Practical 4
Note for Eview 9

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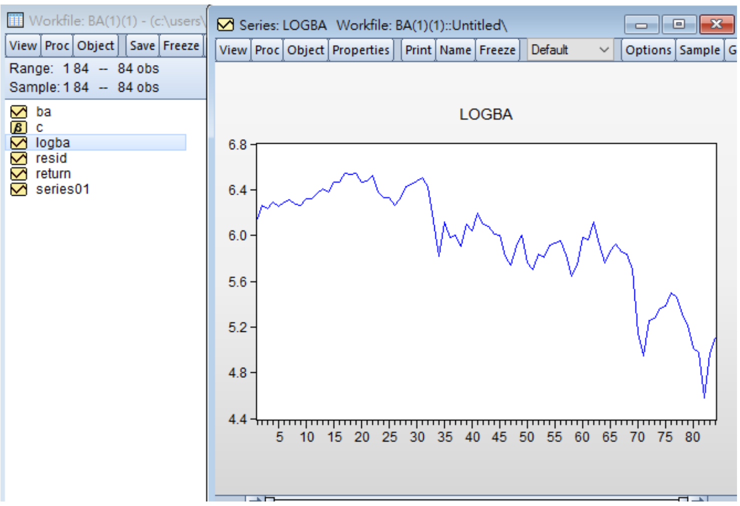
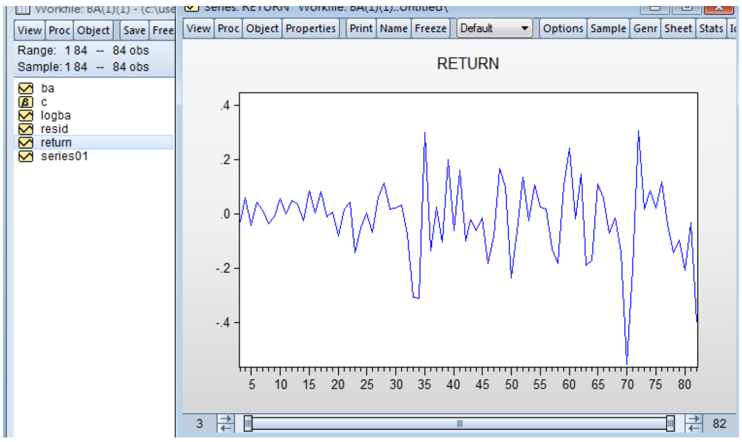
Financial Modelling and Business Forecasting
2016/2017

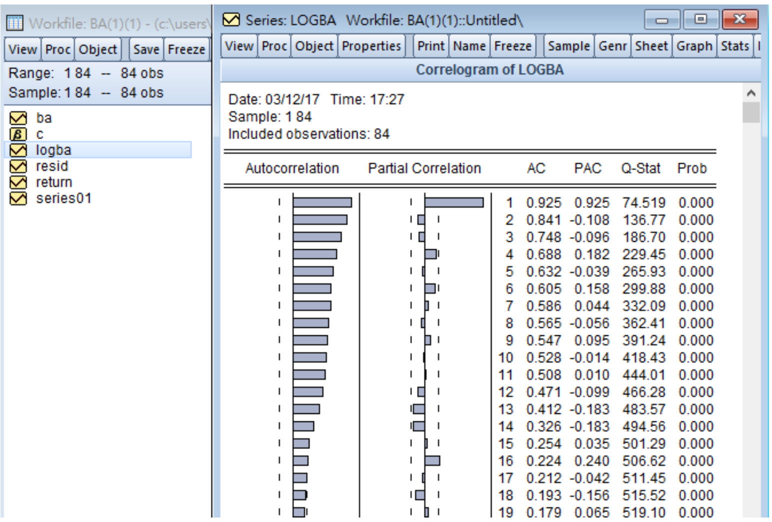
AR Modelling (Dataset: BA)

1. Can Graphics Function suggest a preferred model for the price of British Airways?





Now we look at ACF/PACF plot.


Series: LOGBA Workfile: BA(1)(1)::Untitled\

Correlogram of LOGBA

Date: 03/12/17 Time: 17:27
Sample: 1 84
Included observations: 84

	AC	PAC	Q-Stat	Prob
1	0.925	0.925	74.519	0.000
2	0.841	-0.108	136.77	0.000
3	0.748	-0.096	186.70	0.000
4	0.688	0.182	229.45	0.000
5	0.632	-0.039	265.93	0.000
6	0.605	0.158	299.88	0.000
7	0.586	0.044	332.09	0.000
8	0.565	-0.056	362.41	0.000
9	0.547	0.095	391.24	0.000
10	0.528	-0.014	418.43	0.000
11	0.508	0.010	444.01	0.000
12	0.471	-0.099	466.28	0.000
13	0.412	-0.183	483.57	0.000
14	0.326	-0.183	494.56	0.000
15	0.254	0.035	501.29	0.000
16	0.224	0.240	506.62	0.000
17	0.212	-0.042	511.45	0.000
18	0.193	-0.156	515.52	0.000
19	0.179	0.065	519.10	0.000

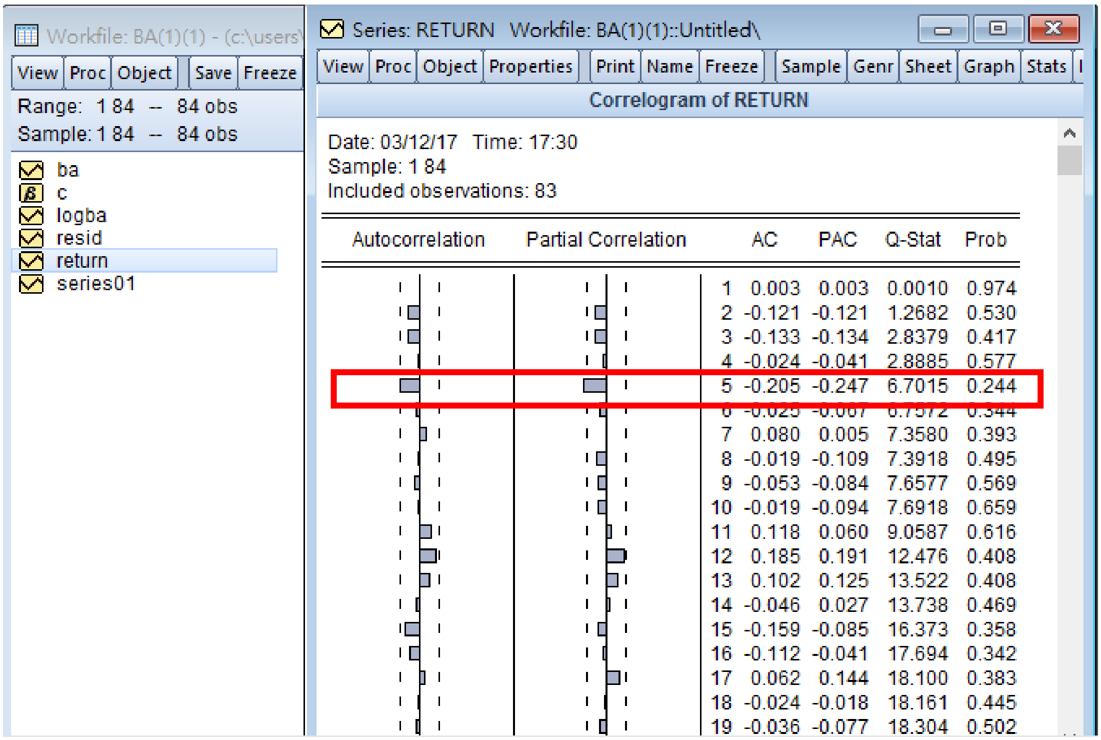
MA(∞), AR(1)➔Non-stationary

2. Constructing the model for price of BA.

Using **Box-Jenkins** approach

The first step is **Identification**

Now we look at return



Series: RETURN Workfile: BA(1)(1)::Untitled\

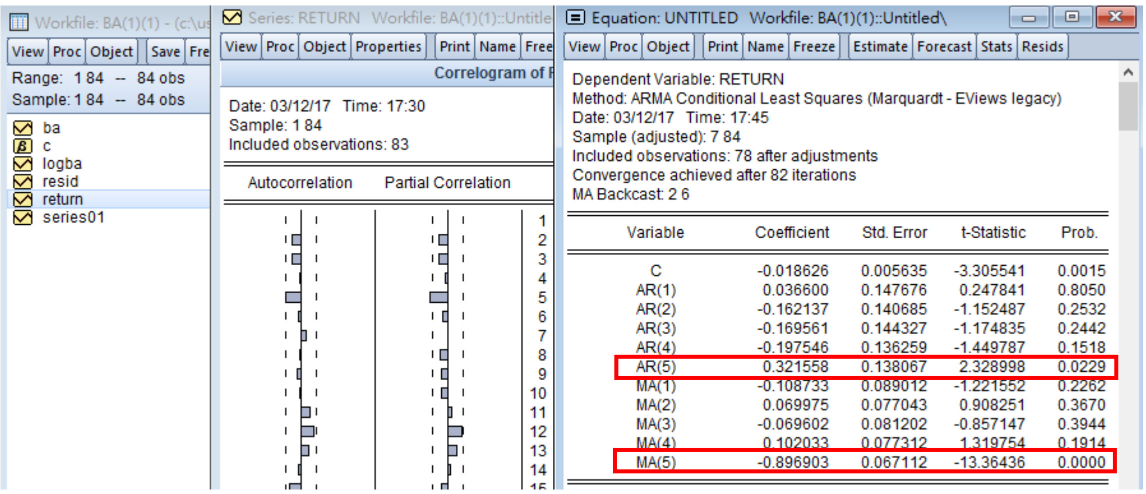
Correlogram of RETURN

Date: 03/12/17 Time: 17:30
Sample: 1 84
Included observations: 83

	AC	PAC	Q-Stat	Prob
1	0.003	0.003	0.0010	0.974
2	-0.121	-0.121	1.2682	0.530
3	-0.133	-0.134	2.8379	0.417
4	-0.024	-0.041	2.8885	0.577
5	-0.205	-0.247	6.7015	0.244
6	-0.025	-0.067	6.7572	0.344
7	0.080	0.005	7.3580	0.393
8	-0.019	-0.109	7.3918	0.495
9	-0.053	-0.084	7.6577	0.569
10	-0.019	-0.094	7.6918	0.659
11	0.118	0.060	9.0587	0.616
12	0.185	0.191	12.476	0.408
13	0.102	0.125	13.522	0.408
14	-0.046	0.027	13.738	0.469
15	-0.159	-0.085	16.373	0.358
16	-0.112	-0.041	17.694	0.342
17	0.062	0.144	18.100	0.383
18	-0.024	-0.018	18.161	0.445
19	-0.036	-0.077	18.304	0.502

We guess the appropriate model is ARMA(5, 5).

The second step is **Estimation**.



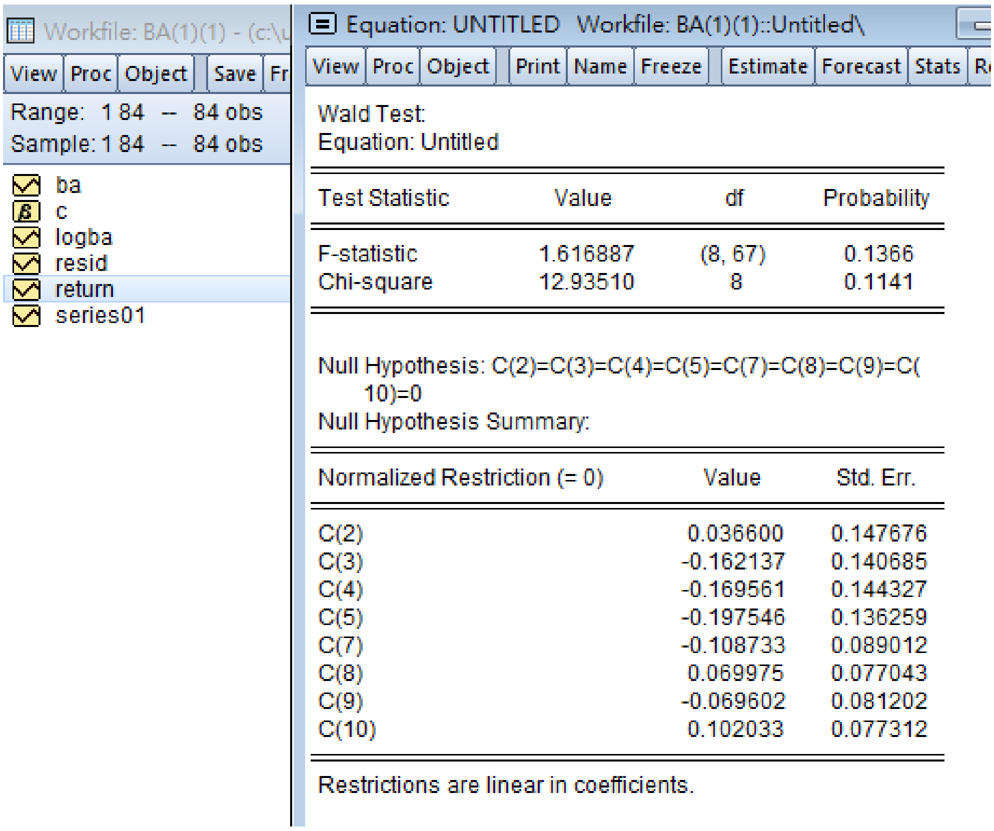
Equation: UNTITLED Workfile: BA(1)(1)::Untitled\

Dependent Variable: RETURN
Method: ARMA Conditional Least Squares (Marquardt - EViews legacy)
Date: 03/12/17 Time: 17:45
Sample (adjusted): 7 84
Included observations: 78 after adjustments
Convergence achieved after 82 iterations
MA Backcast: 2 6

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.018626	0.005635	-3.305541	0.0015
AR(1)	0.036600	0.147676	0.247841	0.8050
AR(2)	-0.162137	0.140685	-1.152487	0.2532
AR(3)	-0.169561	0.144327	-1.174835	0.2442
AR(4)	-0.197546	0.136259	-1.449787	0.1518
AR(5)	0.321558	0.138067	2.328998	0.0229
MA(1)	-0.108733	0.089012	-1.221552	0.2262
MA(2)	0.069975	0.077043	0.908251	0.3670
MA(3)	-0.069602	0.081202	-0.857147	0.3944
MA(4)	0.102033	0.077312	1.319754	0.1914
MA(5)	-0.896903	0.067112	-13.36436	0.0000

3. Process the diagnostic steps to test the fitness of the model built up in question 2

Using **Wald test**



Workfile: BA(1)(1) - (c:\u

View | Proc | Object | Save | Fr

Range: 1 84 -- 84 obs
Sample: 1 84 -- 84 obs

ba
c
logba
resid
return
series01

Equation: UNTITLED Workfile: BA(1)(1)::Untitled\

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

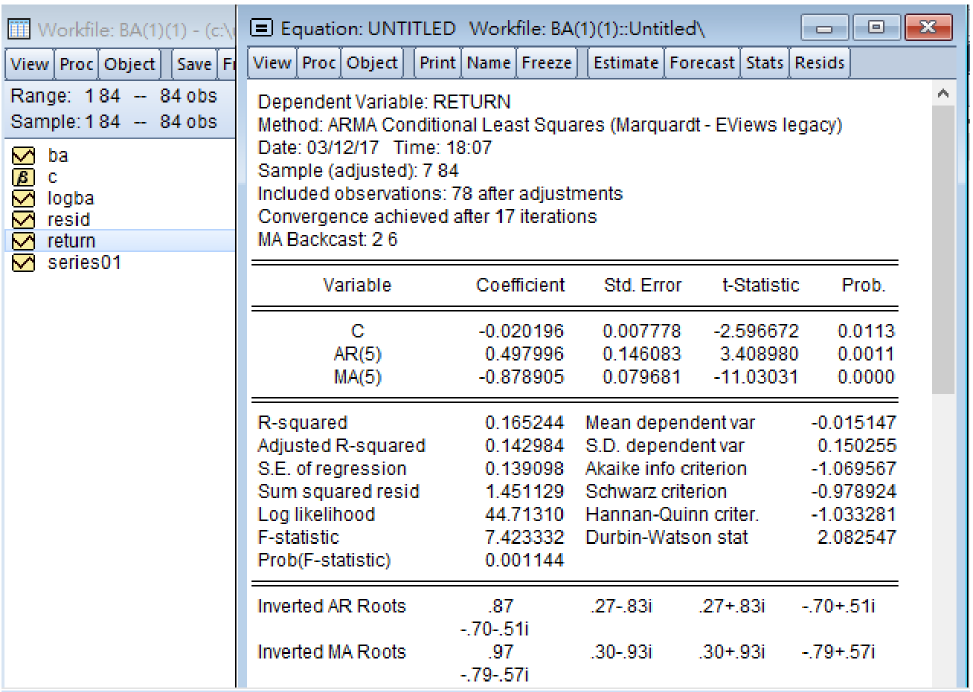
Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.616887	(8, 67)	0.1366
Chi-square	12.93510	8	0.1141

Null Hypothesis: C(2)=C(3)=C(4)=C(5)=C(7)=C(8)=C(9)=C(10)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	0.036600	0.147676
C(3)	-0.162137	0.140685
C(4)	-0.169561	0.144327
C(5)	-0.197546	0.136259
C(7)	-0.108733	0.089012
C(8)	0.069975	0.077043
C(9)	-0.069602	0.081202
C(10)	0.102033	0.077312

Restrictions are linear in coefficients.



Workfile: BA(1)(1) - (c:\

View | Proc | Object | Save | Fi

Range: 1 84 -- 84 obs
Sample: 1 84 -- 84 obs

ba
c
logba
resid
return
series01

Equation: UNTITLED Workfile: BA(1)(1)::Untitled\

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

Dependent Variable: RETURN
Method: ARMA Conditional Least Squares (Marquardt - EViews legacy)
Date: 03/12/17 Time: 18:07
Sample (adjusted): 7 84
Included observations: 78 after adjustments
Convergence achieved after 17 iterations
MA Backcast: 2 6

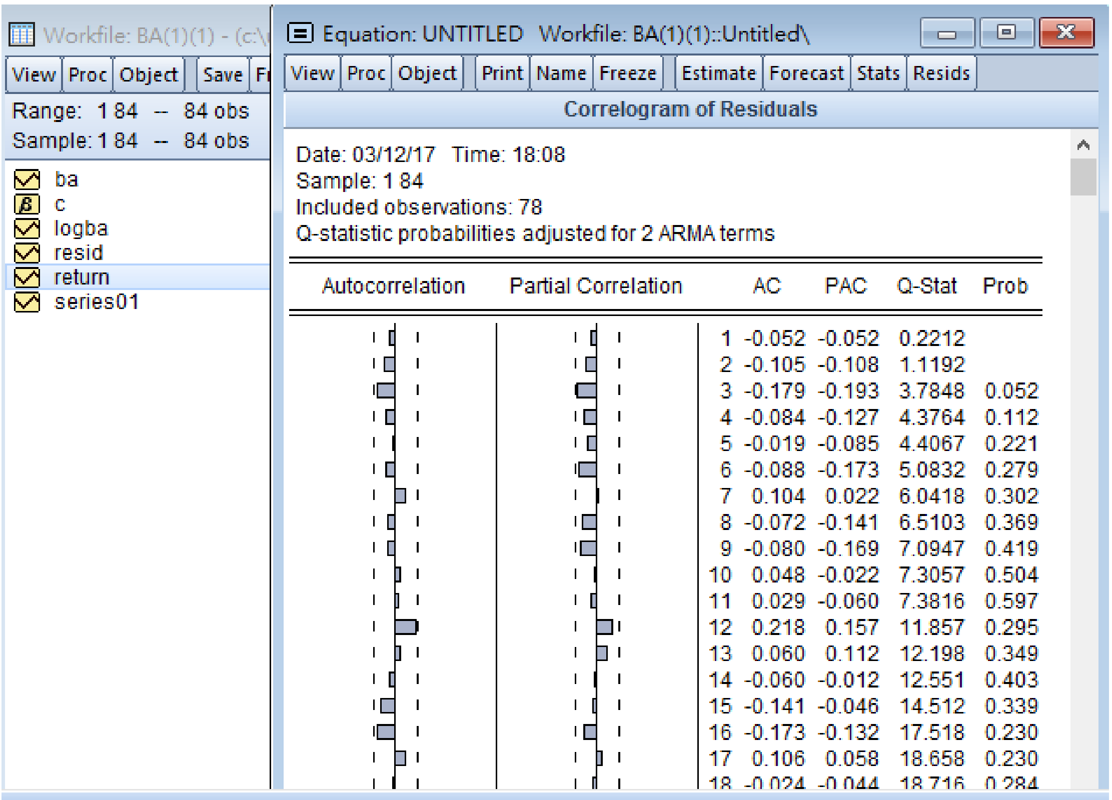
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.020196	0.007778	-2.596672	0.0113
AR(5)	0.497996	0.146083	3.408980	0.0011
MA(5)	-0.878905	0.079681	-11.03031	0.0000

R-squared	0.165244	Mean dependent var	-0.015147
Adjusted R-squared	0.142984	S.D. dependent var	0.150255
S.E. of regression	0.139098	Akaike info criterion	-1.069567
Sum squared resid	1.451129	Schwarz criterion	-0.978924
Log likelihood	44.71310	Hannan-Quinn criter.	-1.033281
F-statistic	7.423332	Durbin-Watson stat	2.082547
Prob(F-statistic)	0.001144		

Inverted AR Roots	.87	.27-.83i	.27+.83i	-.70+.51i
	-.70-.51i			
Inverted MA Roots	.97	.30-.93i	.30+.93i	-.79+.57i
	-.79-.57i			

Now we are sure return is ARMA(5,5). Actually, without first difference, it is ARIMA(5, 1, 5). Why?

The third step is **Diagnostic checking**.

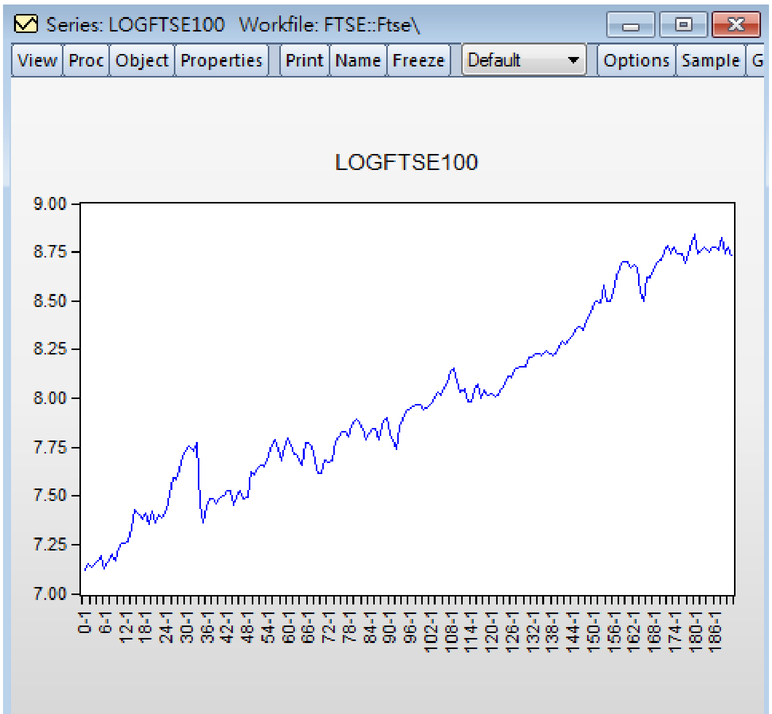


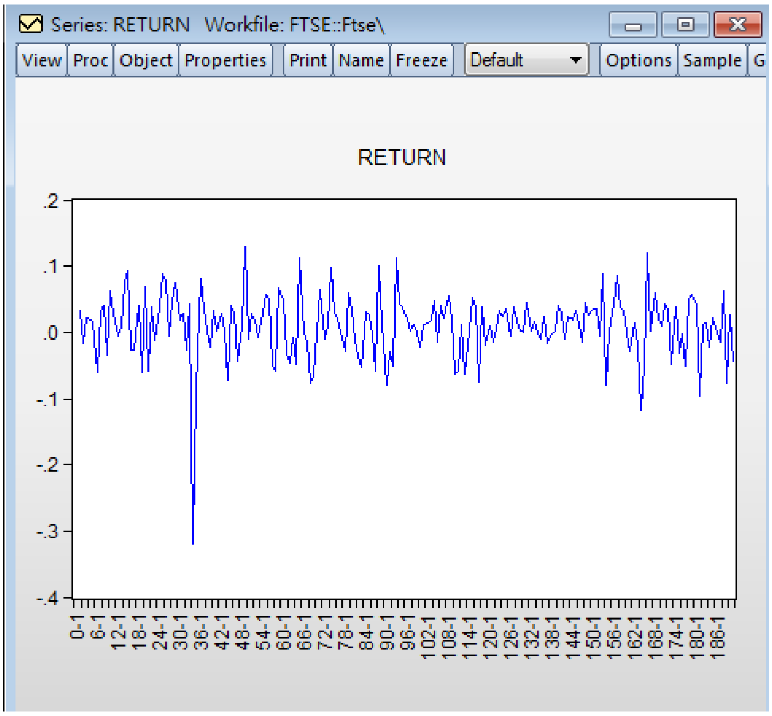
	AC	PAC	Q-Stat	Prob
1	-0.052	-0.052	0.2212	
2	-0.105	-0.108	1.1192	
3	-0.179	-0.193	3.7848	0.052
4	-0.084	-0.127	4.3764	0.112
5	-0.019	-0.085	4.4067	0.221
6	-0.088	-0.173	5.0832	0.279
7	0.104	0.022	6.0418	0.302
8	-0.072	-0.141	6.5103	0.369
9	-0.080	-0.169	7.0947	0.419
10	0.048	-0.022	7.3057	0.504
11	0.029	-0.060	7.3816	0.597
12	0.218	0.157	11.857	0.295
13	0.060	0.112	12.198	0.349
14	-0.060	-0.012	12.551	0.403
15	-0.141	-0.046	14.512	0.339
16	-0.173	-0.132	17.518	0.230
17	0.106	0.058	18.658	0.230
18	-0.024	-0.044	18.716	0.284

Residual diagnostics refers to checking whether the residuals are free from autocorrelation. The model is adequate, if autocorrelations of residuals are zero.

Unit root test (Dataset: FTSE)

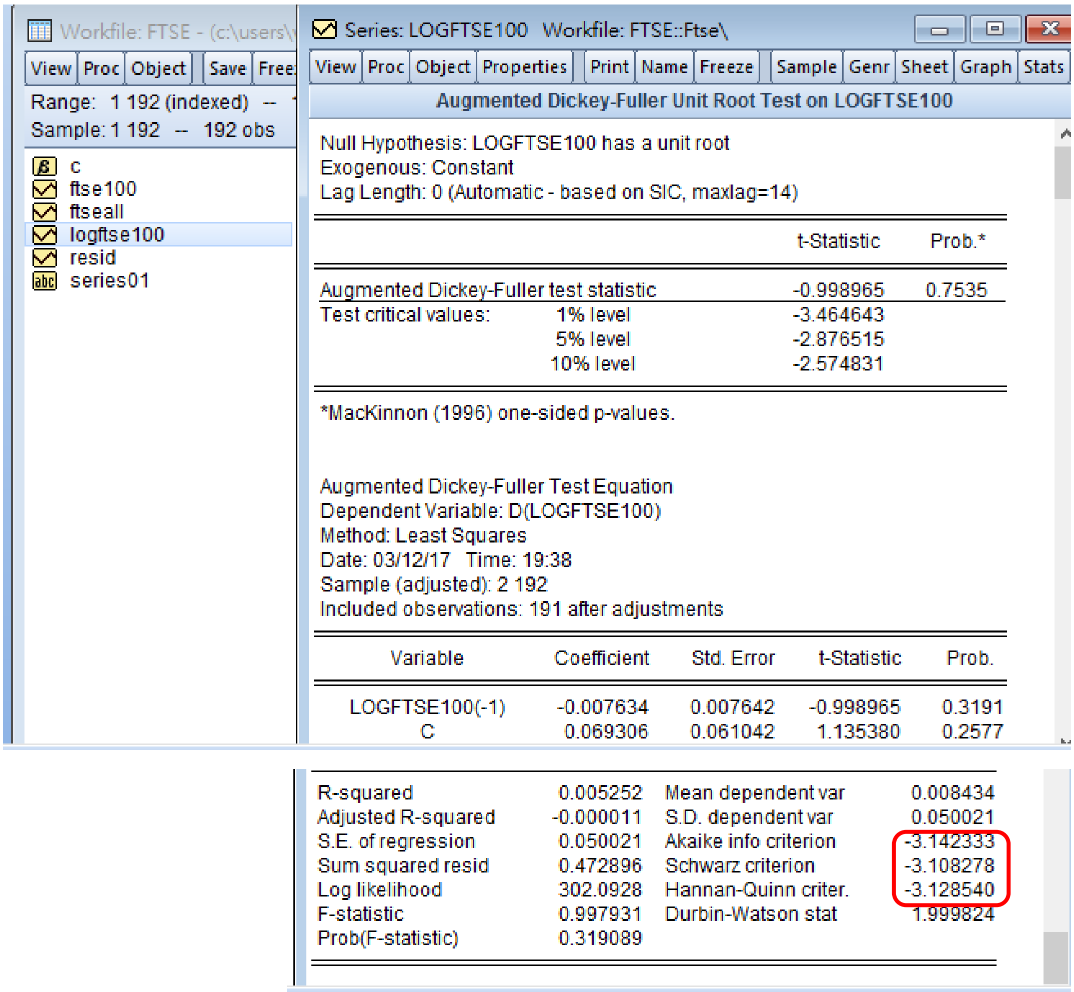
4. Manual unit root test on the variable FTSE100 and explain the result.





5. Automated unit root testing on FTSE100 and explain the result.

Let's look to LOGFTSE100



Workfile: FTSE - (c:\users\

View | Proc | Object | Save | Free

Range: 1 192 (indexed) --

Sample: 1 192 -- 192 obs

c
ftse100
ftseall
logftse100
resid
series01

Series: LOGFTSE100 Workfile: FTSE::Ftse\

View | Proc | Object | Properties | Print | Name | Freeze | Sample | Genr | Sheet | Graph | Stats

Augmented Dickey-Fuller Unit Root Test on LOGFTSE100

Null Hypothesis: LOGFTSE100 has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

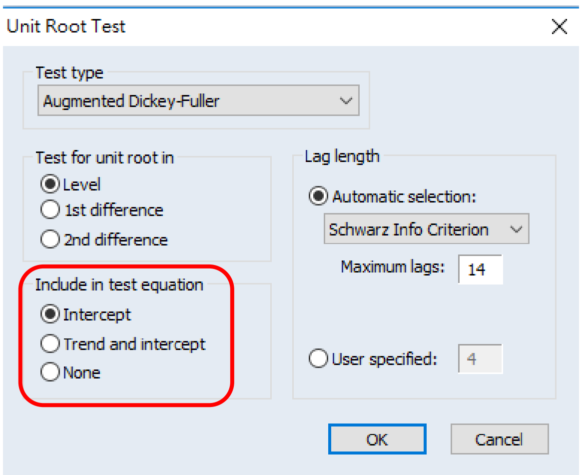
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.998965	0.7535
Test critical values:	1% level	-3.464643	
	5% level	-2.876515	
	10% level	-2.574831	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGFTSE100)
Method: Least Squares
Date: 03/12/17 Time: 19:38
Sample (adjusted): 2 192
Included observations: 191 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGFTSE100(-1)	-0.007634	0.007642	-0.998965	0.3191
C	0.069306	0.061042	1.135380	0.2577

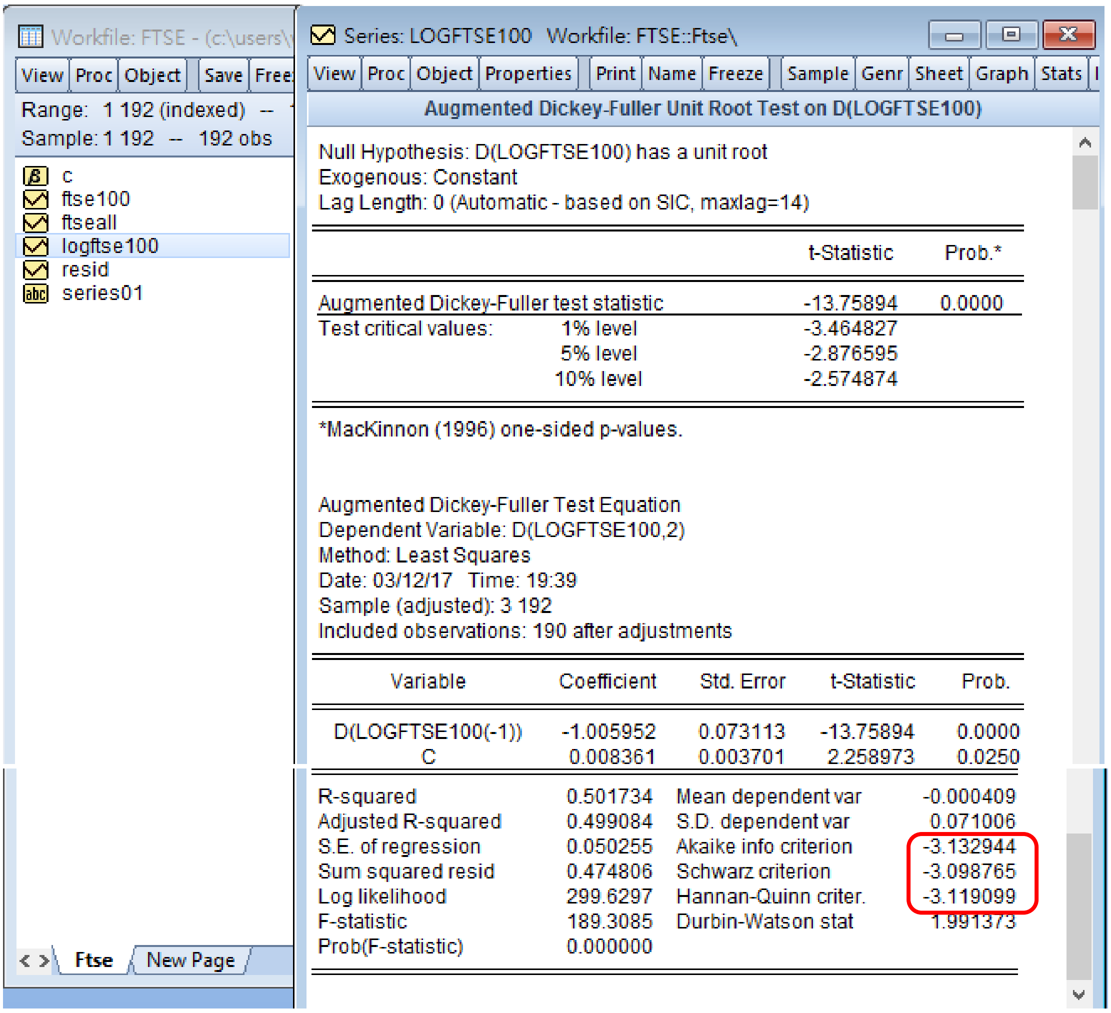
R-squared	0.005252	Mean dependent var	0.008434
Adjusted R-squared	-0.000011	S.D. dependent var	0.050021
S.E. of regression	0.050021	Akaike info criterion	-3.142333
Sum squared resid	0.472896	Schwarz criterion	-3.108278
Log likelihood	302.0928	Hannan-Quinn criter.	-3.128540
F-statistic	0.997931	Durbin-Watson stat	1.999824
Prob(F-statistic)	0.319089		



<u>Include in test equation➔choose your exogenous regressor.</u>

<u>After we taking difference, there is still a trend in graph, then we need to do de-trend(option 2)</u>

Let’s look at D(LOGFTSE100)



Augmented Dickey-Fuller Unit Root Test on D(LOGFTSE100)

Null Hypothesis: D(LOGFTSE100) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.75894	0.0000
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

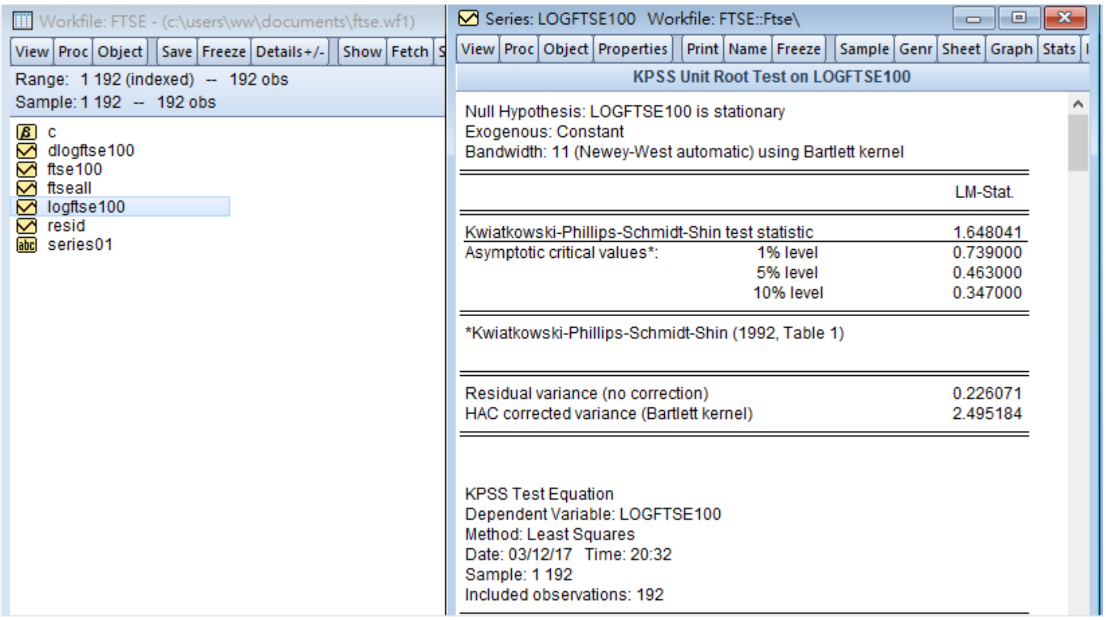
*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGFTSE100,2)
Method: Least Squares
Date: 03/12/17 Time: 19:39
Sample (adjusted): 3 192
Included observations: 190 after adjustments

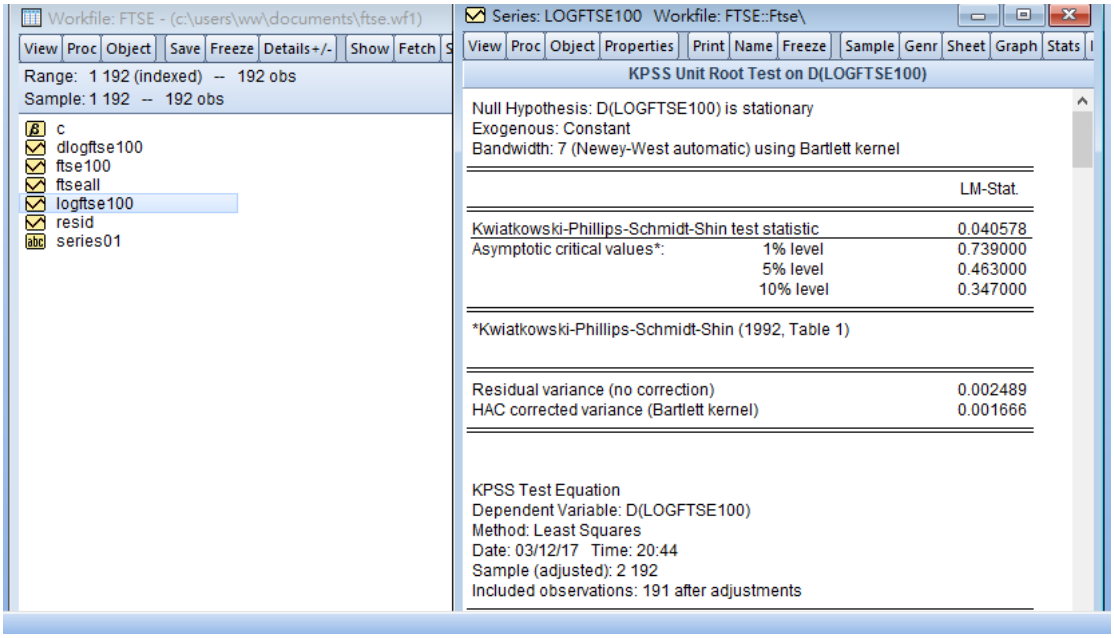
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGFTSE100(-1))	-1.005952	0.073113	-13.75894	0.0000
C	0.008361	0.003701	2.258973	0.0250

R-squared	0.501734	Mean dependent var	-0.000409
Adjusted R-squared	0.499084	S.D. dependent var	0.071006
S.E. of regression	0.050255	Akaike info criterion	-3.132944
Sum squared resid	0.474806	Schwarz criterion	-3.098765
Log likelihood	299.6297	Hannan-Quinn criter.	-3.119099
F-statistic	189.3085	Durbin-Watson stat	1.991373
Prob(F-statistic)	0.000000		

Using **KPSS** here



1.68>0.73(1%)>0.46(5%), so reject Null Hypothesis. This means LOGFTSE100 is non-stationary.



0.73(1%)>0.46(5%)>0.040578, so do not reject Null Hypothesis. This means DLOGFTSE100 is stationary. If you have conflicting results between ADF and KPSS, refer to literature.

6. If appropriate, test for the presence of I(2) for FTSE100 series.

ADF and KPSS give us the same information, so we just focus on ADF.

Let's look at D(LOGFTSE100,2)

Augmented Dickey-Fuller Unit Root Test on D(LOGFTSE100,2)

Null Hypothesis: D(LOGFTSE100,2) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.03751	0.0000
Test critical values:	1% level	-3.465585	
	5% level	-2.876927	
	10% level	-2.575051	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGFTSE100,3)
Method: Least Squares
Date: 03/12/17 Time: 19:46
Sample (adjusted): 7 192
Included observations: 186 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGFTSE100(-1),2)	-3.065201	0.254637	-12.03751	0.0000
D(LOGFTSE100(-1),3)	1.298610	0.207717	6.251828	0.0000
D(LOGFTSE100(-2),3)	0.660382	0.142567	4.632091	0.0000
D(LOGFTSE100(-3),3)	0.207961	0.073722	2.820871	0.0053
C	-0.000500	0.004161	-0.120236	0.9044

R-squared	0.786576	Mean dependent var	-0.000389
Adjusted R-squared	0.781860	S.D. dependent var	0.121491
S.E. of regression	0.056743	Akaike info criterion	-2.874057
Sum squared resid	0.582777	Schwarz criterion	-2.787343
Log likelihood	272.2873	Hannan-Quinn criter.	-2.838917
F-statistic	166.7693	Durbin-Watson stat	2.045672
Prob(F-statistic)	0.000000		

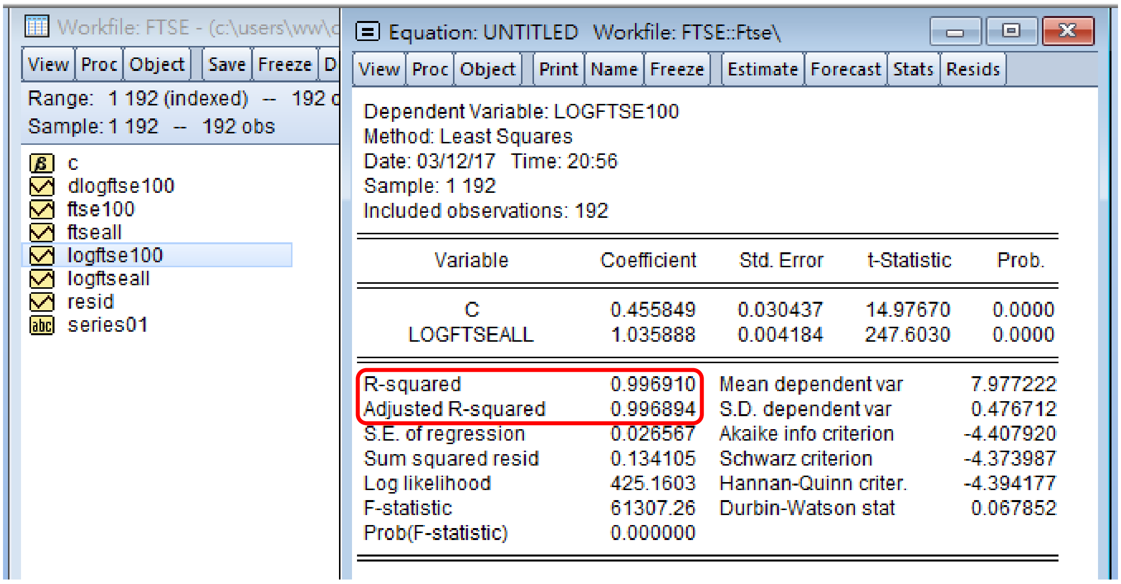
Therefore, we can use I(1) or I(2).

But I(1) is better, if we look at AIC, SBIC, and HQIC (smaller is better).

Cointegration-EG test (Dataset: FTSE)

7. Does cointegration exist between FTSE100 and FTSEALL?

Generate the residuals of the cointegration and ensure the residuals are I(0)



Workfile: FTSE - (c:\users\ww\c

Range: 1 192 (indexed) -- 192 obs
Sample: 1 192 -- 192 obs

c
dlogftse100
ftse100
ftseall
logftse100
logftseall
resid
series01

Equation: UNTITLED Workfile: FTSE::Ftse\

Dependent Variable: LOGFTSE100
Method: Least Squares
Date: 03/12/17 Time: 20:56
Sample: 1 192
Included observations: 192

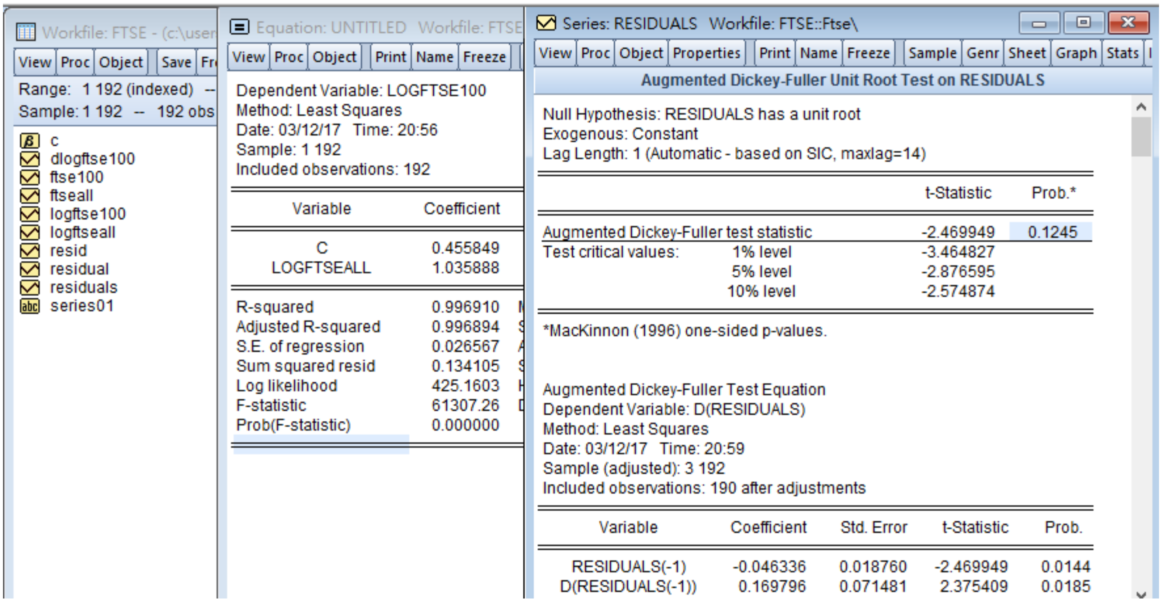
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.455849	0.030437	14.97670	0.0000
LOGFTSEALL	1.035888	0.004184	247.6030	0.0000

R-squared	0.996910	Mean dependent var	7.977222
Adjusted R-squared	0.996894	S.D. dependent var	0.476712
S.E. of regression	0.026567	Akaike info criterion	-4.407920
Sum squared resid	0.134105	Schwarz criterion	-4.373987
Log likelihood	425.1603	Hannan-Quinn criter.	-4.394177
F-statistic	61307.26	Durbin-Watson stat	0.067852
Prob(F-statistic)	0.000000		

R^2 is high. So we consider cointegration.

Proc>Make Residual Series

Conduct unit root test for residuals to examine whether they are I(0), using ADF.



Series: RESIDUALS Workfile: FTSE::Ftse\

Augmented Dickey-Fuller Unit Root Test on RESIDUALS

Null Hypothesis: RESIDUALS has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.469949	0.1245
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESIDUALS)
Method: Least Squares
Date: 03/12/17 Time: 20:59
Sample (adjusted): 3 192
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDUALS(-1)	-0.046336	0.018760	-2.469949	0.0144
D(RESIDUALS(-1))	0.169796	0.071481	2.375409	0.0185

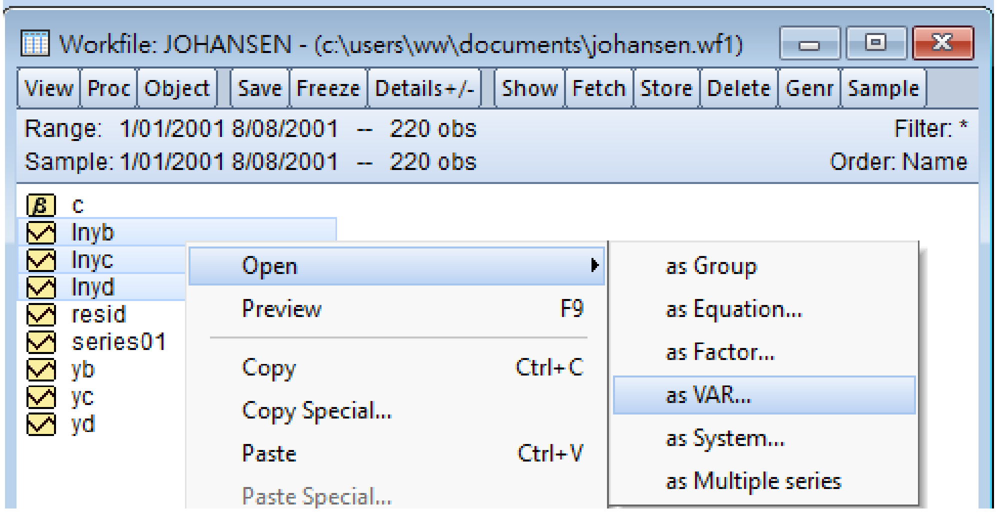
Residuals has a unit root, implying residuals series is non-stationary.

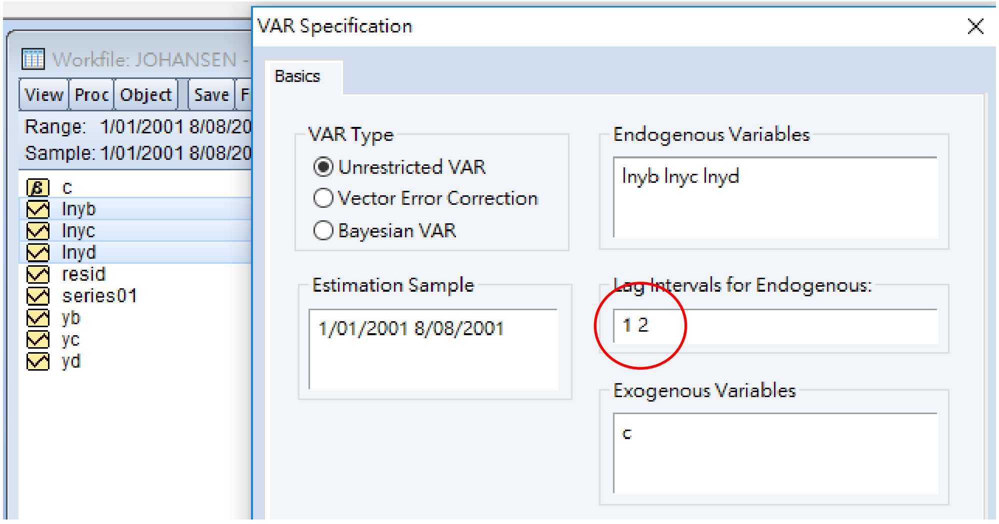
So there is not cointegration relation.

Cointegration-Johansen test (Dataset: Johansen)

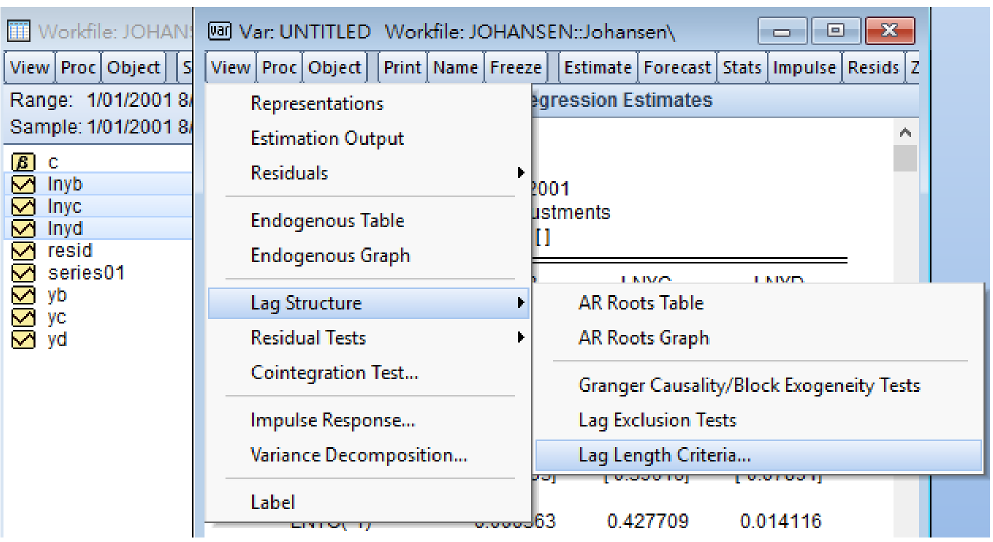
8. Detect cointegration and find out the relationship among Yb Yc Yd.

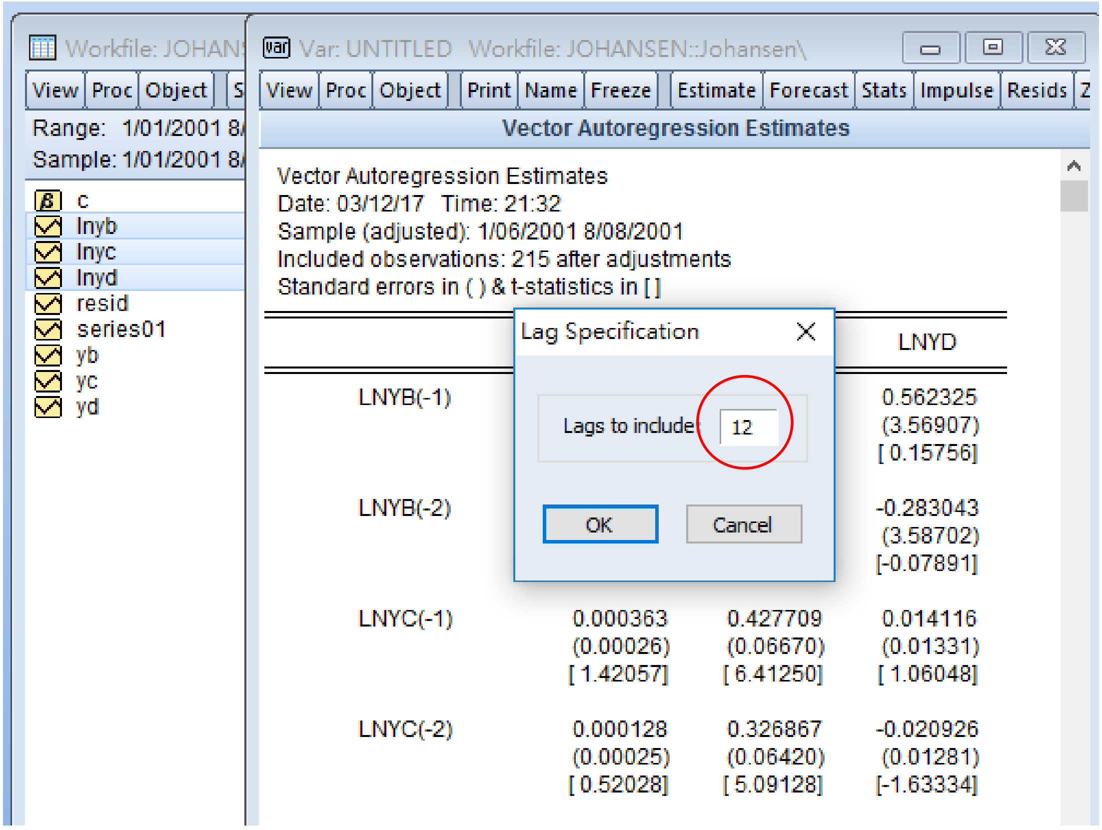
<u>How to choose the optimal lag?</u>

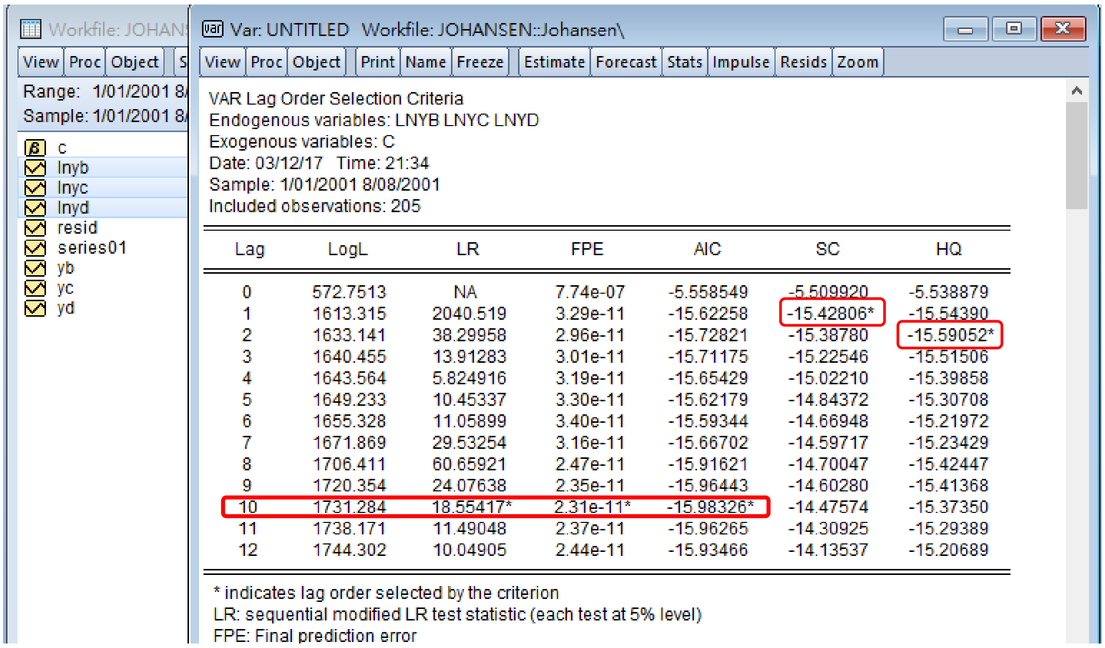




Eviews suggests us to use 2 lags.

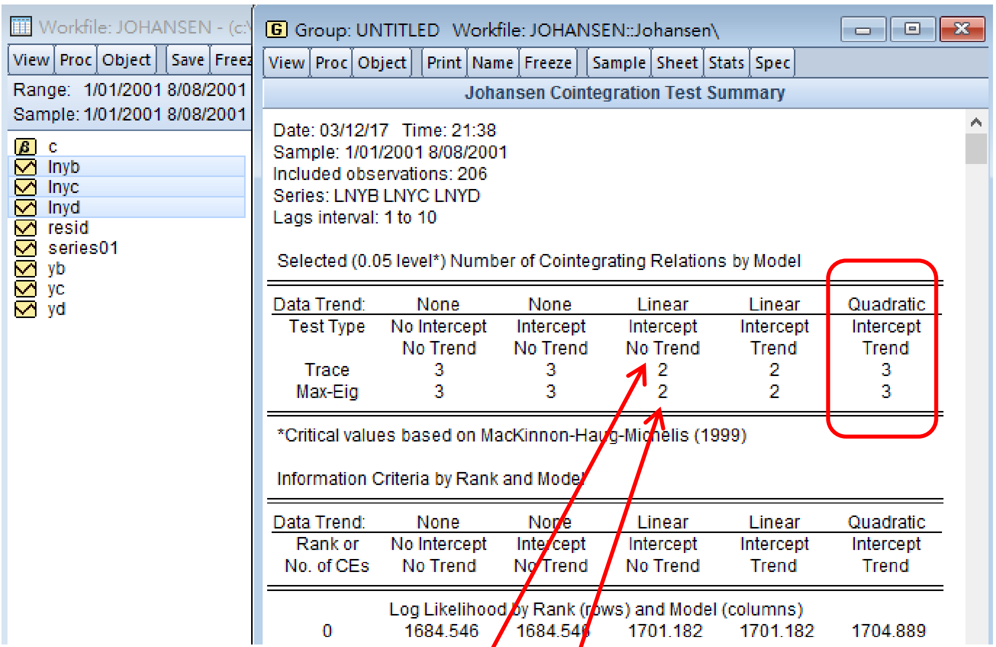


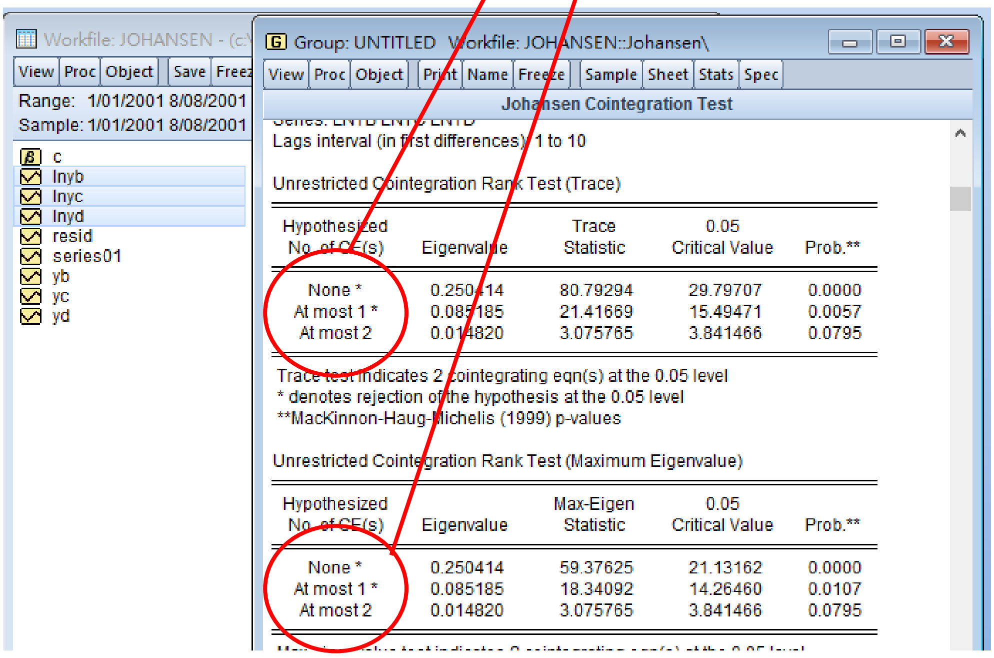




There is no unique way to decide the optimal lag, we could follow Eviews here, using 2.

We choose option 6 that summarize all 5 sets of assumptions to examine whether the results are sensitive to the type of specification used.





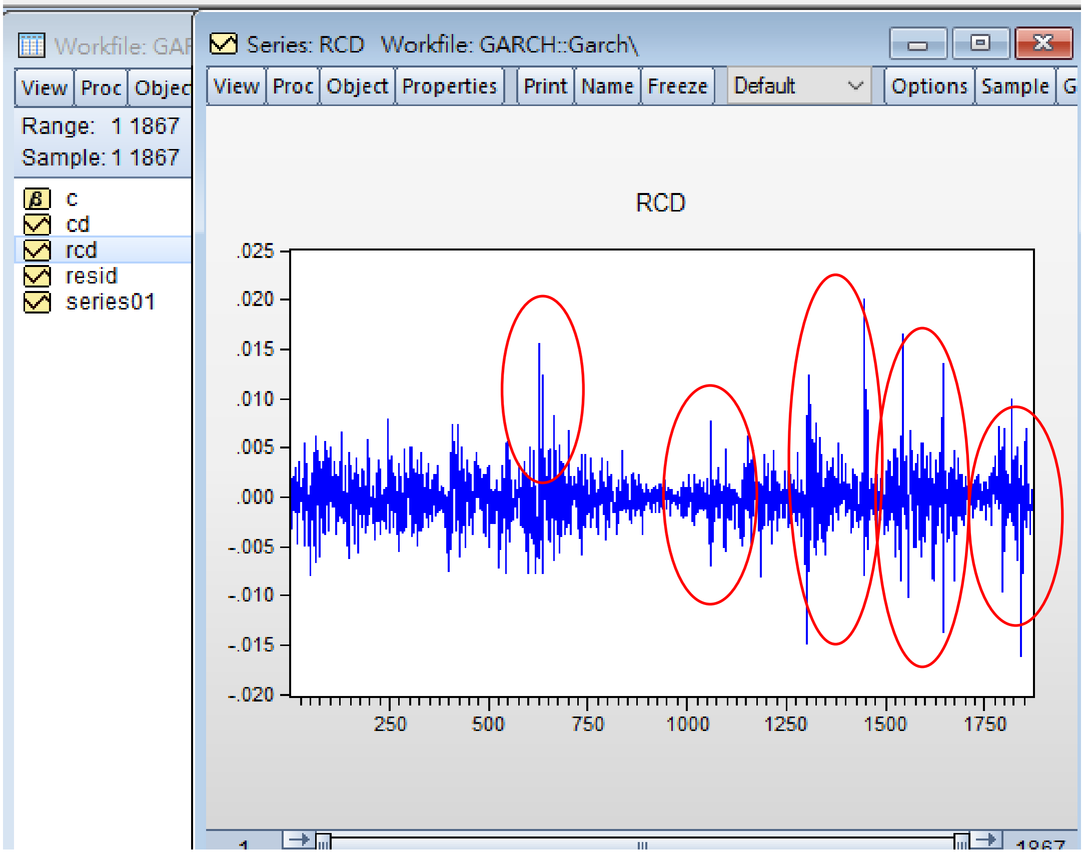
Trace test may have conflicting results from Max-Eig, Johansen and Juselius (1990) suggests using Max-Eig results.

In my understanding: If there is variable with I(0), it is not appropriate to do cointegration test since cointegration is conducted when we have non-stationarity data. We can just proceed with VAR system by taking the first difference for the I(1) variable. With this situation, look at these two papers: Toda, Hiro Y., and Taku Yamamoto (1995) and Pesaran, M. Hashem, Yongcheol Shin and Richard J. Smith (2001)

ARCH and GARCH modelling (Dataset: GARCH)

9. **Build up a proper model for the series of exchange rate of Canadian Dollar (variable CD in the dataset) and explain why the model you obtain should be a preferred model.**

   Let's look at the graph of rcd first

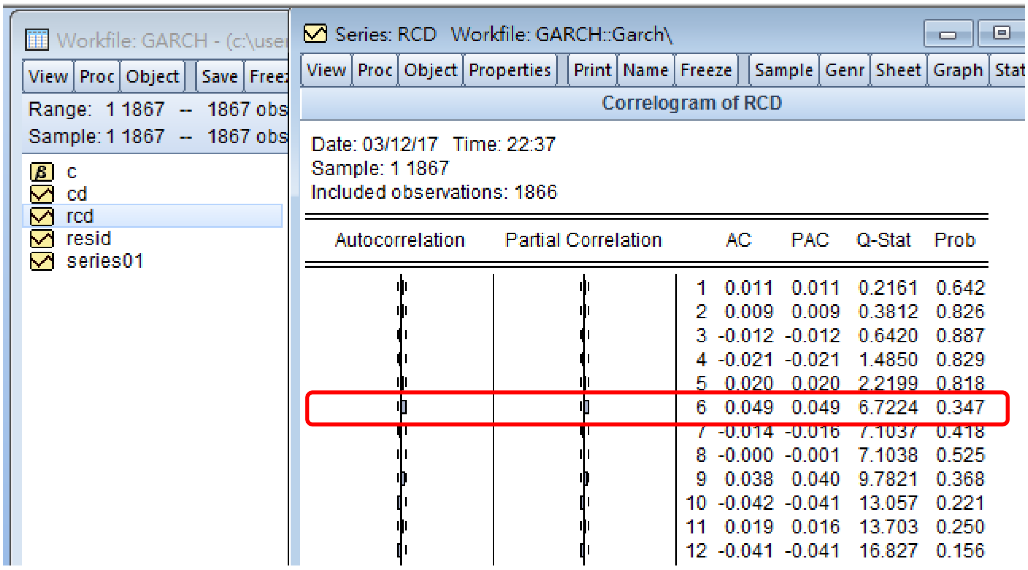


We can see few periods with large increase and decrease.

Volatility Clustering

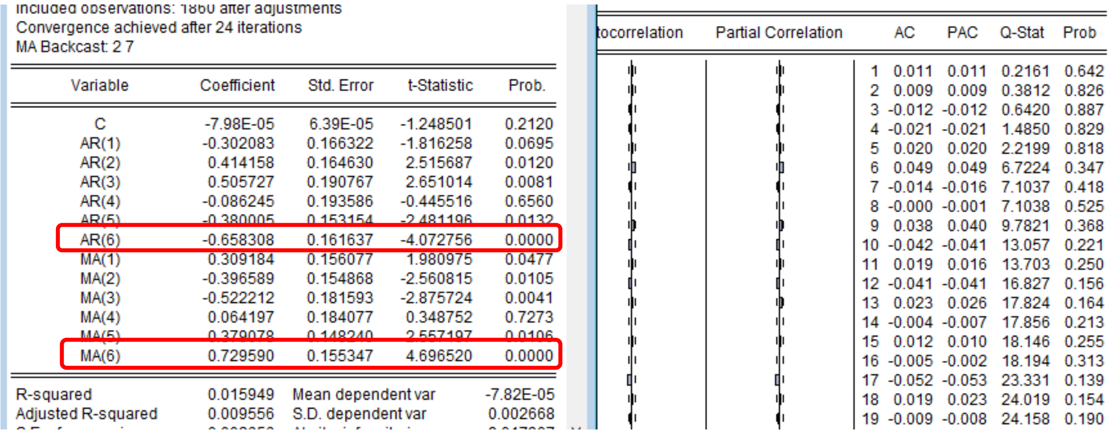
Identify an appropriate ARMA model by following the Box-Jenkins methodology

The first step: Identification



	AC	PAC	Q-Stat	Prob
1	0.011	0.011	0.2161	0.642
2	0.009	0.009	0.3812	0.826
3	-0.012	-0.012	0.6420	0.887
4	-0.021	-0.021	1.4850	0.829
5	0.020	0.020	2.2199	0.818
6	0.049	0.049	6.7224	0.347
7	-0.014	-0.016	7.1037	0.418
8	-0.000	-0.001	7.1038	0.525
9	0.038	0.040	9.7821	0.368
10	-0.042	-0.041	13.057	0.221
11	0.019	0.016	13.703	0.250
12	-0.041	-0.041	16.827	0.156

The second step: estimation



Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.98E-05	6.39E-05	-1.248501	0.2120
AR(1)	-0.302083	0.166322	-1.816258	0.0695
AR(2)	0.414158	0.164630	2.515687	0.0120
AR(3)	0.505727	0.190767	2.651014	0.0081
AR(4)	-0.086245	0.193586	-0.445516	0.6560
AR(5)	-0.380005	0.153154	-2.481196	0.0132
AR(6)	-0.658308	0.161637	-4.072756	0.0000
MA(1)	0.309184	0.156077	1.980975	0.0477
MA(2)	-0.396589	0.154868	-2.560815	0.0105
MA(3)	-0.522212	0.181593	-2.875724	0.0041
MA(4)	0.064197	0.184077	0.348752	0.7273
MA(5)	0.379078	0.148240	2.557197	0.0106
MA(6)	0.729590	0.155347	4.696520	0.0000

R-squared	0.015949	Mean dependent var	-7.82E-05
Adjusted R-squared	0.009556	S.D. dependent var	0.002668

	AC	PAC	Q-Stat	Prob
1	0.011	0.011	0.2161	0.642
2	0.009	0.009	0.3812	0.826
3	-0.012	-0.012	0.6420	0.887
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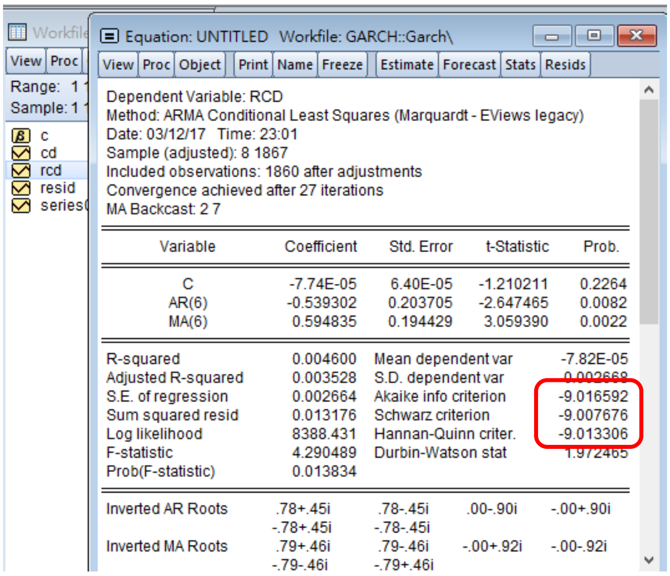
9	0.038	0.040	9.7821	0.368
10	-0.042	-0.041	13.057	0.221
11	0.019	0.016	13.703	0.250
12	-0.041	-0.041	16.827	0.156
13	0.023	0.026	17.824	0.164
14	-0.004	-0.007	17.856	0.213
15	0.012	0.010	18.146	0.255
16	-0.005	-0.002	18.194	0.313
17	-0.052	-0.053	23.331	0.139
18	0.019	0.023	24.019	0.154
19	-0.009	-0.008	24.158	0.190

Other variables are also significant, but combining with ACF/PACF plot, let's do ARMA(6,6). So in estimate equation window, type in rcd c ar(6) ma(6)

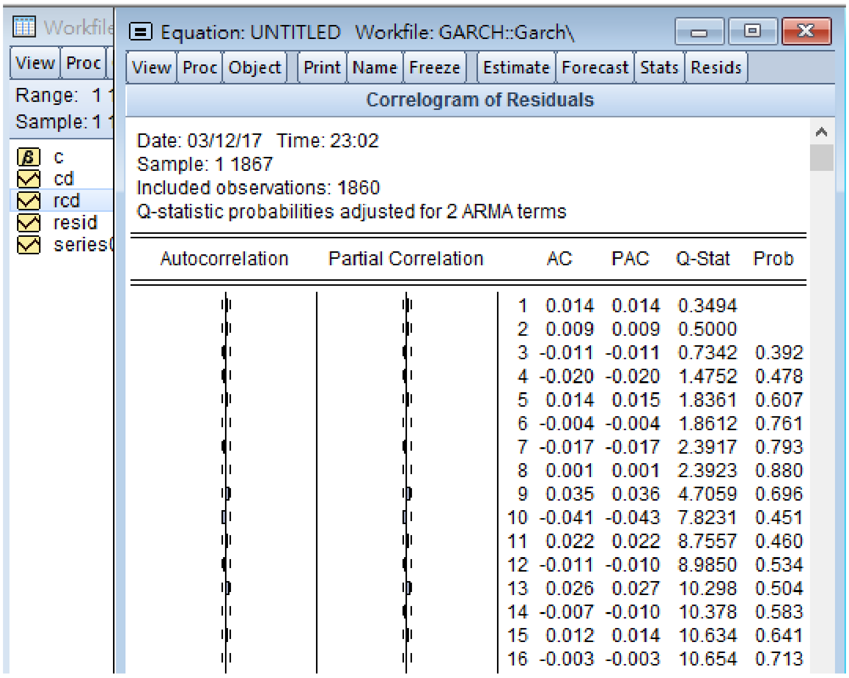


Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.74E-05	6.40E-05	-1.210211	0.2264
AR(6)	-0.539302	0.203705	-2.647465	0.0082
MA(6)	0.594835	0.194429	3.059390	0.0022

R-squared	0.004600	Mean dependent var	-7.82E-05
Adjusted R-squared	0.003528	S.D. dependent var	0.002668
S.E. of regression	0.002664	Akaike info criterion	-9.016592
Sum squared resid	0.013176	Schwarz criterion	-9.007676
Log likelihood	8388.431	Hannan-Quinn criter.	-9.013306
F-statistic	4.290489	Durbin-Watson stat	1.972465
Prob(F-statistic)	0.013834		

Inverted AR Roots	.78+.45i	.78-.45i	.00-.90i	-.00+.90i
	-.78+.45i	-.78-.45i		
Inverted MA Roots	.79+.46i	.79-.46i	-.00+.92i	-.00-.92i
	-.79-.46i	-.79+.46i		

And residual diagnostic



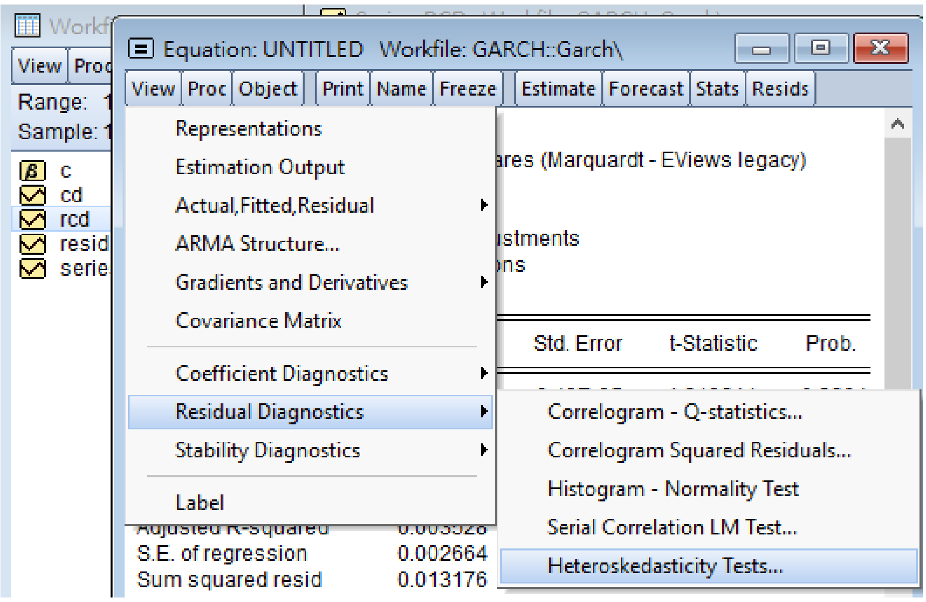
Correlogram of Residuals

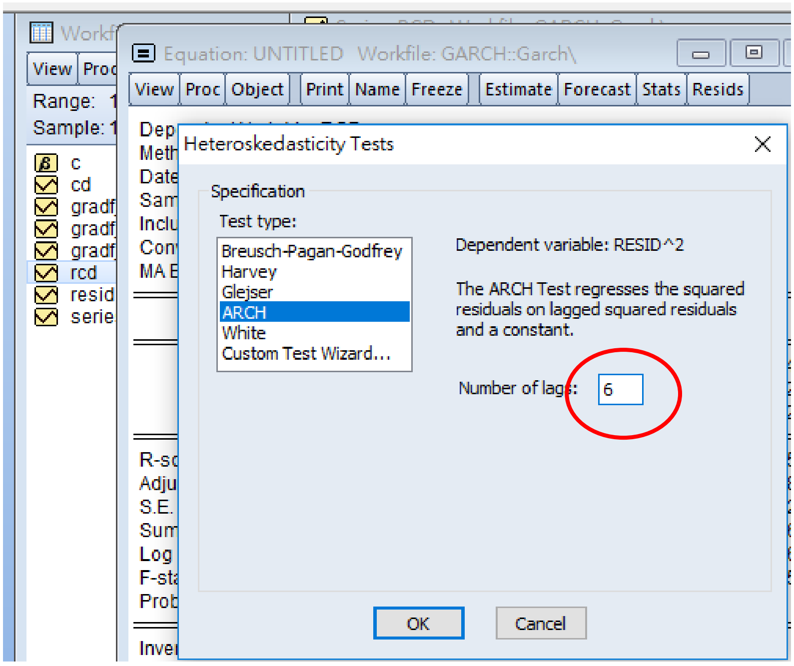
Date: 03/12/17 Time: 23:02
Sample: 1 1867
Included observations: 1860
Q-statistic probabilities adjusted for 2 ARMA terms

	AC	PAC	Q-Stat	Prob
1	0.014	0.014	0.3494	
2	0.009	0.009	0.5000	
3	-0.011	-0.011	0.7342	0.392
4	-0.020	-0.020	1.4752	0.478
5	0.014	0.015	1.8361	0.607
6	-0.004	-0.004	1.8612	0.761
7	-0.017	-0.017	2.3917	0.793
8	0.001	0.001	2.3923	0.880
9	0.035	0.036	4.7059	0.696
10	-0.041	-0.043	7.8231	0.451
11	0.022	0.022	8.7557	0.460
12	-0.011	-0.010	8.9850	0.534
13	0.026	0.027	10.298	0.504
14	-0.007	-0.010	10.378	0.583
15	0.012	0.014	10.634	0.641
16	-0.003	-0.003	10.654	0.713

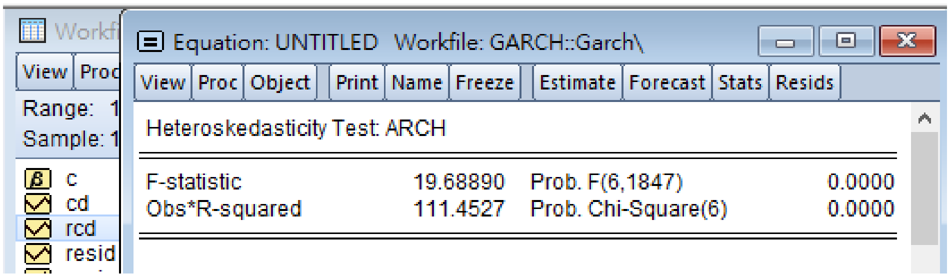
Residual diagnostics refers to checking whether the residuals are free from autocorrelation. The model is adequate, if autocorrelations of residuals are zero.

Now, let’s look at ARCH effect



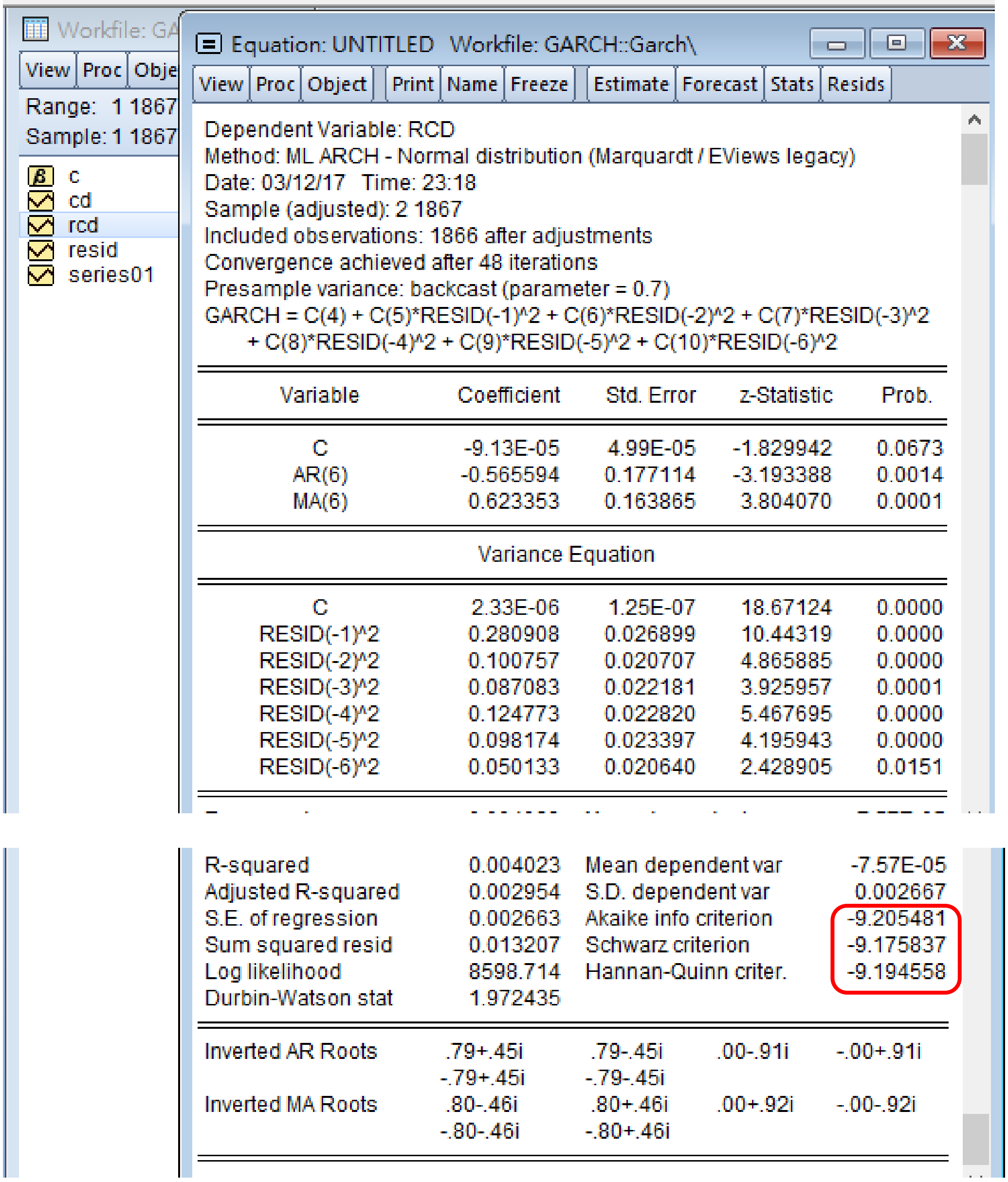


Choose 6, because of AR(6). Eviews suggests us to use 6, so we look at 6 in ACF/PACF plot.



There is ARCH effect.

Estimating ARCH/GARCH models. We look at ARCH first.



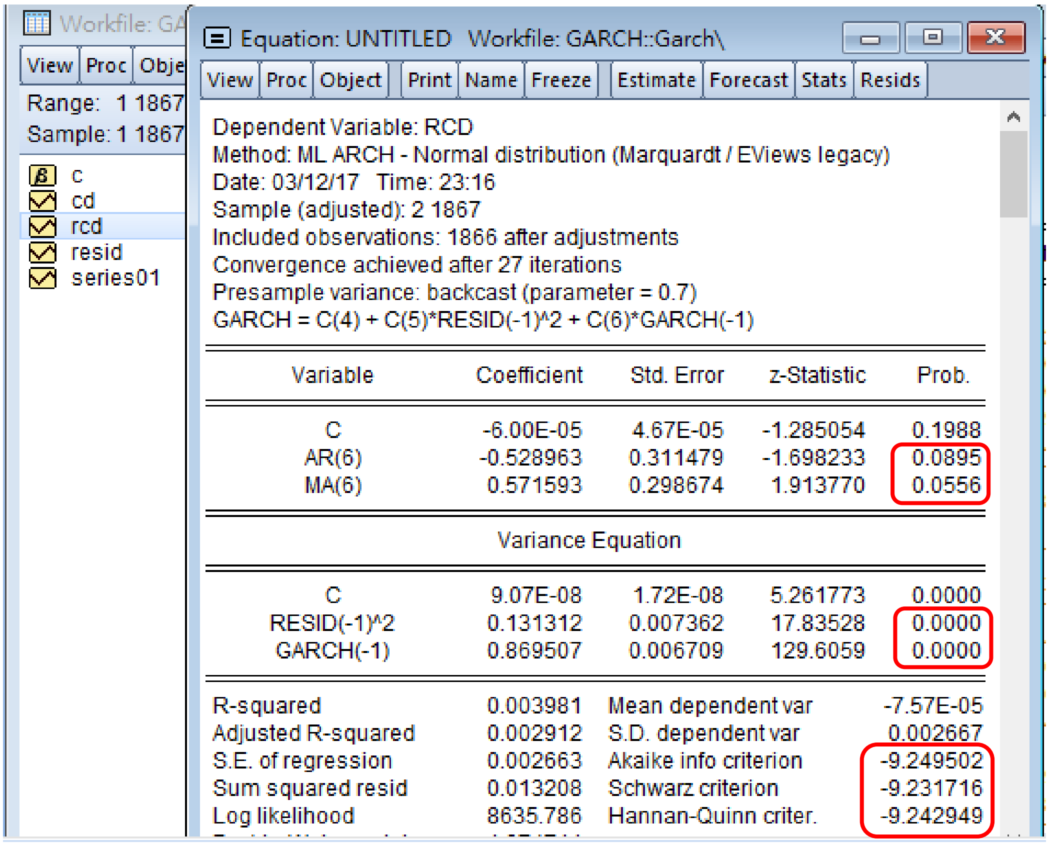
Dependent Variable: RCD
Method: ML ARCH - Normal distribution (Marquardt / EViews legacy)
Date: 03/12/17 Time: 23:18
Sample (adjusted): 2 1867
Included observations: 1866 after adjustments
Convergence achieved after 48 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*RESID(-2)^2 + C(7)*RESID(-3)^2
+ C(8)*RESID(-4)^2 + C(9)*RESID(-5)^2 + C(10)*RESID(-6)^2

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-9.13E-05	4.99E-05	-1.829942	0.0673
AR(6)	-0.565594	0.177114	-3.193388	0.0014
MA(6)	0.623353	0.163865	3.804070	0.0001
Variance Equation				
C	2.33E-06	1.25E-07	18.67124	0.0000
RESID(-1)^2	0.280908	0.026899	10.44319	0.0000
RESID(-2)^2	0.100757	0.020707	4.865885	0.0000
RESID(-3)^2	0.087083	0.022181	3.925957	0.0001
RESID(-4)^2	0.124773	0.022820	5.467695	0.0000
RESID(-5)^2	0.098174	0.023397	4.195943	0.0000
RESID(-6)^2	0.050133	0.020640	2.428905	0.0151

R-squared	0.004023	Mean dependent var	-7.57E-05
Adjusted R-squared	0.002954	S.D. dependent var	0.002667
S.E. of regression	0.002663	Akaike info criterion	-9.205481
Sum squared resid	0.013207	Schwarz criterion	-9.175837
Log likelihood	8598.714	Hannan-Quinn criter.	-9.194558
Durbin-Watson stat	1.972435		

Inverted AR Roots	.79+.45i	.79-.45i	.00-.91i	-.00+.91i
	-.79+.45i	-.79-.45i		
Inverted MA Roots	.80-.46i	.80+.46i	.00+.92i	-.00-.92i
	-.80-.46i	-.80+.46i		

Then, GARCH(1,1)



Dependent Variable: RCD
Method: ML ARCH - Normal distribution (Marquardt / EViews legacy)
Date: 03/12/17 Time: 23:16
Sample (adjusted): 2 1867
Included observations: 1866 after adjustments
Convergence achieved after 27 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-6.00E-05	4.67E-05	-1.285054	0.1988
AR(6)	-0.528963	0.311479	-1.698233	0.0895
MA(6)	0.571593	0.298674	1.913770	0.0556
Variance Equation				
C	9.07E-08	1.72E-08	5.261773	0.0000
RESID(-1)^2	0.131312	0.007362	17.83528	0.0000
GARCH(-1)	0.869507	0.006709	129.6059	0.0000

R-squared	0.003981	Mean dependent var	-7.57E-05
Adjusted R-squared	0.002912	S.D. dependent var	0.002667
S.E. of regression	0.002663	Akaike info criterion	-9.249502
Sum squared resid	0.013208	Schwarz criterion	-9.231716
Log likelihood	8635.786	Hannan-Quinn criter.	-9.242949

We can see the AR(6) and MA(6) becomes less significant. ARCH and GARCH effect are significant. Comparing with ARCH(6), We can use fewer variables with GARCH(1,1).

GJR-GARCH

Note:

Due to Glosten, Jaganathan and Runkle

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta\sigma_{t-1}^2 + \gamma u_{t-1}^2 I_{t-1}$$

where $I_{t-1} = 1$ if $u_{t-1} < 0$

$= 0$ otherwise

For a leverage effect, we would see $\gamma > 0$

We require $\alpha_1 + \gamma \geq 0$ and $\alpha_1 \geq 0$ for non-negativity.

Equation: UNTITLED Workfile: GARCH::Garch\

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

Included observations: 1866 after adjustments
Convergence achieved after 31 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*RESID(-1)^2*(RESID(-1)<0) +
C(7)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000124	4.88E-05	-2.542853	0.0110
AR(6)	-0.524149	0.285453	-1.836201	0.0663
MA(6)	0.570710	0.272475	2.094537	0.0362
		Variance Equation		
C	6.96E-08	1.54E-08	4.514329	0.0000
RESID(-1)^2	0.070711	0.008645	8.179042	0.0000
RESID(-1)^2*(RESID(-1)<0)	0.100703	0.012684	7.939556	0.0000
GARCH(-1)	0.882743	0.006976	126.5449	0.0000

R-squared	0.003830	Mean dependent var	-7.57E-05
Adjusted R-squared	0.002761	S.D. dependent var	0.002667
S.E. of regression	0.002663	Akaike info criterion	-9.264663
Sum squared resid	0.013210	Schwarz criterion	-9.243913
Log likelihood	8650.931	Hannan-Quinn criter.	-9.257017
Durbin-Watson stat	1.973832		

For a leverage effect, the coefficient is positive and significant.

EGARCH(try this)

GARCH-M(standard deviation)

Note:

Engle, Lilien and Robins (1987) suggested the ARCH-M specification. A GARCH-M model would be:

$$y_t = \mu + \delta\sigma_{t\text{-}1} + u_t \quad , u_t \sim \mathrm{N}(0,\sigma_t^2)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta\sigma_{t\text{-}1}{}^2$$

If δ is positive and statistically significant, then increased risk, given by an increase in the conditional variance, leads to a rise in the mean return. Thus δ can be interpreted as a risk premium.

Equation: UNTITLED Workfile: GARCH::Garch\

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

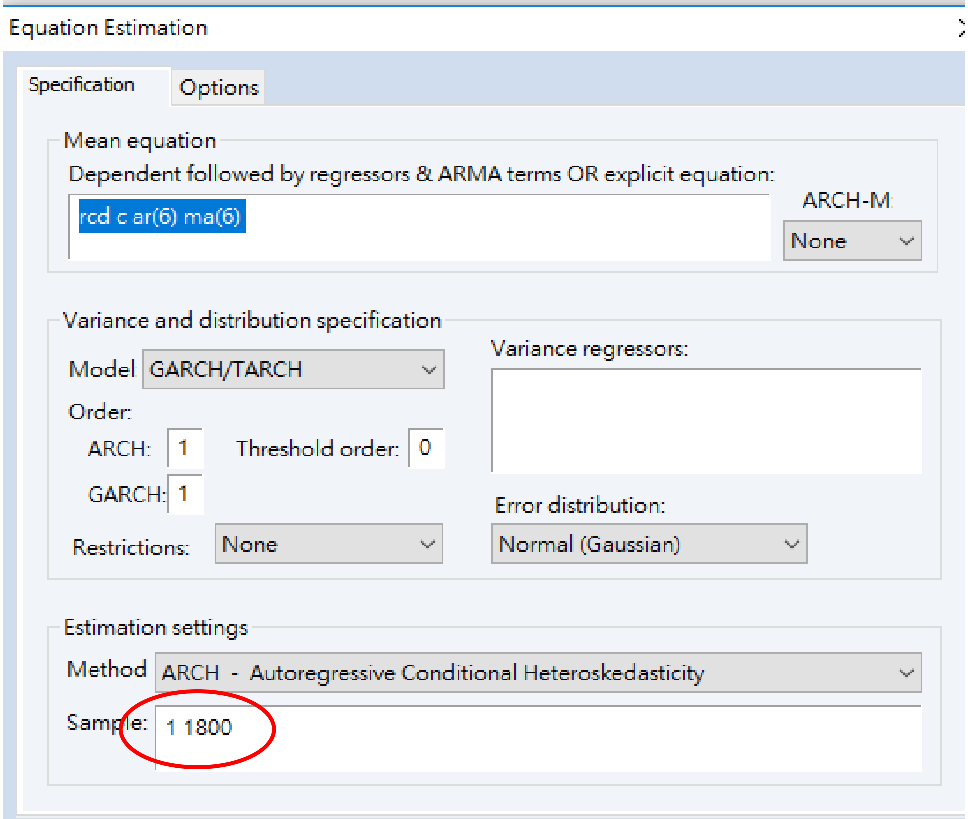
Dependent Variable: RCD
Method: ML ARCH - Normal distribution (Marquardt / EViews legacy)
Date: 03/12/17 Time: 23:54
Sample (adjusted): 2 1867
Included observations: 1866 after adjustments
Convergence achieved after 33 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(5) + C(6)*RESID(-1)^2 + C(7)*GARCH(-1)

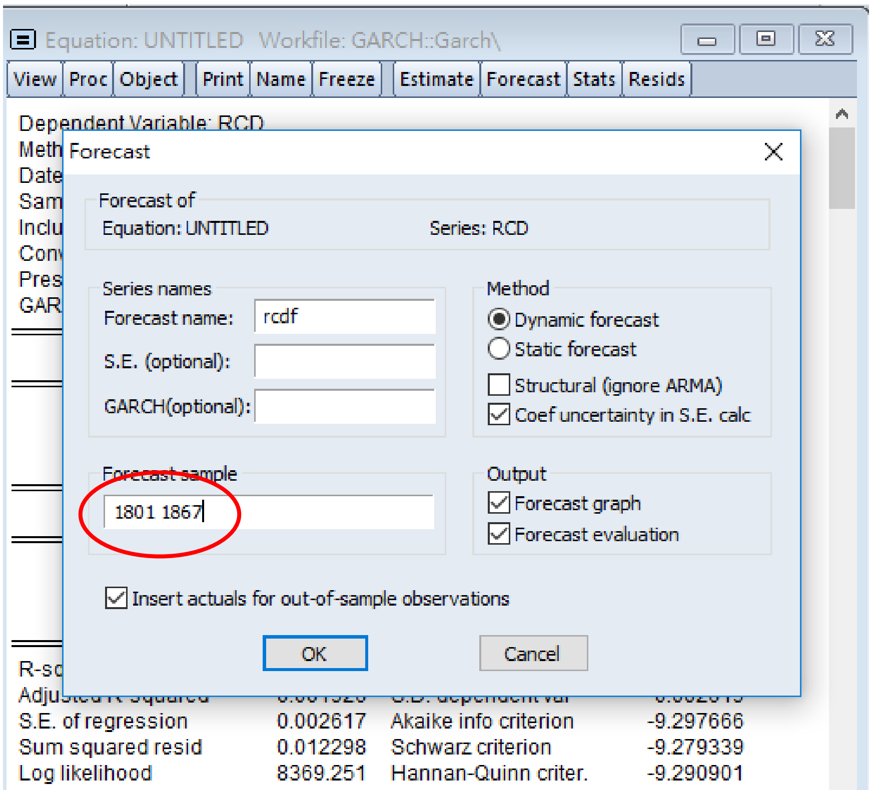
Variable	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	0.119462	0.059750	1.999375	0.0456
C	-0.000285	0.000130	-2.193349	0.0283
AR(6)	-0.529798	0.305002	-1.737030	0.0824
MA(6)	0.572767	0.292083	1.960972	0.0499
Variance Equation				
C	9.67E-08	1.79E-08	5.393219	0.0000
RESID(-1)^2	0.134138	0.007509	17.86298	0.0000
GARCH(-1)	0.865985	0.006697	129.3050	0.0000

R-squared	0.005281	Mean dependent var	-7.57E-05
Adjusted R-squared	0.003678	S.D. dependent var	0.002667
S.E. of regression	0.002662	Akaike info criterion	-9.250710
Sum squared resid	0.013191	Schwarz criterion	-9.229959

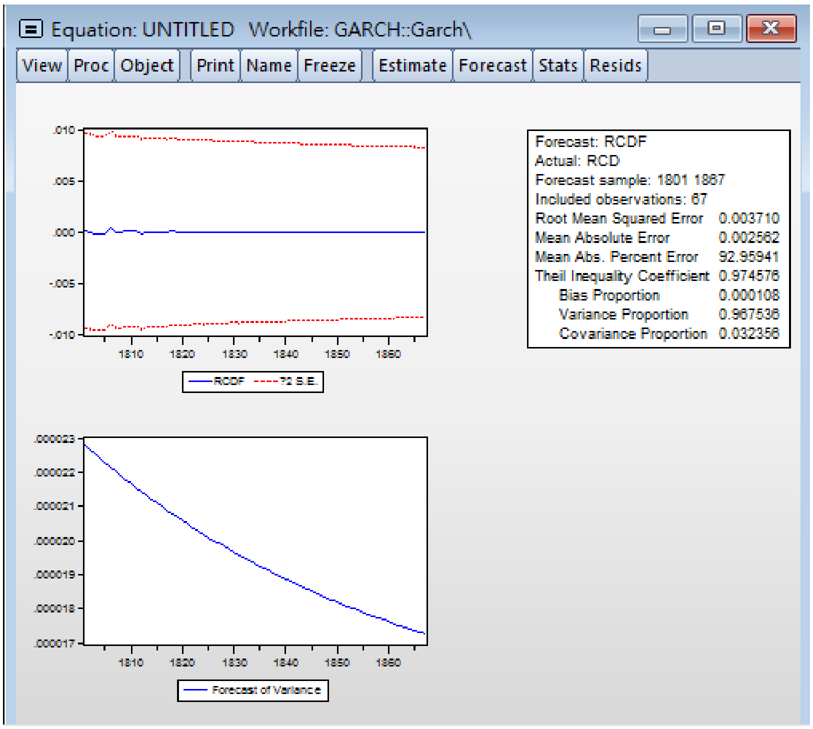
10. Use your preferred model to produce forecasts.

Estimate a new equation, using in-of-sample to forecast out-of-sample

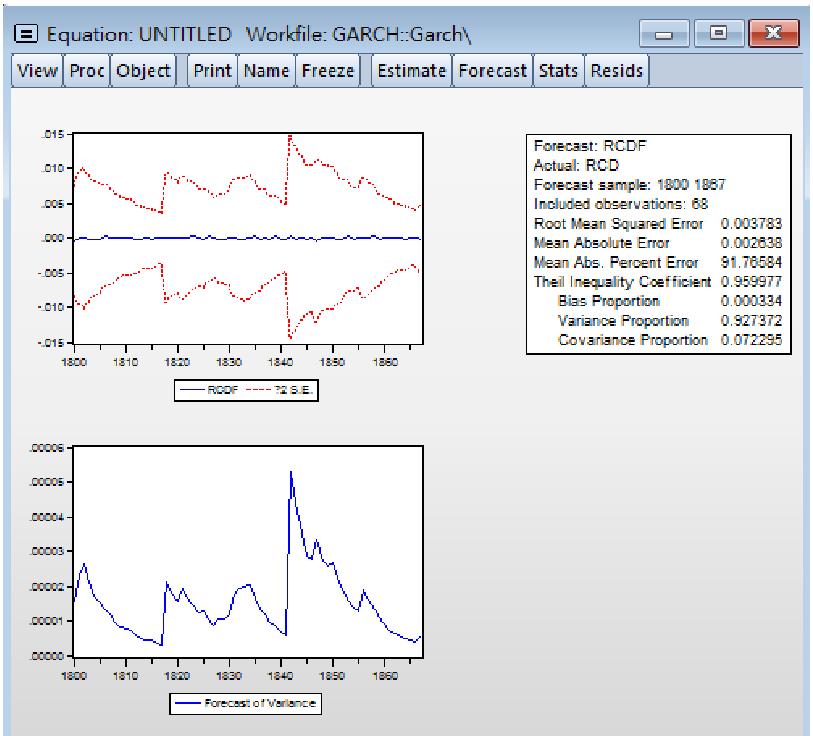




Dynamic forecast(multiple-steps-ahead)



Static forecast(single-step-ahead)



One volatility results in more volatility→ volatility clustering

Static forecast is more unstable.