# Time Series Econometrics

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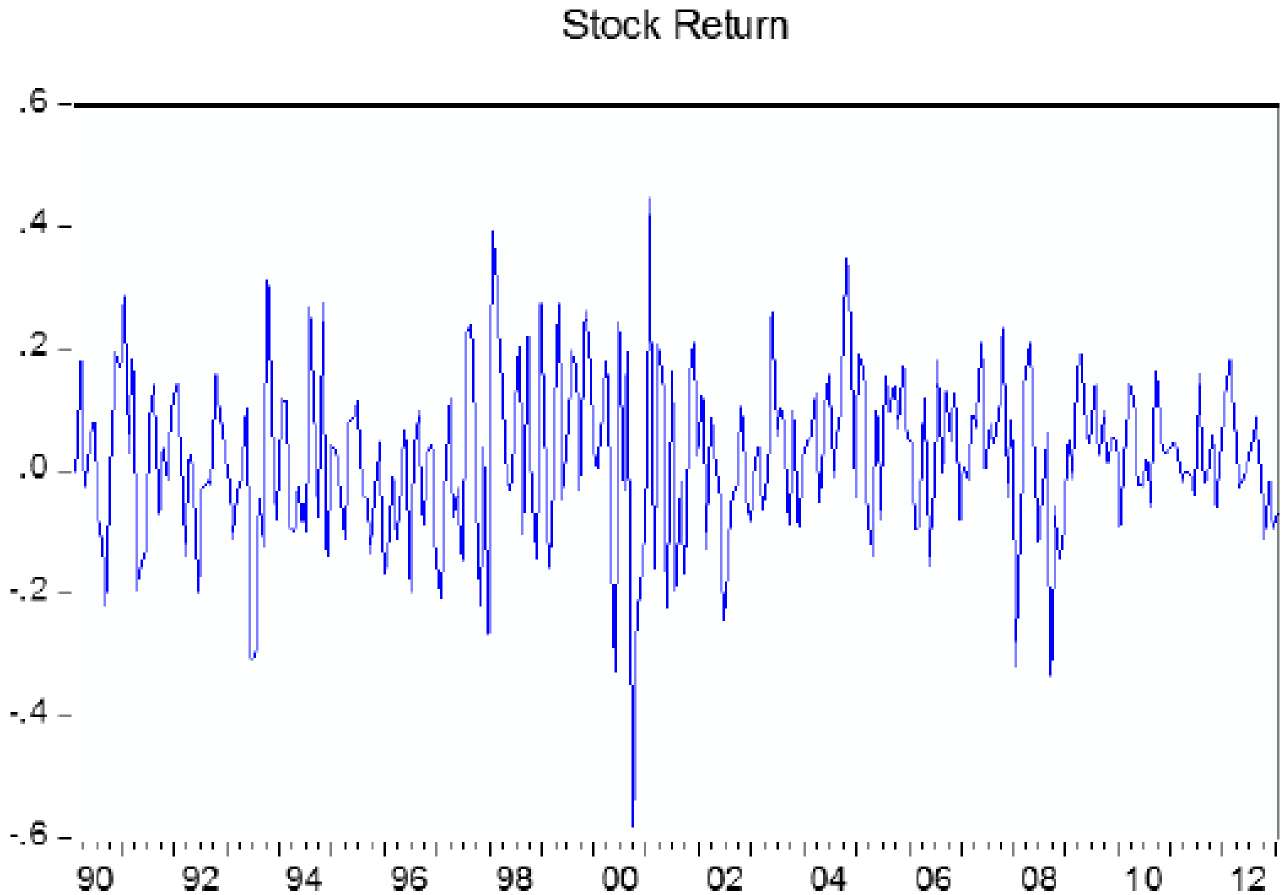
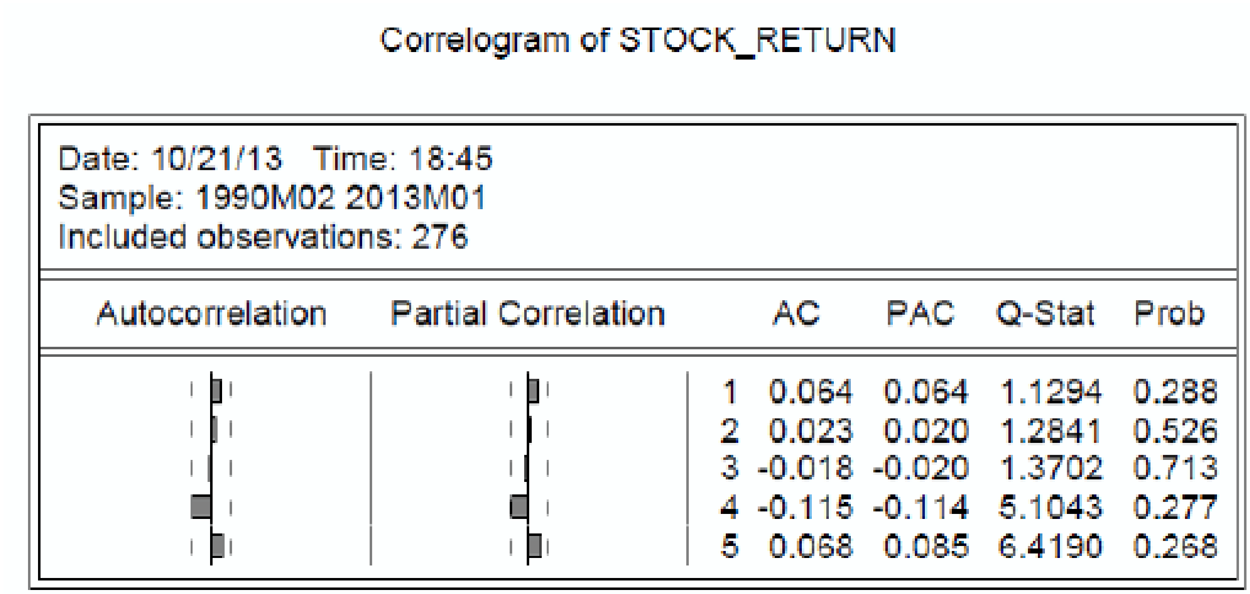
# ECON30401 Class Exercise 2

Semester 1 2016

1. Below is a plot of IBM monthly stock returns from Feb 1991-Jan 2013 with corresponding correlogram up to lag 5, (T=276).



Correlogram of STOCK_RETURN

Date: 10/21/13 Time: 18:45
Sample: 1990M02 2013M01
Included observations: 276

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | 0.064 | 0.064 | 1.1294 | 0.288 |
| | | 2 | 0.023 | 0.020 | 1.2841 | 0.526 |
| | | 3 | -0.018 | -0.020 | 1.3702 | 0.713 |
| | | 4 | -0.115 | -0.114 | 5.1043 | 0.277 |
| | | 5 | 0.068 | 0.085 | 6.4190 | 0.268 |

(a) Comment on the properties of Stock Returns from the graph.

(b) Test at the 5% significance level of the hypothesis that the autocorrelation at lag 4 is equal to zero.

(c) Perform a test at the 10% significance level the hypothesis that the first 5 autocorrelations are jointly equal to zero.

(d) From the evidence in part (a)-(c) comment on the likely form of the underlying process of IBM stock returns.

Below are the estimated output of the MA processes- $Y_t = \varepsilon_t + \theta_1 \varepsilon_{t-1}$ and $Y_t = \varepsilon_t + \theta_2 \varepsilon_{t-4}$.

Dependent Variable: STOCK_RETURN
Method: Least Squares
Date: 10/21/13 Time: 18:42
Sample: 1990M02 2013M01
Included observations: 276
Convergence achieved after 5 iterations
MA Backcast: 1990M01

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.024804 | 0.008720 | 2.844522 | 0.0048 |
| MA(1) | 0.061005 | 0.060330 | 1.011191 | 0.3128 |

| | | | |
|---|---|---|---|
| R-squared | 0.003882 | Mean dependent var | 0.024828 |
| Adjusted R-squared | 0.000246 | S.D. dependent var | 0.136582 |
| S.E. of regression | 0.136565 | Akaike info criterion | -1.136805 |
| Sum squared resid | 5.110136 | Schwarz criterion | -1.110570 |

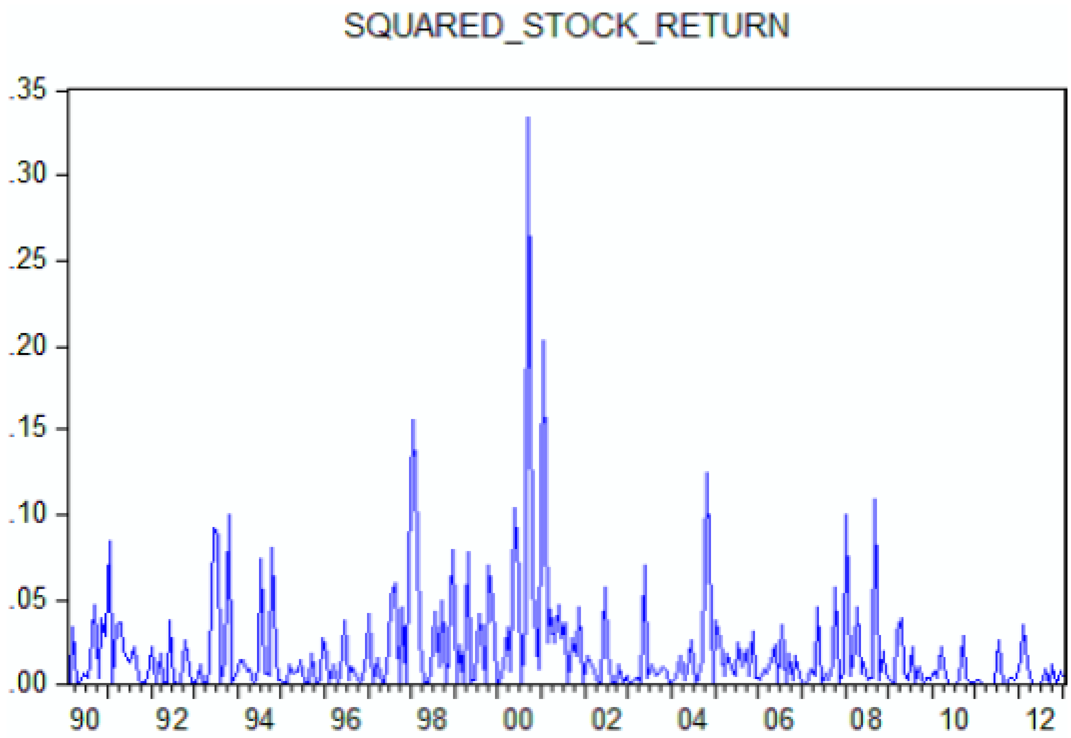
Dependent Variable: STOCK_RETURN
Method: Least Squares
Date: 10/21/13 Time: 18:43
Sample: 1990M02 2013M01
Included observations: 276
Convergence achieved after 5 iterations
MA Backcast: 1989M10 1990M01

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.024953 | 0.007181 | 3.474880 | 0.0006 |
| MA(4) | -0.123749 | 0.060155 | -2.057161 | 0.0406 |

| | | | |
|---|---|---|---|
| R-squared | 0.014377 | Mean dependent var | 0.024828 |
| Adjusted R-squared | 0.010779 | S.D. dependent var | 0.136582 |
| S.E. of regression | 0.135844 | Akaike info criterion | -1.147397 |
| Sum squared resid | 5.056297 | Schwarz criterion | -1.121162 |

(e) Using this estimation output discuss the properties of the true underlying process, performing formal tests. Does this correspond with the discussion in (d)?

2. We now perform a similar analysis as in parts 1 (a)-(e) but for the square of IBM monthly stock returns over the same period.




Correlogram of SQUARED_STOCK_RETURN

Date: 10/21/13 Time: 18:31
Sample: 1990M02 2013M01
Included observations: 276

| Lag | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|
| 1 | 0.144 | 0.144 | 5.7786 | 0.016 |
| 2 | 0.014 | -0.007 | 5.8360 | 0.054 |
| 3 | 0.131 | 0.133 | 10.664 | 0.014 |
| 4 | 0.341 | 0.315 | 43.376 | 0.000 |
| 5 | 0.043 | -0.043 | 43.894 | 0.000 |

(a) Comment on the properties of squared stock returns from the graph.

(b) Test at the 5% significance level the hypothesis that the autocorrelation at lag 4 is equal to zero.

(c) Perform a test at the 10% significance level the hypothesis that the first 5 autocorrelations are jointly equal to zero

(d) From the graph and information in parts (f)-(h) commont on the properties of the theoretical process of the square of IBM stock returns?

Dependent Variable: SQUARED_STOCK_RETURN
Method: Least Squares
Date: 10/21/13 Time: 18:24
Sample: 1990M02 2013M01
Included observations: 276
Convergence achieved after 4 iterations
MA Backcast: 1990M01

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.019186 | 0.002261 | 8.487168 | 0.0000 |
| MA(1) | 0.147673 | 0.059764 | 2.470945 | 0.0141 |

| | | | |
|---|---|---|---|
| R-squared | 0.021141 | Mean dependent var | 0.019204 |
| Adjusted R-squared | 0.017568 | S.D. dependent var | 0.033029 |
| S.E. of regression | 0.032738 | Akaike info criterion | -3.993352 |
| Sum squared resid | 0.293663 | Schwarz criterion | -3.967117 |

Dependent Variable: SQUARED_STOCK_RETURN
Method: Least Squares
Date: 10/21/13 Time: 18:29
Sample: 1990M02 2013M01
Included observations: 276
Convergence achieved after 8 iterations
MA Backcast: 1989M10 1990M01

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.019133 | 0.002730 | 7.009356 | 0.0000 |
| MA(1) | 0.103565 | 0.057614 | 1.797566 | 0.0734 |
| MA(2) | -0.044011 | 0.057688 | -0.762914 | 0.4462 |
| MA(3) | 0.087327 | 0.057746 | 1.512267 | 0.1316 |
| MA(4) | 0.315124 | 0.057642 | 5.466928 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.125990 | Mean dependent var | 0.019204 |
| Adjusted R-squared | 0.113090 | S.D. dependent var | 0.033029 |
| S.E. of regression | 0.031106 | Akaike info criterion | -4.084909 |
| Sum squared resid | 0.262208 | Schwarz criterion | -4.019322 |

(e) Using the estimated output from an MA(1) and MA(4) below discuss the properties of the underlying process, providing formal argument for you answer . Does this correspond with the intuition from part (d)?

3. Suppose a researcher believes the true process is AR(1), i.e

$$Y_t = \mu + \phi_1 Y_{t-1} + \varepsilon_t \tag{1}$$

   (a) If $Cov(\varepsilon_t, \varepsilon_{t-1}) \neq 0$ will OLS applied in (1) provide a consistent estimator of $\phi_1$? Discuss. [No formal proof needed.]

   (b) Suppose $\varepsilon_t$ is a stationary mean zero ARMA(1,1), i.e

$$\varepsilon_t = \gamma_1 \varepsilon_{t-1} + v_t + \kappa_1 v_{t-1} \tag{2}$$

   for some coefficients $\gamma_1, \kappa_1$ where $v_t \sim$ WN $(\sigma^2)$. Given (1) and (2) derive the true form of the process $Y_t$.