Westminster Business School
School of Finance and Accounting
7FNCE044 Predictive Analysis for Decision Making
Semester 2
Week 10
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Seminar Week 10

Q1.

a) Explain the meaning of ARCH and GARCH models showing how each of the two is a form of heteroscedasticity.

b) Explain how we can test for the presence of ARCH effects in a ordinary least squares estimation framework.

c) Explain the meaning of asymmetries in news in the financial markets and provide an appropriate GARCH-type specification that accounts for those effects.

Q2.

(a) Explain what Autoregressive Conditional Heteroskedastic (ARCH) effects are and why they are particularly likely to occur in financial data.

(b) Suppose you wish test for the presence of ARCH effects in a stock market index. Explain how you would conduct a test for the presence of the 4^{th} order ARCH effects.

(c) Using monthly data for y_t, the FTSE100 index, from January 2013 to January 2018, the following set of results were obtained

$$\hat{y}_t = \underset{(0.0002)}{0.0004} - \underset{(0.03)}{0.08} y_{t-1},$$

$$\log(\hat{\sigma}_t^2) = \underset{(0.11)}{-0.792} + \underset{(0.022)}{0.129} \frac{|u_{t-1}|}{\sqrt{\hat{\sigma}_{t-1}^2}} - \underset{(0.02)}{0.233} \frac{u_{t-1}}{\sqrt{\hat{\sigma}_{t-1}^2}} + \underset{(0.01)}{0.93} \log(\hat{\sigma}_{t-1}^2)$$

Values in ( ) are the standard errors of the coefficient estimates and. What is the model being estimated by the conditional variance?

i. What is the interpretation of the estimated value of lagged conditional variance, $\log\left(\hat{\sigma}_{t-1}^2\right)$, 0.93?

ii. With reference to conditional variance equation, if $\sigma_{t-1}^2 = 0.4$, consider that $\hat{u}_{t-1} = 0.2$. Estimate the value of σ_t^2, for a positive and negative unit shocks.

Q3. The graph below plots the daily returns the SP500 from the period from 19/10/1983 to 18/10/1991.The series DLSP500 is log return of daily SP500 index.

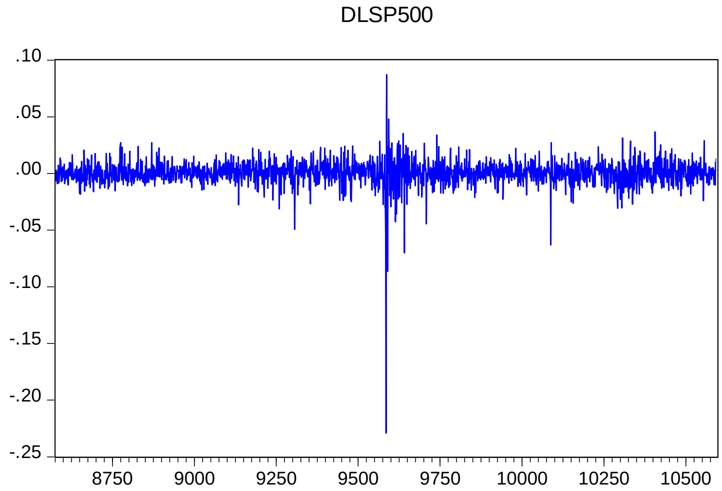

Figure 1

a). Discuss the main statistical challenges in modelling the series above and describe how you would obtain a univariate model of stock returns for forecasting purposes.

b). Consider the results reported in Tables 5a, 5b and 5c. Indicate which model was estimated. Interpret the results. Is the model acceptable?

Table 5a

Dependent Variable: DLSP500
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 11/06/18 Time: 13:42
Sample: 8575 10597
Included observations: 2023
Convergence achieved after 9 iterations
Coefficient covariance computed using QML sandwich with observed Hessian
Presample variance: backcast (parameter = 0.7)
GARCH = C(2) + C(3)*RESID(-1)^2

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000546	0.000223	2.451791	0.0142
Variance Equation				
C	7.99E-05	7.29E-06	10.95440	0.0000
RESID(-1)^2	0.250108	0.099465	2.514545	0.0119

R-squared	-0.000128	Mean dependent var	0.000420
Adjusted R-squared	-0.000128	S.D. dependent var	0.011165
S.E. of regression	0.011165	Akaike info criterion	-6.398049
Sum squared resid	0.252070	Schwarz criterion	-6.389726
Log likelihood	6474.626	Hannan-Quinn criter.	-6.394995
Durbin-Watson stat	1.918355		

Table 5b (use lag 10)

Date: 11/13/18 Time: 12:19
Sample: 8575 10597
Included observations: 2023

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.004	0.004	0.0285	0.866
		2	0.027	0.027	1.5237	0.467
		3	0.169	0.169	59.200	0.000
		4	0.037	0.037	61.988	0.000
		5	0.273	0.272	213.04	0.000
		6	0.084	0.067	227.46	0.000
		7	0.016	0.006	227.98	0.000
		8	0.142	0.061	269.06	0.000
		9	0.058	0.023	276.02	0.000
		10	0.036	-0.045	278.61	0.000

Table 5c

Heteroskedasticity Test: ARCH

F-statistic	0.758246	Prob. F(2,2018)	0.4686
Obs*R-squared	1.517605	Prob. Chi-Square(2)	0.4682

c) Consider the results below (Tables 6a, 6b and 6c). Indicate which model was estimated. Interpret the results. Is the model acceptable?

Table 6a

Dependent Variable: DLSP500
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 11/06/18 Time: 13:56
Sample: 8575 10597
Included observations: 2023
Convergence achieved after 22 iterations
Coefficient covariance computed using QML sandwich with observed Hessian
Presample variance: backcast (parameter = 0.7)
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000688	0.000214	3.212171	0.0013
Variance Equation				
C	6.85E-06	4.63E-06	1.480652	0.1387
RESID(-1)^2	0.118245	0.070566	1.675666	0.0938
GARCH(-1)	0.818748	0.094453	8.668270	0.0000

R-squared	-0.000576	Mean dependent var	0.000420
Adjusted R-squared	-0.000576	S.D. dependent var	0.011165
S.E. of regression	0.011168	Akaike info criterion	-6.502017
Sum squared resid	0.252183	Schwarz criterion	-6.490920
Log likelihood	6580.791	Hannan-Quinn criter.	-6.497945
Durbin-Watson stat	1.917497		

Table 6b (use lag 10)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.027	0.027	1.5129	0.219
		2	-0.009	-0.010	1.6835	0.431
		3	0.005	0.006	1.7447	0.627
		4	-0.007	-0.008	1.8473	0.764
		5	-0.009	-0.008	2.0116	0.848
		6	-0.004	-0.003	2.0399	0.916
		7	-0.018	-0.018	2.6809	0.913
		8	0.004	0.005	2.7215	0.951
		9	0.028	0.028	4.3422	0.887
		10	-0.010	-0.012	4.5553	0.919

Table 6c

Heteroskedasticity Test: ARCH

F-statistic	0.854889	Prob. F(2,2018)	0.4255
Obs*R-squared	1.710871	Prob. Chi-Square(2)	0.4251

Q4. Assume that you have estimated a GJR model of monthly stock returns and you obtain the following equations:

$$y_t = 0.125$$

$$\sigma_t^2 = 1.102 + 0.115u_{t-1}^2 + 0.641\sigma_{t-1}^2 + 0.175u_{t-1}^2 I_{t-1}$$

Suppose that $\sigma_{t-1}^2 = 0.721$, what would be the fitted conditional variance for time t if $\hat{u}_{t-1} = 0.5$ and then if $\hat{u}_{t-1} = -0.5$?

Q5. Using monthly data for y_t, the FTSE100 index, from January 1992 to December 2005, the following set of results were obtained:

$$\hat{y}_t = 0.35,$$
$$(0.10)$$

$$\hat{\sigma}_t^2 = 0.05 + 0.17u_{t-1}^2 + 0.80\sigma_{t-1}^2 - 0.30u_{t-1}^2 I_{t-1}$$
$$(0.002) \quad (0.02) \quad (0.12) \quad (0.10)$$

$$R^2 = 0.70$$

Values in ( ) are the standard errors of the coefficient estimates and $I_{t-1} = 1$ if $u_{t-1} < 0$, $I_{t-1} = 0$ otherwise. σ_{t-1} is the conditional deviation.

i. What role does the final term in the above conditional variance equation serve?
ii. What is the interpretation of the estimated value of lagged conditional variance (σ_{t-1}^2)?

iii. With reference to conditional variance equation, if $\sigma_{t-1}^2 = 0.60$, consider that $\hat{u}_{t-1} = \pm 0.5$. Estimate the value of σ_t^2, for a positive shock (+0.5) and a negative shock (-0.5).