of FB. For each, use the forecast method implied by the definition of each model.

Ques 04: Assume that FB is a RW. Using the RW model, forecast the next price of FB (for October 1, 2014) and provide an approximate 90% confidence interval for your forecast. What fact (if any) do you need to assume or (better) demonstrate [do not actually demonstrate it] in order to have a valid confidence interval?

If FB is a RW, then the difference is a RS. Thus, we forecast FB - FB Lag as the mean. Further, we calculate forecast for next price as $79.21. The 90% confidence interval is (77.32, 81.10). To calculate this 90% confidence interval, the fact one needs to assume is N or normality.

Ques 01	
Mean	0.170380952
Std Dev	1.148944268
AutoCorr	-0.072808762
Expected AutoCorr	0.097590007
T-Stat	0.746067797
P-Value	0.455626461

Ques 4	
FB - FB Lag	0.17038095
FB Lag	79.04
Forecast	79.21038095
Interval	1.89001332
Upper Limit	81.10039427
Lower Limit	77.32036763

Ques 05: Assume that FB is a GRW. Using the GRW model, forecast the next price of FB (for October 1, 2014) and provide an approximate 90% confidence interval for your forecast. What fact (if any) do you need to assume or (better) demonstrate [do not actually demonstrate it] in order to have a valid confidence interval?

If FB is a GRW, then the log difference is a RS. Thus, we forecast return as the mean of previous returns. Further, we calculate forecast for next price as $79.24. The 90% confidence interval is (77.02, 81.46). To calculate this 90% confidence interval, the fact one needs to assume is N or normality.

Ques 02	
Mean	0.00259
Std Dev	0.01708735
AutoCorr	-0.0572719
Expected AutoCorr	0.097590007
T-Stat	0.586862343
P-Value	0.557296163

Ques 5	
Return	0.00259
FB Lag	79.04
Forecast	79.24479528
Interval	2.221710978
Upper Limit	81.46650626
Lower Limit	77.02308431

Ques 06: Assume that log(FB) is a RW. Using the RW model for log(FB), forecast the next price of FB (for October 1, 2014) and provide an approximate 90% confidence interval for your forecast. What fact (if any) do you need to assume or (better) demonstrate [do not actually demonstrate it] in order to have a valid confidence interval?

If log(FB) is a RW, then the log difference is a RS. Thus, we forecast log difference as the mean of previous returns. Further, we calculate forecast for next price as $79.23. The 90% confidence interval is (77.04, 81.28). To calculate this 90% confidence interval, the fact one needs to assume is N or normality.

Ques 03	
Mean	0.00244
Std Dev	0.01702546
AutoCorr	-0.057712469
Expected AutoCorr	0.097590007
T-Stat	0.591376829
P-Value	0.554267962

Ques 6	
Log FB - Log FB Lag	0.00244
Log FB Lag	4.36995
Log FB	4.37240
Forecast	79.23341317
Log Interval	0.028006881
Interval	1.028402761
Log Upper Limit	4.39796
Upper Limit	81.28495421
Log Lower Limit	4.34439
Lower Limit	77.04511909

Calculate the daily returns (daily percentage [or proportion] changes) in FB, FPL, and the S&P 500 index over the time period covered by the data.

Ques 7: Using the method taught in this course, calculate the betas of FB and FPL over the given time period. How does the riskiness of each stock compare with the General Market, as represented by the S&P 500 index? Is there a convincing case that FPL is less risky than the General Market and that FB is riskier than the General Market?

Noting the two regression summaries below:

SUMMARY OUTPUT

Regression of FB vs S&P

Regression Statistics	
Multiple R	0.55692863
R Square	0.31016949
Adjusted R Sq	0.30347211
Standard Erro	0.0142608
Observations	105

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.0094185	0.0094185	46.3120399	6.8413E-10
Residual	103	0.02094716	0.00020337		
Total	104	0.03036566			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.00179376	0.00139663	1.28434278	0.2019033	-0.0009761	0.00456365	-0.0009761	0.00456365
X Variable 1	1.76247585	0.25898596	6.80529499	6.8413E-10	1.24883829	2.27611342	1.24883829	2.27611342

SUMMARY OUTPUT

Regression of FPL vs S&P

Regression Statistics	
Multiple R	0.28948725
R Square	0.08380287
Adjusted R Sq	0.07490775
Standard Erro	0.0089179
Observations	105

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.00074926	0.00074926	9.42122099	0.00274207
Residual	103	0.00819149	7.9529E-05		
Total	104	0.00894075			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.0006376	0.00087338	-0.7300822	0.46699719	-0.0023698	0.0010945	-0.0023698	0.0010945
X Variable 1	0.49710562	0.16195527	3.06940075	0.00274207	0.17590555	0.8183057	0.17590555	0.8183057

Beta for FB = 1.762

Beta for FPL = 0.497

Further, p-values for both regression < 0.05

The betas show us that FB is riskier than the market since it's beta is greater than market beta (i.e. 1). On the other hand, FPL is less risky than the market as it has a beta less than 1.

Test for Beta = 1 for FB	
Std Error	0.25898596
T Stat	2.94408181
p value	0.00323914
Ho: Beta = 1	Reject

Test for Beta = 1 for FPL	
Std Error	0.16195527
T Stat	-3.1051437
p value	0.00190187
Ho: Beta = 1	Reject

Ques 08: Is it believable that the alphas of FB and FPL are both zero?

Looking at the p-value for the intercept estimates in both the regression, it can be concluded that it is believable that alphas (intercept of the regression) are close to zero.

From the regression summary above:
Alpha for FB = 0.0017 (p-value = 0.20)
Alpha for FPL = -0.0006 (p-value = 0.46)

Test for Alpha = 0 for FB	
Std Error	0.00139663
T Stat	1.28434278
p value	0.19902204
Ho: Alpha = 0	Accept

Test for alpha = 0 for FPL	
Std Error	0.00087338
T Stat	-0.7300822
p value	0.46533994
Ho: Alpha = 0	Accept

Stan wonders what the riskiness of his portfolio will be if he invests $10,000 in FB and $10,000 in FPL. Suppose that Stan buys $10,000 of FB and $10,000 of FPL on May 1, 2014. Stan subsequently makes no additions or withdrawals from his account.

Ques 09: Calculate the beta of Stan's portfolio over the given time period. [Hint: You will need to calculate Stan's daily portfolio returns over the given time period, based upon the daily total portfolio value.]

SUMMARY OUTPUT

Regression of Portfolio vs S&P

Regression Statistics	
Multiple R	0.61688808
R Square	0.38055091
Adjusted R Sq	0.37453684
Standard Erro	0.00782066
Observations	105

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.00387018	0.00387018	63.2767787	2.4325E-12
Residual	103	0.00629977	6.1163E-05		
Total	104	0.01016995			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.00057806	0.00076592	0.75472855	0.45213408	-0.000941	0.00209708	-0.000941	0.00209708
X Variable 1	1.12979074	0.14202861	7.95467024	2.4325E-12	0.84811049	1.41147098	0.84811049	1.41147098

Beta for the portfolio = 1.1297
But there is not enough evidence to support that beta is different from 1.

StdError	0.14202861
T Stat	0.91383517
P Value	0.36080346

Ques 10: How much of the volatility of Stan's portfolio value can be attributed to the influence of the General Market? Are you surprised by this – given the corresponding figures for FB and FPL separately?

For this analysis, it is important to look at the R^2 of the individual regressions:

1. Portfolio Vs Market = 38% of the volatility of the portfolio can be attributed to influence of general market.
2. FB Vs Market = 31% of the volatility of the stock can be attributed to influence of general market.
3. FPL Vs Market = 8% of the volatility of the stock can be attributed to influence of general market.

This result is slightly surprising but can be attributed to the fact that one stock in the portfolio is riskier than the market while other is less risky than the market itself. Thus, both the stock complement each other. Looking at the R^2 of the regression, it can be concluded that the portfolio is more explicable by the market than each of the individual stocks.