ECOM073: Topics in Financial Econometrics

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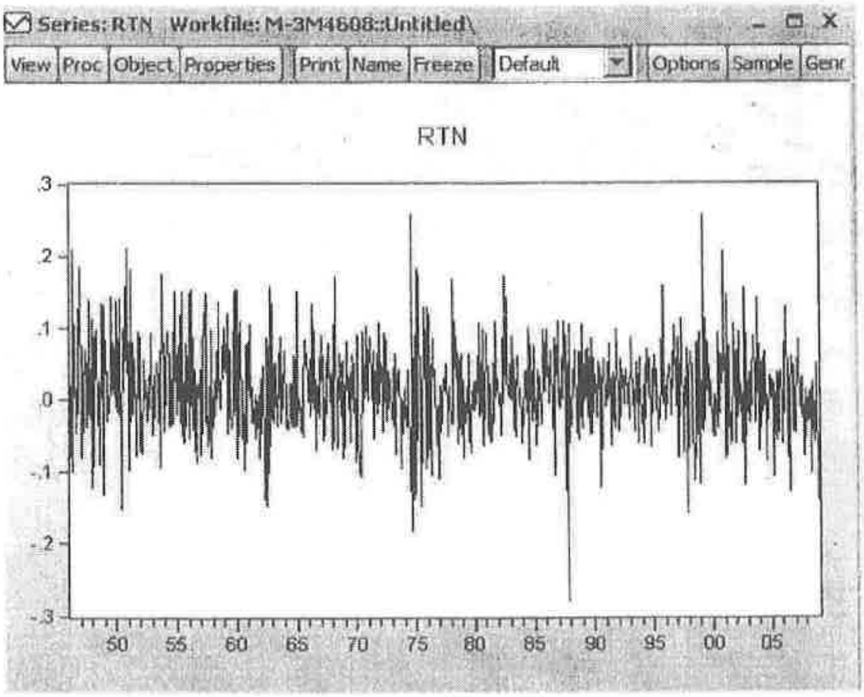
Exercise 8

Problem 1.
Build the model for 3M stock returns



Plot of the series indicates stationary.

The ACF tends to zero fast.

Comparing ACF with $2/\sqrt{N} = 2/\sqrt{755} = 0.0728$, we see that ACF is significant at lag 3

The critical value is approximately 0.072, so we can estimate an AR(3) model.

EViews - [Series: RTN Workfile: M-3M4608::Untitled\]

File Edit Object View Proc Quick Options Add-ins Window Help

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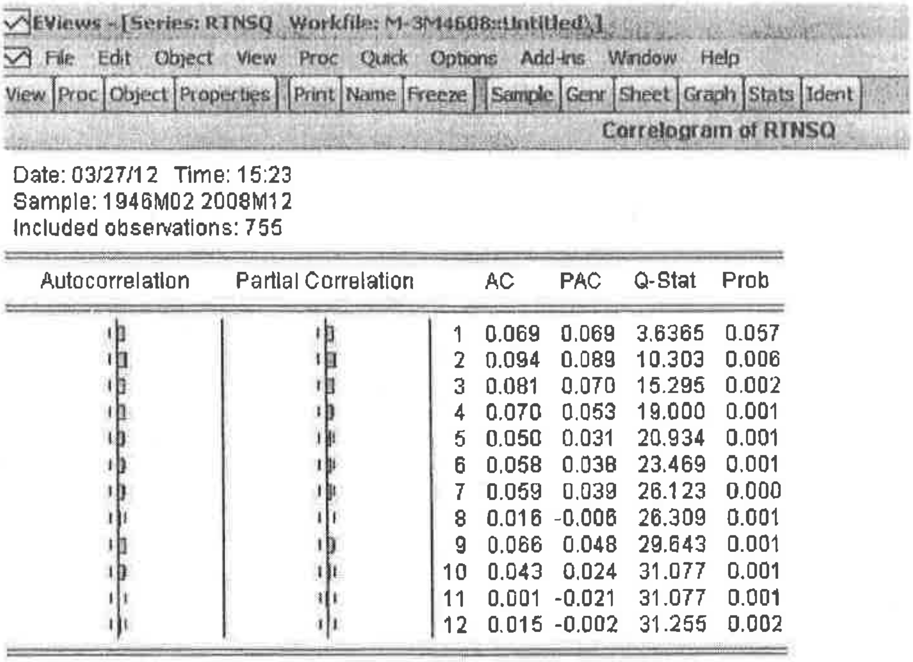
Correlogram of RTN

Date: 03/27/12 Time: 15:21
Sample: 1946M02 2008M12
Included observations: 755

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.061	-0.061	2.7972	0.094
		2	-0.039	-0.043	3.9497	0.139
		3	-0.081	-0.087	8.9643	0.030
		4	-0.002	-0.015	8.9682	0.062
		5	0.015	0.006	9.1301	0.104
		6	0.085	0.080	14.653	0.023
		7	0.011	0.022	14.749	0.039
		8	0.011	0.023	14.838	0.062
		9	-0.030	-0.013	15.530	0.077
		10	-0.084	-0.084	20.926	0.022
		11	0.049	0.037	22.767	0.019
		12	0.089	0.079	28.879	0.004

Now do the analysis on the squared variable.

The ACF of the squares r_t^2 is also significant, which suggest ARCH effect in r_t.



EViews - [Series: RTNSQ Workfile: M-3M4608::Untitled\]

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Correlogram of RTNSQ

Date: 03/27/12 Time: 15:23
Sample: 1946M02 2008M12
Included observations: 755

	AC	PAC	Q-Stat	Prob
1	0.069	0.069	3.6365	0.057
2	0.094	0.089	10.303	0.006
3	0.081	0.070	15.295	0.002
4	0.070	0.053	19.000	0.001
5	0.050	0.031	20.934	0.001
6	0.058	0.038	23.469	0.001
7	0.059	0.039	26.123	0.000
8	0.016	-0.006	26.309	0.001
9	0.066	0.048	29.643	0.001
10	0.043	0.024	31.077	0.001
11	0.001	-0.021	31.077	0.001
12	0.015	-0.002	31.255	0.002

Check for ARCH effects.

Select View then residuals diagnostic then heteroskedasticity test and select ARCH. Leave as lags the default 1.

EViews - [Equation: UNTITLED Workfile: ...]

File Edit Object View Proc Quick Options Add-ins Window Help

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Heteroskedasticity Test: ARCH

F-statistic	7.626335	Prob. F(1,749)	0.0059
Obs*R-squared	7.569625	Prob. Chi-Square(1)	0.0059

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/27/12 Time: 15:40
Sample (adjusted): 1946M06 2008M12
Included observations: 751 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003667	0.000296	12.40272	0.0000
RESID^2(-1)	0.099615	0.036072	2.761582	0.0059

R-squared	0.010079	Mean dependent var	0.004074
Adjusted R-squared	0.008758	S.D. dependent var	0.007053
S.E. of regression	0.007022	Akaike info criterion	-7.076999
Sum squared resid	0.036928	Schwarz criterion	-7.064691
Log likelihood	2659.413	Hannan-Quinn criter.	-7.072257
F-statistic	7.626335	Durbin-Watson stat	1.996436
Prob(F-statistic)	0.005893		

The null hypothesis in test for ARCH effect is that all the coefficients are 0.
If we accept the null then the series r_t has no ARCH effect.
p-value 0.0059 indicates that we should reject the null hypothesis in favor of the presence of a ARCH effect.

EViews - [Equation: UNTITLED Workfile: M-3M4608::Untitled\]

File Edit Object View Proc Quick Options Add-ins Window Help

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: RTN
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 03/27/12 Time: 16:45
Sample (adjusted): 1946M05 2008M12
Included observations: 752 after adjustments
Convergence achieved after 11 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(5) + C(6)*RESID(-1)^2 + C(7)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.012347	0.001856	6.651889	0.0000
AR(1)	-0.064148	0.039059	-1.642326	0.1005
AR(2)	-0.035085	0.036718	-0.955502	0.3393
AR(3)	-0.083262	0.038056	-2.187909	0.0287
		Variance Equation		
C	0.000522	0.000247	2.119066	0.0341
RESID(-1)^2	0.072099	0.024305	2.966379	0.0030
GARCH(-1)	0.787392	0.075777	10.52287	0.0000

R-squared	0.013190	Mean dependent var	0.012662
Adjusted R-squared	0.009232	S.D. dependent var	0.064419
S.E. of regression	0.064121	Akaike info criterion	-2.677443
Sum squared resid	3.075446	Schwarz criterion	-2.634412
Log likelihood	1013.719	Hannan-Quinn criter.	-2.660864
Durbin-Watson stat	1.977026		

Inverted AR Roots	.18+.40i	.18-.40i	-.43

Model fitting: we fit the model

$$r_t = c + \phi_1 r_{t-1} + \phi_2 r_{t-2} + \phi_3 r_{t-3} + e_t, \quad e_t = \varepsilon_t \sigma_t \qquad GARCH$$

$$\sigma_t^2 = c + \alpha e_{t-1}^2 + \beta \sigma_{t-1}^2.$$

Graphs shows that parameter ϕ_1 and ϕ_2 are not significant. We drop them and re-estimate the model.

EViews - [Equation: UNTITLED Workfile: M-3M4608::Untitled\]

File Edit Object View Proc Quick Options Add-ins Window Help

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: RTN
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 03/27/12 Time: 16:47
Sample (adjusted): 1946M05 2008M12
Included observations: 752 after adjustments
Convergence achieved after 10 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.012369	0.002007	6.161609	0.0000
AR(3)	-0.080255	0.037956	-2.114426	0.0345
		Variance Equation		
C	0.000562	0.000254	2.211802	0.0270
RESID(-1)^2	0.075242	0.024762	3.038554	0.0024
GARCH(-1)	0.785081	0.077603	10.11661	0.0000

R-squared	0.006681	Mean dependent var	0.012662
Adjusted R-squared	0.005357	S.D. dependent var	0.064419
S.E. of regression	0.064247	Akaike info criterion	-2.678153
Sum squared resid	3.095731	Schwarz criterion	-2.647417
Log likelihood	1011.986	Hannan-Quinn criter.	-2.666311
Durbin-Watson stat	2.096852		

Inverted AR Roots	.22+.37i	.22-.37i	-.43

So the equation looks like:

$$rtn = 0.012369 - 0.080255 rtn_{t-3} + \varepsilon_t$$
$$\sigma_t^2 = 0.000562 + 0.075242 u_{t-1}^2 + 0.785081 \sigma_{t-1}^2$$

The coefficients of the lagged squared residuals and the lagged conditional variance terms are highly statistically significant. In addition, the sum of the two coefficients is generally taken as an indicator of persistence. Since their sum is 0.86, we can say that shocks to the conditional variance will be highly persistent.

Residual check. Now we need to check for residuals. Are they i.i.d.?

EViews - [Equation: UNTITLED Workfile: M-3M4608::Untitled\]

File Edit Object View Proc Quick Options Add-ins Window Help

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Correlogram of Standardized Residuals

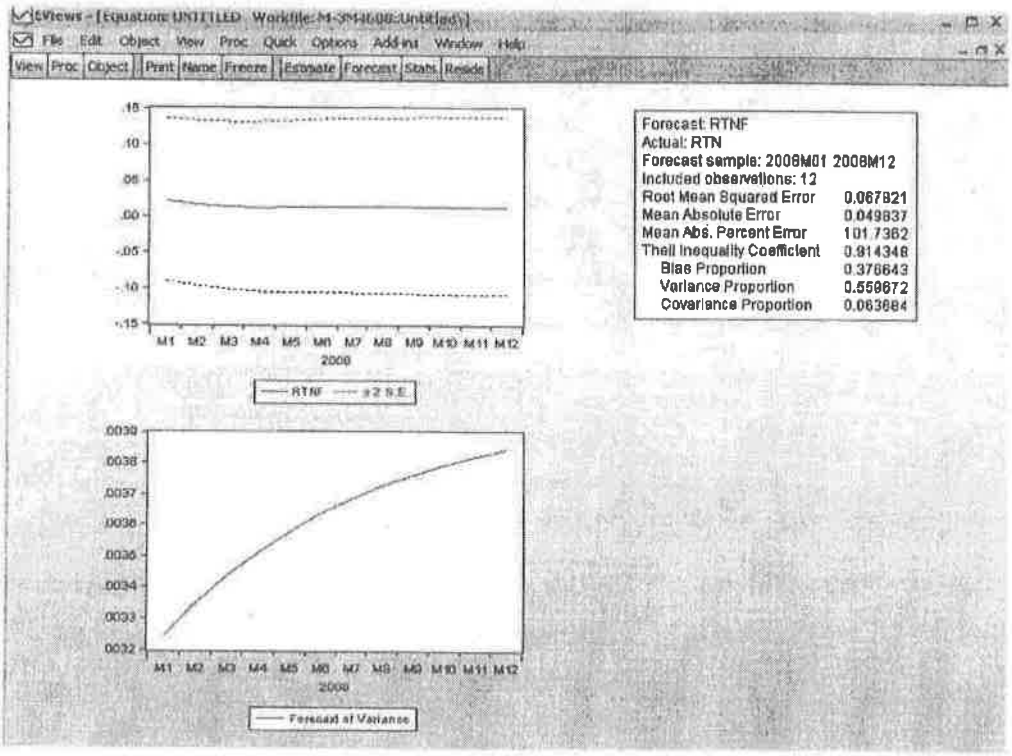
Date: 03/27/12 Time: 16:49
Sample: 1946M05 2008M12
Included observations: 752
Q-statistic probabilities adjusted for 1 ARMA term(s)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.046	-0.046	1.6319	
		2	-0.028	-0.030	2.2137	0.137
		3	0.012	0.009	2.3221	0.313
		4	-0.008	-0.008	2.3694	0.499
		5	0.030	0.030	3.0351	0.552
		6	0.074	0.076	7.1496	0.210
		7	0.009	0.018	7.2142	0.301

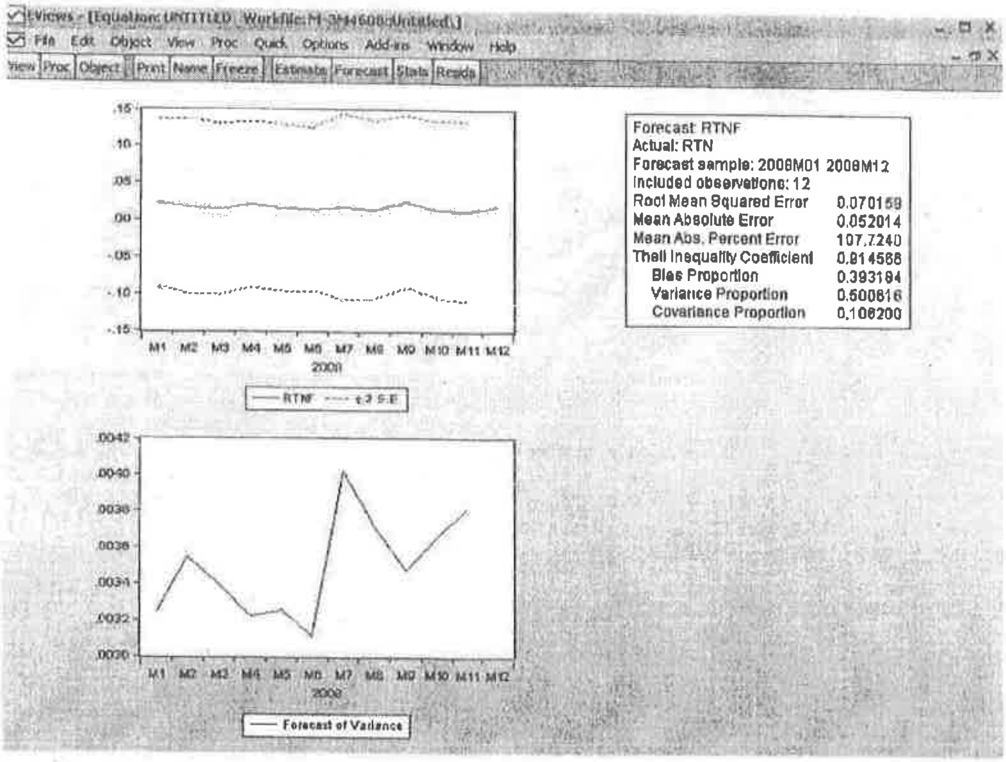
Residuals from a white noise process indeed.

Forecast:

Estimate the equation on the sample till 2007 and then forecast the last year with a one-step ahead forecast. We get.
For the dynamic.



For the static:



Problem 2 . The below graph gives summary statistics of time series w_t. Discuss it. Justify your conclusions.

- Mean -0.000202 is not significant at 5% significance level since $|0.000202| < 2SD = 2(0.045855)$
- Skewness -0.458048 is significant at 5% significance level since

$$\left|\frac{\hat{S}(X)}{\sqrt{6/N}}\right| = \frac{0.458048}{(6/131)^{0.5}} = 2.14 > 2.$$

- Excess kurtosis $K(X) - 3 = 5.551 - 3 = 3.551$ is significant at 5% significance level since

$$\left|\frac{\hat{K}(X) - 3}{\sqrt{24/N}}\right| = \frac{3.551}{(24/131)^{0.5}} = 8.29 > 2.$$

- Distribution of w_t is not normal since p-value of Jargue-Bera test is 0.00000