Assignment 8
Guideline Solution

The following VARs models:

$$Y_t = A_0 + A_1 Y_{t-1} + \in_t$$

where: $Y_t = \begin{pmatrix} rspot_t \\ rfuture_t \end{pmatrix}$, $A_0 = \begin{pmatrix} a_{10} \\ a_{20} \end{pmatrix}$, $A_1 = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$, $\in_t = \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix}$

From the data set assign04.dta:

Requirements:

1. Estimate VARs models using spot return (*rspot*) and future return (*rfuture*) as endogenous variables and determine the most appropriated lags models using SBIC.

```
. varsoc rfuture rspot, maxlag(10)

   Selection-order criteria
   Sample:  12 - 7684                              Number of obs      =      7673
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE        AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 |  76671.7                      7.2e-12  -19.9843  -19.9837  -19.9825  |
  |  1 |  76840.9   338.5    4  0.000  6.9e-12  -20.0274  -20.0255  -20.0219  |
  |  2 |  76931.4   180.85   4  0.000  6.7e-12  -20.0499  -20.0468  -20.0408  |
  |  3 |  76963.2   63.709   4  0.000  6.7e-12  -20.0571  -20.0528  -20.0445  |
  |  4 |  76979.4   32.291   4  0.000  6.7e-12  -20.0603  -20.0547   -20.044  |
  |  5 |  77017.6   76.544   4  0.000  6.6e-12  -20.0692  -20.0624  -20.0493  |
  |  6 |  77049.6   63.872   4  0.000  6.5e-12  -20.0765  -20.0684   -20.053* |
  |  7 |  77059.6   20.054   4  0.000  6.5e-12  -20.0781  -20.0688  -20.0509  |
  |  8 |  77070.3   21.332   4  0.000  6.5e-12  -20.0798  -20.0693* -20.0491  |
  |  9 |  77076.4    12.37*  4  0.015  6.5e-12* -20.0804* -20.0686   -20.046  |
  | 10 |  77080.2   7.4487   4  0.114  6.5e-12  -20.0803  -20.0673  -20.0423  |
  +---------------------------------------------------------------------------+
   Endogenous:  rfuture rspot
    Exogenous:  _cons
```

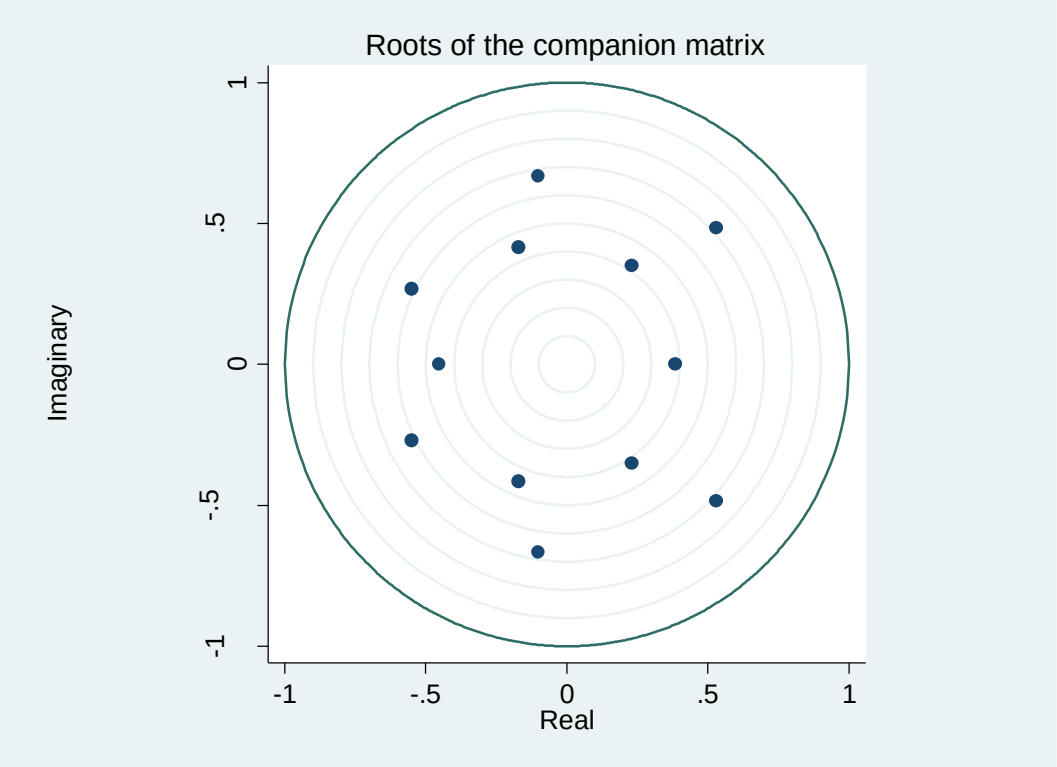
- ***According to SBIC, the most appropriated lag order is* 6.**

2. Perform stability test and Granger exogeneity test.

```
. var rfuture rspot, lag(1/6)

Vector autoregression

Sample:  8 - 7684                               Number of obs     =      7,677
Log likelihood =    77062.5                     AIC               =  -20.06943
FPE            =   6.59e-12                     HQIC              =  -20.06136
Det(Sigma_ml)  =   6.55e-12                     SBIC              =   -20.0459

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
rfuture              13     .002042   0.0211   165.0864   0.0000
rspot                13     .001777   0.0159   124.0308   0.0000
------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
rfuture      |
     rfuture |
         L1. |  -.1623592   .0160974   -10.09   0.000    -.1939096   -.1308088
```

```
         L2. |  -.1054217   .0165328    -6.38   0.000    -.1378253    -.073018
         L3. |  -.0724314   .0167319    -4.33   0.000    -.1052253   -.0396376
         L4. |   -.042915   .0167203    -2.57   0.010    -.0756863   -.0101437
         L5. |  -.0604119    .016544    -3.65   0.000    -.0928375   -.0279863
         L6. |  -.0392965   .0161092    -2.44   0.015    -.0708699   -.0077232
             |
       rspot |
         L1. |   .2117743   .0185008    11.45   0.000     .1755133    .2480352
         L2. |   .0743206   .0188235     3.95   0.000     .0374272    .1112139
         L3. |   .0828566   .0190252     4.36   0.000     .0455679    .1201454
         L4. |   .0448446   .0190355     2.36   0.018     .0075357    .0821535
         L5. |   .0674903   .0187999     3.59   0.000     .0306433    .1043374
         L6. |   .0590473   .0184511     3.20   0.001     .0228838    .0952109
             |
       _cons |   .0000259   .0000233     1.11   0.266    -.0000198    .0000715
-------------+------------------------------------------------------------------
rspot        |
     rfuture |
         L1. |   .1025108   .0140081     7.32   0.000     .0750554    .1299661
         L2. |   .0827253   .0143869     5.75   0.000     .0545274    .1109231
         L3. |   .0530446   .0145602     3.64   0.000     .0245072     .081582
         L4. |    .057478   .0145501     3.95   0.000     .0289603    .0859958
         L5. |   .0435619   .0143967     3.03   0.002     .0153449    .0717788
         L6. |   .0372007   .0140183     2.65   0.008     .0097254     .064676
             |
       rspot |
         L1. |  -.0429887   .0160995    -2.67   0.008    -.0745432   -.0114342
         L2. |  -.1255145   .0163803    -7.66   0.000    -.1576194   -.0934097
         L3. |  -.0654555   .0165559    -3.95   0.000    -.0979044   -.0330066
         L4. |  -.0555308   .0165648    -3.35   0.001    -.0879973   -.0230644
         L5. |  -.0646528   .0163598    -3.95   0.000    -.0967173   -.0325882
         L6. |  -.0420281   .0160563    -2.62   0.009    -.0734979   -.0105584
             |
       _cons |   .0000232   .0000203     1.14   0.252    -.0000165    .0000629
------------------------------------------------------------------------------
```

```
. varstable, graph

   Eigenvalue stability condition
  +---------------------------------------+
  |        Eigenvalue         |   Modulus   |
  |---------------------------+-------------|
  |   .5279554 +  .4847924i   |   .716771   |
  |   .5279554 -  .4847924i   |   .716771   |
  |  -.1022778 +  .6675194i   |    .67531   |
  |  -.1022778 -  .6675194i   |    .67531   |
  |  -.5513603 +  .2689237i   |   .613448   |
  |  -.5513603 -  .2689237i   |   .613448   |
  |  -.4536067                |   .453607   |
  |  -.1726167 +  .4151256i   |   .449584   |
  |  -.1726167 -  .4151256i   |   .449584   |
  |   .2305361 +  .3500458i   |   .419141   |
  |   .2305361 -  .3500458i   |   .419141   |
  |   .3837855                |   .383786   |
  +---------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.
```




```
. vargranger

  Granger causality Wald tests
  +-------------------------------------------------------------------------+
  |          Equation           Excluded |   chi2     df Prob > chi2 |
  |-------------------------------------+-----------------------------|
  |            rfuture              rspot |  148.42     6    0.000     |
  |            rfuture                ALL |  148.42     6    0.000     |
  |-------------------------------------+-----------------------------|
  |              rspot            rfuture |  82.299     6    0.000     |
  |              rspot                ALL |  82.299     6    0.000     |
  +-------------------------------------------------------------------------+
```

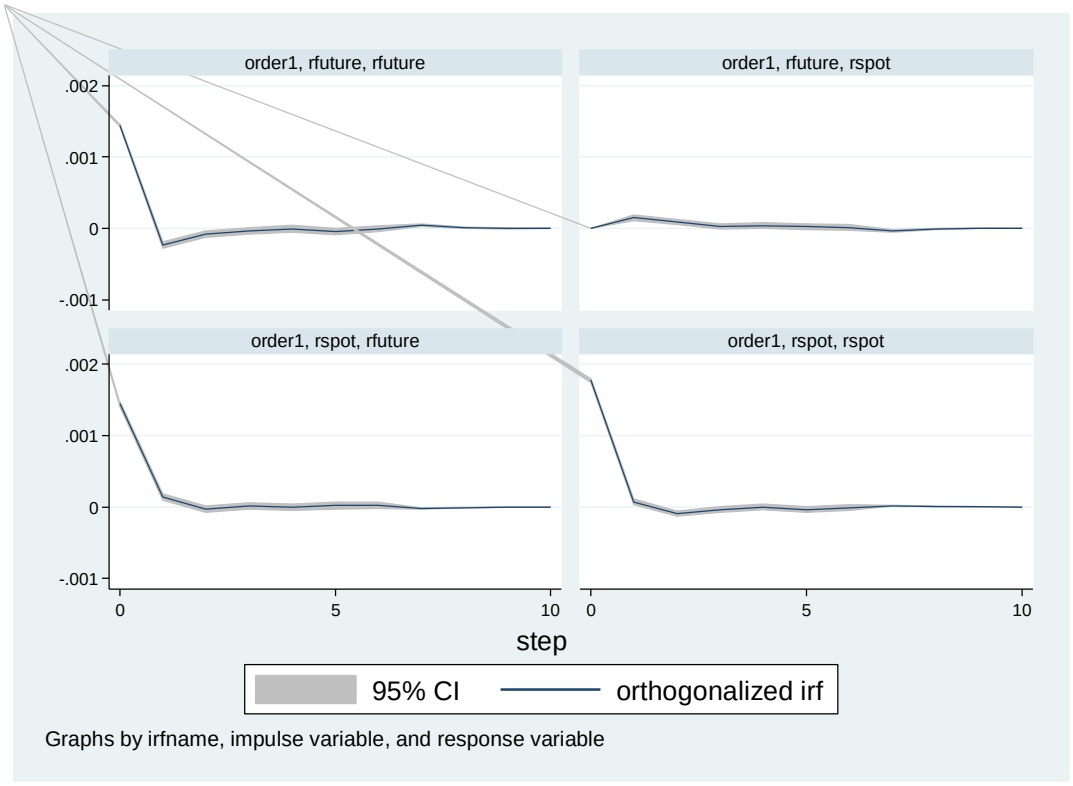
- ***According to stability test, the system is stable since all the eigenvalues lie inside the unit circle.***
- ***According to Granger exogeneity, both rspot and rfuture are all endogenous variables since all the tests are significant.***

3. Perform Impulse response analysis (irf, oirf, coirf), make interpretation of the results (Direction, Magnitude, & Duration), and determine which variable has more impact.

```
. irf create order1, o(rspot rfuture) step(10) set(irf01)
(file irf01.irf created)
(file irf01.irf now active)
(file irf01.irf updated)

. irf table oirf, impulse(rspot rfuture) response(rspot rfuture)

                                Results from order1
+-------------------------------------------------------------------------------+
|        |    (1)         (1)         (1)     |    (2)         (2)         (2)    |
|  step  |   oirf       Lower       Upper     |   oirf       Lower       Upper    |
|--------+-------------------------------------+-------------------------------|
|0       | .001775     .001747     .001803     | .001444     .001404     .001483   |
|1       | .000072     .000032     .000112     | .000142     .000096     .000188   |
|2       | -.000092    -.000132    -.000052    | -.000028    -.000074    .000018   |
|3       | -.000036    -.000076    4.1e-06     | .000018     -.000028    .000064   |
|4       | -1.8e-07    -.00004     .00004      | -1.0e-06    -.000047    .000045   |
```

```
|5        | -.000037    -.000077    2.5e-06   | .00002      -.000026    .000066   |
|6        | -9.0e-06    -.000049    .000031   | .000026     -.00002     .000072   |
|7        | .000019     .000011     .000028   | -.000019    -.000028    -1.0e-05  |
|8        | 9.9e-06     3.6e-06     .000016   | -8.5e-06    -.000015    -2.5e-06  |
|9        | 2.0e-06     -1.8e-06    5.8e-06   | -1.0e-06    -4.7e-06    2.7e-06   |
|10       | 8.3e-07     -2.1e-06    3.8e-06   | 6.5e-09     -3.0e-06    3.0e-06   |
+-------------------------------------------------------------------------------+

+-------------------------------------------------------------------------------+
|         |    (3)         (3)         (3)    |    (4)         (4)         (4)    |
|  step   |   oirf       Lower       Upper    |   oirf       Lower       Upper    |
|---------+-----------------------------------+-----------------------------------|
|0        | 0           0           0         | .001441     .001419     .001464   |
|1        | .000148     .000108     .000187   | -.000234    -.00028     -.000188  |
|2        | .000089     .000049     .000128   | -.000083    -.000128    -.000037  |
|3        | .000026     -.000013    .000066   | -.000037    -.000082    9.2e-06   |
|4        | .000038     -1.6e-06    .000077   | -5.9e-06    -.000051    .00004    |
|5        | .000022     -.000017    .000062   | -.000042    -.000087    2.9e-06   |
|6        | 1.0e-05     -.000029    .000049   | -5.1e-06    -.00005     .000039   |
|7        | -.000038    -.000053    -.000023  | .000044     .000026     .000063   |
|8        | -.000012    -.000021    -2.6e-06  | 5.4e-06     -3.2e-06    .000014   |
|9        | -2.9e-07    -5.1e-06    4.5e-06   | -9.4e-07    -5.5e-06    3.6e-06   |
|10       | 7.2e-07     -3.3e-06    4.8e-06   | -5.0e-07    -4.6e-06    3.6e-06   |
+-------------------------------------------------------------------------------+
95% lower and upper bounds reported
(1) irfname = order1, impulse = rspot, and response = rspot
(2) irfname = order1, impulse = rspot, and response = rfuture
(3) irfname = order1, impulse = rfuture, and response = rspot
(4) irfname = order1, impulse = rfuture, and response = rfuture
```

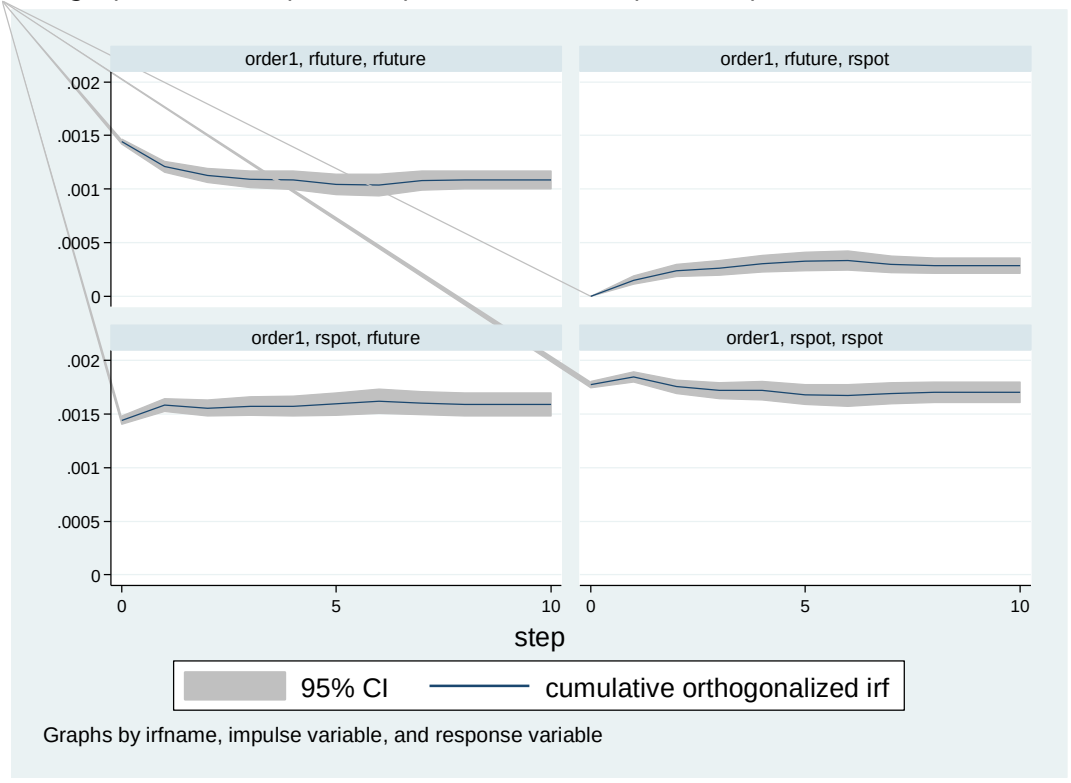
```
. irf graph oirf, impulse(rspot rfuture) response(rspot rfuture)
```




```
. irf table coirf, impulse(rspot rfuture) response(rspot rfuture)

                                Results from order1

+-------------------------------------------------------------------------------+
|         |    (1)         (1)         (1)    |    (2)         (2)         (2)    |
|  step   |  coirf       Lower       Upper    |  coirf       Lower       Upper    |
|---------+-----------------------------------+-----------------------------------|
|0        | .001775     .001747     .001803   | .001444     .001404     .001483   |
|1        | .001847     .001798     .001896   | .001585     .001527     .001644   |
```

```
|2        | .001755     .001691     .001819   | .001557     .001484     .00163    |
|3        | .001719     .001644     .001794   | .001575     .001491     .001659   |
|4        | .001719     .001635     .001803   | .001574     .00148      .001668   |
|5        | .001682     .001589     .001774   | .001594     .001491     .001697   |
|6        | .001673     .001573     .001772   | .00162      .001509     .001731   |
|7        | .001692     .001594     .00179    | .001601     .001492     .00171    |
|8        | .001702     .001606     .001797   | .001592     .001485     .001699   |
|9        | .001704     .001609     .001798   | .001591     .001485     .001698   |
|10       | .001705     .00161      .001799   | .001591     .001485     .001698   |
+-------------------------------------------------------------------------------+

+-------------------------------------------------------------------------------+
|         |    (3)          (3)          (3)    |    (4)          (4)          (4)  |
|  step   |  coirf        Lower        Upper    |  coirf        Lower        Upper  |
|---------+-------------------------------------+-------------------------------|
|0        | 0             0            0        | .001441     .001419     .001464   |
|1        | .000148     .000108     .000187     | .001207     .001158     .001257   |
|2        | .000237     .00018      .000294     | .001125     .001059     .00119    |
|3        | .000263     .000194     .000332     | .001088     .00101      .001166   |
|4        | .000301     .000223     .000379     | .001082     .000995     .00117    |
|5        | .000323     .000238     .000409     | .00104      .000945     .001136   |
|6        | .000333     .000242     .000424     | .001035     .000934     .001136   |
|7        | .000295     .000216     .000374     | .001079     .000991     .001167   |
|8        | .000284     .00021      .000357     | .001085     .001001     .001168   |
|9        | .000283     .000211     .000355     | .001084     .001001     .001166   |
|10       | .000284     .000212     .000356     | .001083     .001001     .001166   |
+-------------------------------------------------------------------------------+
95% lower and upper bounds reported
(1) irfname = order1, impulse = rspot, and response = rspot
(2) irfname = order1, impulse = rspot, and response = rfuture
(3) irfname = order1, impulse = rfuture, and response = rspot
(4) irfname = order1, impulse = rfuture, and response = rfuture
```

```
. irf graph coirf, impulse(rspot rfuture) response(rspot rfuture)
```



- ***According to IRF analysis, rspot has more impact on rfuture.***

4. Perform Forecast error variance decomposition and determine variable that has the largest impact on each endogenous variable.

```
. irf table fevd, impulse(rspot rfuture) response(rspot rfuture)

                    Results from order1
```

step	(1) fevd	(1) Lower	(1) Upper	(2) fevd	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1	1	1	.500791	.484986	.516596
2	.993131	.989465	.996798	.496679	.480799	.512558
3	.990693	.98638	.995006	.495972	.480066	.511879
4	.990483	.986145	.994821	.495855	.479951	.51176
5	.990038	.98565	.994426	.495851	.479947	.511756
6	.989888	.985487	.994289	.495689	.479783	.511594
7	.989857	.985466	.994248	.495767	.479862	.511672
8	.989415	.984856	.993973	.495582	.479675	.511488
9	.989372	.9848	.993944	.495587	.479681	.511493
10	.989372	.9848	.993944	.495587	.479681	.511493

step	(3) fevd	(3) Lower	(3) Upper	(4) fevd	(4) Lower	(4) Upper
0	0	0	0	0	0	0
1	0	0	0	.499209	.483404	.515014
2	.006869	.003202	.010535	.503321	.487442	.519201
3	.009307	.004994	.01362	.504028	.488121	.519934
4	.009517	.005179	.013855	.504145	.48824	.520049
5	.009962	.005574	.01435	.504149	.488244	.520053
6	.010112	.005711	.014513	.504311	.488406	.520217
7	.010143	.005752	.014534	.504233	.488328	.520138
8	.010585	.006027	.015144	.504418	.488512	.520325
9	.010628	.006056	.0152	.504413	.488507	.520319
10	.010628	.006056	.0152	.504413	.488507	.520319

95% lower and upper bounds reported
(1) irfname = order1, impulse = rspot, and response = rspot
(2) irfname = order1, impulse = rspot, and response = rfuture
(3) irfname = order1, impulse = rfuture, and response = rspot
(4) irfname = order1, impulse = rfuture, and response = rfuture

- ***According to Forecast error variance decomposition, rspot has more impact on rfuture.***