Apichaya Wongkolkitsilp
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Assignment 7

1. Test whether there exist significant ARCH effects.

```
. g rspot = (spot/l.spot)-1
(1 missing value generated)

. g rfuture = (future/l.future)-1
(1 missing value generated)
```

```
. reg rfuture rspot
```

Source	SS	df	MS	Number of obs	=	7,683
				F(1, 7681)	=	6787.70
Model	.01531231	1	.01531231	Prob > F	=	0.0000
Residual	.017327485	7,681	2.2559e-06	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	-.000026	.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

Firstly, we use OLS estimation to test the mean equation with the assumption of no ARCH effects. And then, use LM-test to find ARCH effects. From the LM-test, the p-value of Chi^2 is 0.0084 which is lower than 0.05 of the critical point. Then, we reject the null hypothesis, meaning that ARCH effects exist.

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.

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

ARCH family regression

Sample: 2 - 7684                                Number of obs   =      7,683
Distribution: Gaussian                          Wald chi2(1)    =  110869.06
Log likelihood =  39218.14                      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	-.000027	.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                                Number of obs   =      7,683
Distribution: Gaussian                          Wald chi2(1)    =  108337.25
Log likelihood =  39351.85                      Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.8356598	.0025389	329.15	0.000	.8306837	.8406359
_cons	-.0000147	9.46e-06	-1.55	0.121	-.0000332	3.89e-06
ARCH						
arch						
L1.	.2467977	.0079396	31.08	0.000	.2312364	.2623589
L2.	.1915008	.0060913	31.44	0.000	.1795621	.2034395
_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.

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

ARCH family regression

Sample: 2 - 7684                                Number of obs   =      7,683
Distribution: Gaussian                          Wald chi2(1)    =  144306.71
Log likelihood =  39695.02                      Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.8163584	.002149	379.88	0.000	.8121464	.8205704
_cons	9.03e-06	.0000117	0.77	0.442	-.000014	.000032
ARCH						
arch						
L1.	.1583914	.0035413	44.73	0.000	.1514505	.1653322
garch						
L1.	.7734061	.0038485	200.96	0.000	.7658632	.7809491
_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, arch(1/1) garch(1/2) nolog

ARCH family regression

Sample: 2 - 7684                                Number of obs   =      7,683
Distribution: Gaussian                          Wald chi2(1)    =  118874.40
Log likelihood =  39697.75                      Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.815306	.0023647	344.78	0.000	.8106713	.8199407
_cons	8.43e-06	.0000118	0.71	0.476	-.0000148	.0000316
ARCH						
arch						
L1.	.1729268	.0061173	28.27	0.000	.1609371	.1849165
garch						
L1.	.6135949	.031071	19.75	0.000	.5526969	.674493
L2.	.1402142	.0250335	5.60	0.000	.0911494	.189279
_cons	2.09e-07	8.64e-09	24.17	0.000	1.92e-07	2.26e-07

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```
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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(1/1) nolog
flat log likelihood encountered, cannot find uphill direction
r(430);

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

ARCH family regression

Sample: 2 - 7684                                Number of obs   =      7,683
Distribution: Gaussian                          Wald chi2(1)    =  110218.44
Log likelihood =  39717.26                      Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.8240952	.0024823	331.99	0.000	.81923	.8289603
_cons	9.85e-06	.0000119	0.83	0.409	-.0000135	.0000332
ARCH						
arch						
L1.	.13296	.0033007	40.28	0.000	.1264908	.1394292
L2.	.1345722	.0032469	41.45	0.000	.1282084	.140936
garch						
L1.	-.1805799	.0040099	-45.03	0.000	-.1884392	-.1727207
L2.	.8100838	.0034601	234.12	0.000	.8033022	.8168653
_cons	2.94e-07	1.07e-08	27.39	0.000	2.73e-07	3.15e-07

```
. estat ic

Akaike's information criterion and Bayesian information criterion
```

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39717.26	7	-79420.51	-79371.89

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

From the estimated results, the model that has the lowest value of SBIC is GARCH(2,2) in which SBIC equals to -79,371.89. Therefore, GARCH(2,2) is the most appropriated model with a maximum lag of 2.

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

```
. predict sigmahat, v

. line sigmahat t
```