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Assignment 7

1. Test whether there exists significant ARCH effects.

```
. reg rfuture rspot if t>1
```

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

From running ARCH effect test, it shows us that Prob>Chi2 is 0.0084 which is less than 0.05 significant level. Thus, we reject the H_0: no ARCH effects. There is an ARCH.

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.

```
. reg rspot rfuture if t>1
```

Source	SS	df	MS	Number of obs	=	7,683
				F(1, 7681)	=	6787.70
Model	.011539538	1	.011539538	Prob > F	=	0.0000
Residual	.013058198	7,681	1.7001e-06	R-squared	=	0.4691
				Adj R-squared	=	0.4691
Total	.024597736	7,682	3.2020e-06	Root MSE	=	.0013

rspot	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rfuture	.594594	.007217	82.39	0.000	.5804466	.6087413
_cons	8.01e-06	.0000149	0.54	0.590	-.0000212	.0000372

```
. est store ols

. est table ols arch*, star(0.1 0.05 0.01) stat(N rss LL F chi2 aic bic)
```

Variable	ols	arch1	arch2
_			
rfuture	.59459397***		
_cons	8.007e-06		
rfuture			
rspot		.81227442***	.83565658***
_cons		-1.776e-06	-.00001465
ARCH			
arch			
L1.		.23368968***	.24680333***
L2.			.19149974***
_cons		1.839e-06***	1.497e-06***
Statistics			
N	7683	7683	7683
rss	.0130582		
LL			
F	6787.7049		
chi2		110868.99	108339.96
aic	-80262.049	-78428.289	-78693.691
bic	-80248.155	-78400.502	-78658.957

legend: * p<.1; ** p<.05; *** p<.01

```
//Estimate ARCH(q) using MLE
qui arch rfuture rspot, arch(1) nolog
est store arch1
qui arch rfuture rspot, arch(1/2) nolog
est store arch2
est table ols arch*, star(0.1 0.05 0.01) stat(N rss LL F chi2 aic bic)

  //Estimate GARCH(p,q) using MLE
  qui arch rspot rfuture, arch(1) garch(1) nolog
  est store garch11
  qui arch rspot rfuture, arch(1) garch(1/2) nolog
  est store garch21
  qui arch rspot rfuture, arch(1/2) garch(1) nolog
  est store garch12
  qui arch rspot rfuture, arch(1/2) garch(1/2) nolog
  est store garch22
  est table garch*, star(0.1 0.05 0.01) stat(N LL chi2 aic bic)
```

```
. est table garch*, star(0.1 0.05 0.01) stat(N LL chi2 aic bic)
```

Variable	garch11	garch21	garch12	garch22
rspot				
rfuture	.64717084***	.64002048***	.62591038***	.62371083***
_cons	6.460e-07	-2.531e-06	-8.750e-06	-.00001062
ARCH				
arch				
L1.	.18339114***	.17044696***	.10390572***	.10141532***
L2.			.23783658***	.29885683***
garch				
L1.	.60659952***	.84899371***	.34036795***	.07659108***
L2.		-.20697486***		.17715968***
_cons	3.858e-07***	3.503e-07***	6.225e-07***	6.862e-07***
Statistics				
N	7683	7683	7683	7683
LL				
chi2	126854.57	131273.47	127297.52	120955.35
aic	-81027.53	-81061.507	-81150.803	-81192.527
bic	-80992.796	-81019.826	-81109.122	-81143.899

legend: * p<.1; ** p<.05; *** p<.01

From GARCH table on the left, the model with the lowest BIC or SBIC (-81143.899), with the maximum lag equals to 2, is GARCH(2, 2). Thus, the most appropriated order of p, and q is 2 and 2, respectively.

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

```
//Forecast using GARCH(2,2)
arch rspot rfuture, arch(1/2) garch(1/2) nolog
predict sigma2, variance
line sigma2 t
```