Assignment 15
VARs Models
Guideline Solutions

From the data set `assign_timeseries.dta`:

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 rspot rfuture

   Selection-order criteria
   Sample:  6 - 795                                  Number of obs      =       790
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 |  4781.51                       1.9e-08     -12.1  -12.0955  -12.0882  |
  |  1 |  4844.67  126.31    4  0.000  1.6e-08  -12.2498  -12.2362  -12.2143  |
  |  2 |  4864.91  40.486    4  0.000  1.6e-08  -12.2909  -12.2682  -12.2318  |
  |  3 |  4889.07  48.318*   4  0.000  1.5e-08* -12.3419* -12.3101* -12.2592* |
  |  4 |  4891.32  4.4952    4  0.343  1.5e-08  -12.3375  -12.2966  -12.2311  |
  +---------------------------------------------------------------------------+
   Endogenous:  rspot rfuture
    Exogenous:  _cons
```

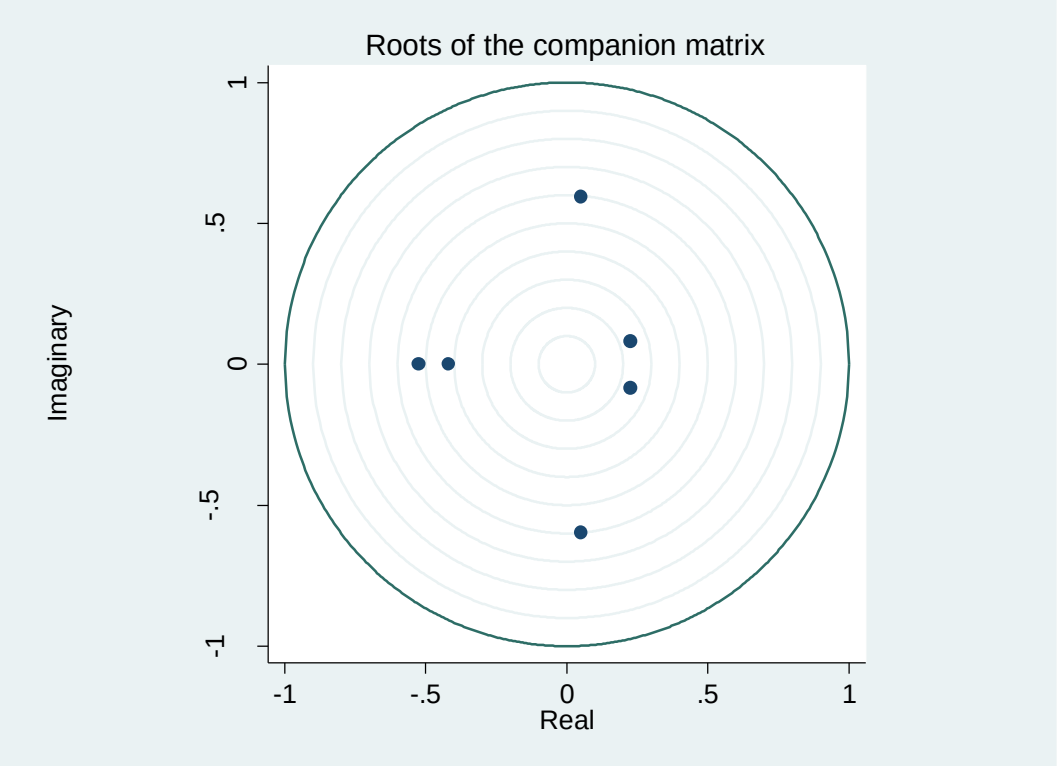
- ***According to SBIC, the most appropriated lag order is 3.***

2. Perform stability test and Granger exogeneity test.

```
. var rspot rfuture, lag(1/3)

Vector autoregression

Sample:  5 - 795                                  Number of obs     =       791
Log likelihood =    4893.31                       AIC               =  -12.33707
FPE            =   1.50e-08                       HQIC              =  -12.30527
Det(Sigma_ml)  =   1.45e-08                       SBIC              =  -12.25435

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
rspot                  7     .018581   0.0169     13.624   0.0341
rfuture                7       .0217   0.0338   27.62952   0.0001
------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
rspot        |
       rspot |
         L1. |   .1282088   .1145511     1.12   0.263    -.0963071    .3527248
         L2. |   .2334538    .118681     1.97   0.049     .0008434    .4660643
         L3. |  -.1169759   .1100791    -1.06   0.288     -.332727    .0987753
             |
     rfuture |
         L1. |  -.0590319   .0980706    -0.60   0.547    -.2512466    .1331829
         L2. |  -.1415632   .1041653    -1.36   0.174    -.3457234     .062597
         L3. |   .1057702    .096238     1.10   0.272    -.0828529    .2943933
             |
       _cons |   -.000025   .0006579    -0.04   0.970    -.0013144    .0012644
-------------+----------------------------------------------------------------
rfuture      |
       rspot |
         L1. |   .5741704   .1337768     4.29   0.000     .3119727    .8363682
         L2. |   .5086657   .1385999     3.67   0.000      .237015    .7803165
         L3. |   .0617779   .1285544     0.48   0.631     -.190184    .3137398
             |
```

```
------------------------------------------------------------------------------
     rfuture |
         L1. |   -.520118   .1145303    -4.54   0.000    -.7445933   -.2956428
         L2. |  -.4253538   .1216479    -3.50   0.000    -.6637794   -.1869283
         L3. |  -.0947954   .1123902    -0.84   0.399    -.3150762    .1254854
             |
       _cons |   .0000732   .0007683     0.10   0.924    -.0014326     .001579
------------------------------------------------------------------------------
```

```
. varstable, graph

   Eigenvalue stability condition
  +--------------------------------------+
  |        Eigenvalue        |   Modulus   |
  |--------------------------+-------------|
  |  .05126276 +  .5960908i  |   .598291   |
  |  .05126276 -  .5960908i  |   .598291   |
  |  -.5255917               |   .525592   |
  |  -.4199276               |   .419928   |
  |   .2255423 +  .0823411i  |   .240103   |
  |   .2255423 -  .0823411i  |   .240103   |
  +--------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.
```



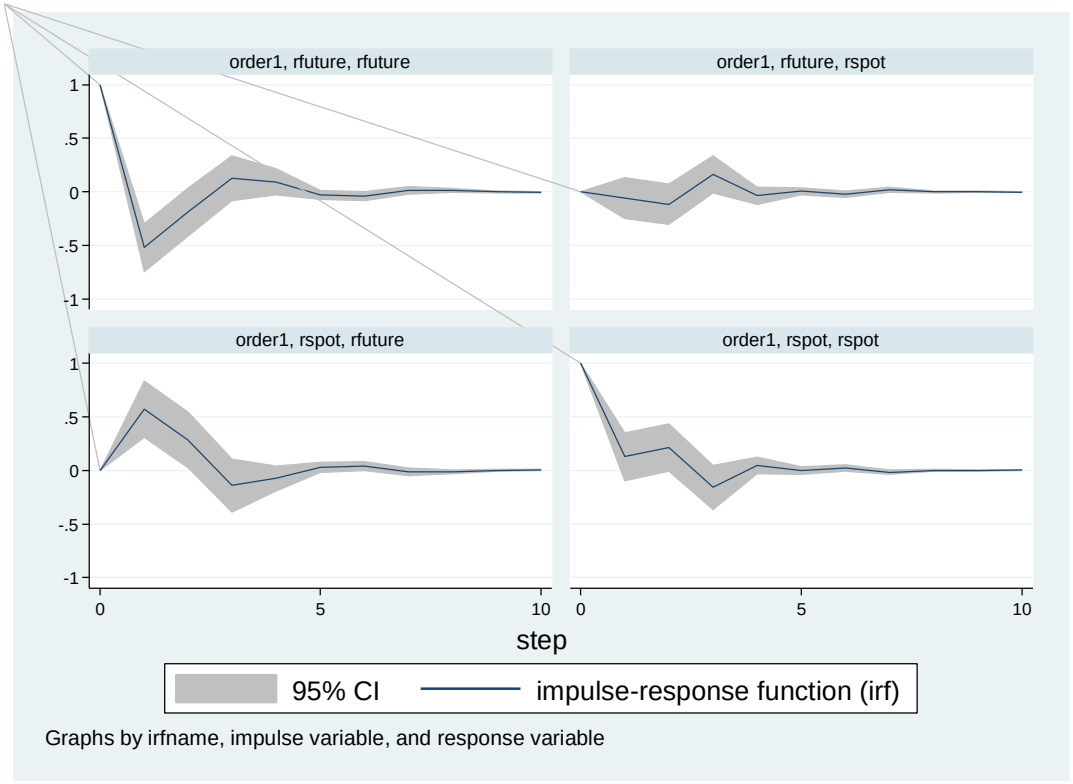

```
. vargranger

   Granger causality Wald tests
  +-------------------------------------------------------------------------+
  |          Equation           Excluded |   chi2     df Prob > chi2 |
  |--------------------------------------+--------------------------|
  |              rspot            rfuture |  4.8624     3    0.182     |
  |              rspot                ALL |  4.8624     3    0.182     |
  |--------------------------------------+--------------------------|
  |            rfuture              rspot |   25.19     3    0.000     |
  |            rfuture                ALL |   25.19     3    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 is endogenous variable since the tests are significant while rfuture seems not to be endogenous.***

3. Perform Impulse response function analysis (irf), Orthogonal impulse response function analysis (oirf), Cumulative impulse response function analysis (coirf), make interpretation of the analysis, and determine which variable has more impact (using Cholesky order – rspot rfuture).

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

                                    Results from order1

+-------------------------------------------------------------------------------+
|        |    (1)         (1)         (1)    |    (2)         (2)         (2)    |
|  step  |   irf        Lower       Upper    |   irf        Lower       Upper    |
|--------+-----------------------------------+-----------------------------------|
|0       | 1           1           1        | 0           0           0        |
|1       | .128209     -.096307    .352725  | .57417      .311973     .836368  |
|2       | .215997     -.004582    .436576  | .283643     .022104     .545182  |
|3       | -.157378    -.363594    .048839  | -.140741    -.388189    .106707  |
|4       | .044136     -.033389    .12166   | -.074446    -.192648    .043755  |
|5       | -.002029    -.037484    .033426  | .03033      -.017472    .078132  |
|6       | .022315     -.005354    .049985  | .040795     -.001138    .082729  |
|7       | -.017352    -.039079    .004376  | -.012555    -.046981    .021871  |
|8       | .001396     -.007411    .010204  | -.012435    -.030685    .005816  |
|9       | .000344     -.005515    .006203  | .001295     -.00695     .00954   |
|10      | .002756     -.001529    .00704   | .005642     -.001275    .012559  |
+-------------------------------------------------------------------------------+

+-------------------------------------------------------------------------------+
|        |    (3)         (3)         (3)    |    (4)         (4)         (4)    |
|  step  |   irf        Lower       Upper    |   irf        Lower       Upper    |
|--------+-----------------------------------+-----------------------------------|
|0       | 0           0           0        | 1           1           1        |
|1       | -.059032    -.251247    .133183  | -.520118    -.744593    -.295643 |
|2       | -.118428    -.30696     .070103  | -.188725    -.412415    .034964  |
|3       | .161576     -.013545    .336696  | .126573     -.084013    .337158  |
|4       | -.035795    -.116425    .044835  | .092632     -.027457    .212721  |
|5       | .003637     -.027138    .034412  | -.029808    -.073835    .014219  |
|6       | -.024757    -.053973    .00446   | -.042034    -.084634    .000566  |
|7       | .018361     -.003916    .040638  | .011184     -.023351    .04572   |
|8       | -.001713    -.010741    .007314  | .013062     -.005704    .031828  |
|9       | .000162     -.00564     .005964  | -.00074     -.00899     .00751   |
|10      | -.003149    -.007589    .001291  | -.005875    -.012953    .001203  |
+-------------------------------------------------------------------------------+
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 irf, impulse(rspot rfuture) response(rspot rfuture)
```



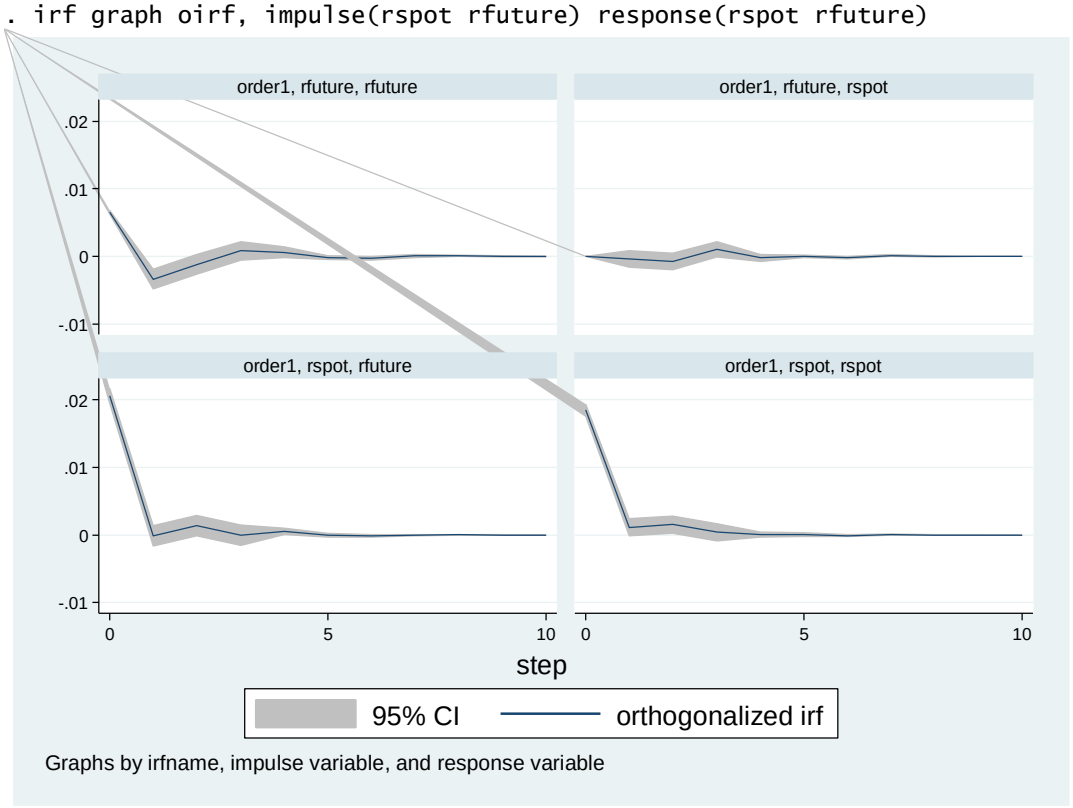

```
. irf table oirf, impulse(rspot rfuture) response(rspot rfuture)

                                                Results from order1
```

step	(1) oirf	(1) Lower	(1) Upper	(2) oirf	(2) Lower	(2) Upper
0	.018499	.017587	.019411	.020599	.019487	.021711
1	.001156	-.000134	.002445	-.000092	-.001615	.00143
2	.001556	.000268	.002844	.00136	-.000159	.002878
3	.000417	-.000872	.001706	3.7e-06	-.001515	.001522
4	.000079	-.000334	.000492	.000531	.000055	.001007
5	.000037	-.000242	.000317	-.000053	-.000327	.000222
6	-.000097	-.00025	.000055	-.000111	-.000265	.000043
7	.000057	-.000016	.000131	-1.9e-06	-.000115	.000111
8	-9.5e-06	-.000045	.000026	.000039	-.000017	.000095
9	9.7e-06	-.000016	.000035	8.7e-06	-.000023	.000041
10	-.000014	-.000032	4.7e-06	-.000017	-.000039	5.8e-06

step	(3) oirf	(3) Lower	(3) Upper	(4) oirf	(4) Lower	(4) Upper
0	0	0	0	.006512	.006191	.006833
1	-.000384	-.001636	.000867	-.003387	-.004858	-.001916
2	-.000771	-.002	.000457	-.001229	-.002687	.000229
3	.001052	-.000089	.002194	.000824	-.000548	.002196
4	-.000233	-.000758	.000292	.000603	-.000179	.001386
5	.000024	-.000177	.000224	-.000194	-.000481	.000093
6	-.000161	-.000352	.000029	-.000274	-.000551	4.0e-06
7	.00012	-.000026	.000265	.000073	-.000152	.000298
8	-.000011	-.00007	.000048	.000085	-.000037	.000207
9	1.1e-06	-.000037	.000039	-4.8e-06	-.000059	.000049
10	-.000021	-.000049	8.4e-06	-.000038	-.000084	7.9e-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
```

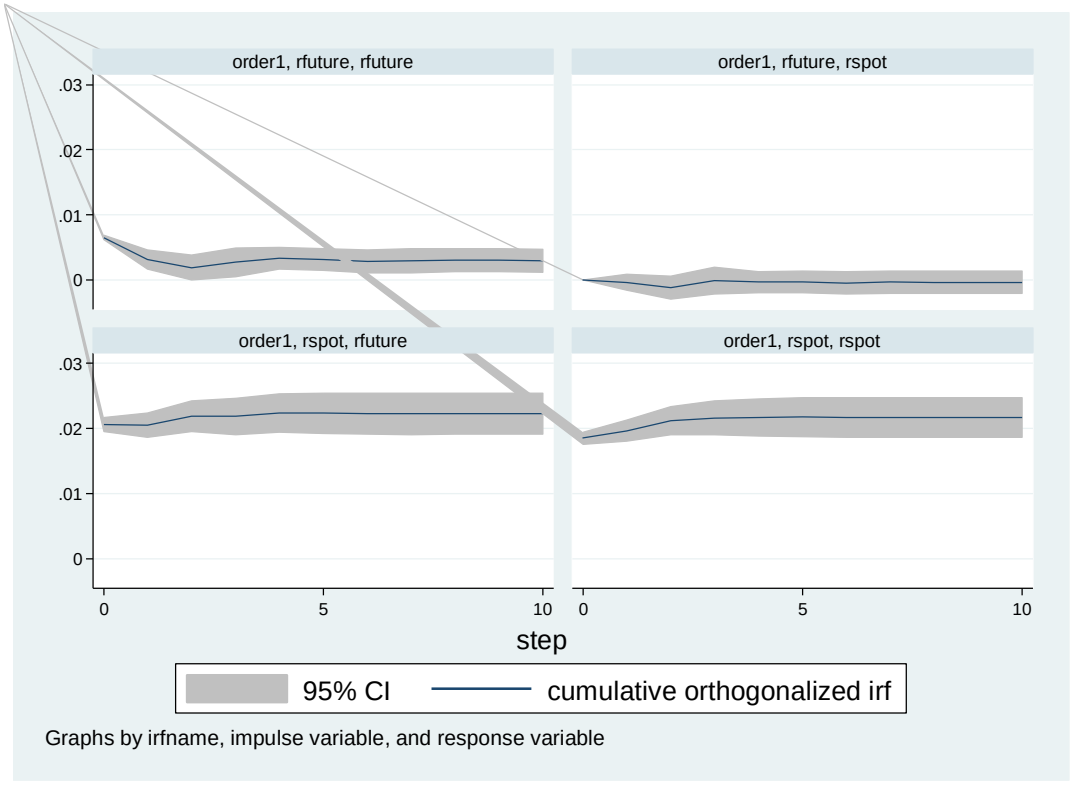
step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	.018499	.017587	.019411	.020599	.019487	.021711
1	.019655	.018043	.021266	.020507	.018681	.022332
2	.021211	.01906	.023362	.021866	.019517	.024215
3	.021628	.019017	.024239	.02187	.019072	.024668
4	.021707	.018875	.024539	.022401	.019447	.025355
5	.021744	.018756	.024733	.022348	.019246	.025449
6	.021647	.018604	.024691	.022237	.019084	.025389
7	.021704	.018654	.024755	.022235	.019068	.025401
8	.021695	.018639	.024751	.022274	.019106	.025441
9	.021705	.018651	.024758	.022283	.019118	.025447
10	.021691	.018633	.024748	.022266	.019097	.025435

step	(3) coirf	(3) Lower	(3) Upper	(4) coirf	(4) Lower	(4) Upper
0	0	0	0	.006512	.006191	.006833
1	-.000384	-.001636	.000867	.003125	.001655	.004595
2	-.001156	-.002924	.000612	.001896	-.000065	.003858
3	-.000103	-.002162	.001955	.00272	.000502	.004939
4	-.000337	-.001961	.001288	.003324	.001697	.004951
5	-.000313	-.00196	.001334	.003129	.001427	.004832
6	-.000474	-.002169	.001221	.002856	.001078	.004633
7	-.000355	-.0021	.001391	.002929	.001091	.004766
8	-.000366	-.002066	.001334	.003014	.001258	.004769
9	-.000365	-.002057	.001328	.003009	.001257	.004761
10	-.000385	-.002087	.001316	.002971	.001202	.004739

```
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 (fevd) and determine variable that has more 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	.909133	.897058	.921209
2	.99957	.99677	1.00237	.887324	.863844	.910804
3	.997858	.991698	1.00402	.884973	.861047	.908899
4	.994684	.985216	1.00415	.883726	.859086	.908366
5	.994529	.984823	1.00424	.883128	.858185	.908071
6	.994528	.984818	1.00424	.88306	.858024	.908096
7	.994454	.984616	1.00429	.882926	.857813	.908039
8	.994413	.984505	1.00432	.882916	.857791	.908042
9	.994412	.984505	1.00432	.882903	.857767	.90804
10	.994412	.984505	1.00432	.882903	.857766	.90804

step	(3) fevd	(3) Lower	(3) Upper	(4) fevd	(4) Lower	(4) Upper
0	0	0	0	0	0	0
1	0	0	0	.090867	.078791	.102942
2	.00043	-.00237	.00323	.112676	.089196	.136156
3	.002142	-.004018	.008302	.115027	.091101	.138953

```
|4       | .005316     -.004153    .014784   | .116274     .091634     .140914   |
|5       | .005471     -.004235    .015177   | .116872     .091929     .141815   |
|6       | .005472     -.004237    .015182   | .11694      .091904     .141976   |
|7       | .005546     -.004291    .015384   | .117074     .091961     .142187   |
|8       | .005587     -.00432     .015495   | .117084     .091958     .142209   |
|9       | .005588     -.00432     .015495   | .117097     .09196      .142233   |
|10      | .005588     -.00432     .015495   | .117097     .09196      .142234   |
+------------------------------------------------------------------------------+
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.***

5. Determine whether changing Cholesky order from – "rspot rfuture" to "rfuture rspot" will change the results of irf, oirf, coirf, and fevd. Why? or why not?