

Assignment 7

Guideline Solution

The following GARCH model:

Mean Equation: $rfuture_t = \alpha + \beta rspot_t + \varepsilon_t$ (1)

Variance Equation: $\sigma_t^2 = \alpha_0 + \sum_{j=1}^p \delta_j \sigma_{t-j}^2 + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2$ (2)

From the data set Assignment 5-8.dta:

Requirements:

1. Test whether there exists significant ARCH effects.

```
. reg rfuture rspot
```

Source	SS	df	MS	Number of obs	=	7,683
Model	.01531231	1	.01531231	F(1, 7681)	=	6787.70
Residual	.017327485	7,681	2.2559e-06	Prob > F	=	0.0000
				R-squared	=	0.4691
				Adj R-squared	=	0.4691
Total	.032639795	7,682	4.2489e-06	Root MSE	=	.0015

rfuture	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
rspot	.7889924	.0095766	82.39	0.000	.7702196 .8077651
_cons	7.58e-06	.0000171	0.44	0.658	-.0000026 .0000412

```
. estat archlm
```

LM test for autoregressive conditional heteroskedasticity (ARCH)

lags(p)	chi2	df	Prob > chi2
1	6.951	1	0.0084

H0: no ARCH effects vs. H1: ARCH(p) disturbance

- **According to ARCH-effect test, there exists significant ARCH effect.**

2. Estimate GARCH(p,q) for spot return (*rspot*) using future return (*rfuture*) as explanatory variable for mean equation – determine the most appropriated order p and q for variance equation using SBIC given the maximum lag equals to 2.

```
. arch rfuture rspot, arch(1/1) nolog
```

ARCH family regression

Sample: 2 - 7684

Distribution: Gaussian

Log likelihood = -39218.14

Number of obs = 7,683

wald chi2(1) = 110869.07

Prob > chi2 = 0.0000

rfuture	Coef.	OPG Std. Err.	z	P> z	[95% Conf. Interval]
rfuture					
rspot	.8122744	.0024395	332.97	0.000	.8074931 .8170557
_cons	-1.78e-06	.0000129	-0.14	0.890	-.0000027 .0000234
ARCH					

arch						
L1.	.2336897	.0081368	28.72	0.000	.2177418	.2496375
_cons	1.84e-06	8.36e-09	219.94	0.000	1.82e-06	1.86e-06

. estat ic

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39218.14	4	-78428.29	-78400.5

Note: N=Obs used in calculating BIC; see [R] BIC note.

. arch rfuture rspot, arch(1/2) nolog

ARCH family regression

Sample: 2 - 7684
Distribution: Gaussian
Log likelihood = 39351.85

Number of obs = 7,683
Wald chi2(1) = 108339.66
Prob > chi2 = 0.0000

rfuture	Coef.	OPG Std. Err.	z	P> z	[95% Conf. Interval]
rfuture					
rspot	.8356575	.0025388	329.15	0.000	.8306815 .8406336
_cons	-.0000147	9.46e-06	-1.55	0.122	-.0000332 3.90e-06
ARCH					
arch					
L1.	.2468041	.0079396	31.09	0.000	.2312427 .2623654
L2.	.1914985	.0060912	31.44	0.000	.17956 .2034369
_cons	1.50e-06	1.03e-08	145.53	0.000	1.48e-06 1.52e-06

. estat ic

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39351.85	5	-78693.69	-78658.96

Note: N=Obs used in calculating BIC; see [R] BIC note.

. arch rfuture rspot, garch(1/1) arch(1/1) nolog

ARCH family regression

Sample: 2 - 7684
Distribution: Gaussian
Log likelihood = 39695.02

Number of obs = 7,683
Wald chi2(1) = 144307.39
Prob > chi2 = 0.0000

rfuture	Coef.	OPG Std. Err.	z	P> z	[95% Conf. Interval]
rfuture					
rspot	.8163566	.002149	379.88	0.000	.8121447 .8205686
_cons	9.03e-06	.0000117	0.77	0.441	-.000014 .000032
ARCH					
arch					
L1.	.158392	.0035413	44.73	0.000	.1514512 .1653329
garch					
L1.	.7734036	.0038485	200.96	0.000	.7658607 .7809465
_cons	1.95e-07	5.80e-09	33.59	0.000	1.84e-07 2.06e-07

```
. estat ic
```

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39695.02	5	-79380.04	-79345.3

Note: N=Obs used in calculating BIC; see [R] BIC note.

```
. arch rfuture rspot, garch(1/1) arch(1/2) nolog
flat log likelihood encountered, cannot find uphill direction
r(430);
```

```
. arch rfuture rspot, garch(1/2) arch(1/1) nolog
```

ARCH family regression

Sample: 2 - 7684
Distribution: Gaussian
Log likelihood = 39697.75

Number of obs = 7,683
Wald chi2(1) = 118874.79
Prob > chi2 = 0.0000

rfuture	Coef.	OPG Std. Err.	z	P> z	[95% Conf. Interval]	
rfuture						
rspot	.8153053	.0023647	344.78	0.000	.8106705	.81994
_cons	8.43e-06	.0000118	0.71	0.476	-.0000148	.0000316
ARCH						
arch						
L1.	.1729232	.0061172	28.27	0.000	.1609338	.1849126
garch						
L1.	.6135917	.0310709	19.75	0.000	.5526938	.6744896
L2.	.1402191	.0250335	5.60	0.000	.0911543	.1892838
_cons	2.09e-07	8.64e-09	24.17	0.000	1.92e-07	2.26e-07

```
. estat ic
```

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39697.75	6	-79383.5	-79341.82

Note: N=Obs used in calculating BIC; see [R] BIC note.

```
. arch rfuture rspot, arch(1/2) garch(1/2) nolog
flat log likelihood encountered, cannot find uphill direction
r(430);
```

- **According BIC, the most appropriated lags order in this case is GARCH(1,1)**

3. From (2), predict the variance of future return (*rfuture*).

```
. predict sigmahat, v
```

```
. line sigmahat t
```

