

## Homework8

1.

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

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

. varsoc rspot rfuture, 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  | -20.0444 |
| 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: rspot rfuture

Exogenous: \_cons

**By using SBIC to determine the lag order of VAR, the most appropriated lags models should have the lowest SBIC (-20.053) which is the one with the 6<sup>th</sup> lag order.**

```
. var rspot rfuture, 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 |
|----------|-------|---------|--------|----------|--------|
| rspot    | 13    | .001777 | 0.0159 | 124.0308 | 0.0000 |
| rfuture  | 13    | .002042 | 0.0211 | 165.0864 | 0.0000 |

|         | Coef.     | Std. Err. | z      | P> z  | [95% Conf. Interval] |           |
|---------|-----------|-----------|--------|-------|----------------------|-----------|
| rspot   |           |           |        |       |                      |           |
| 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 |
| 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   |
| _cons   | .0000232  | .0000203  | 1.14   | 0.252 | -.0000165            | .0000629  |
| rfuture |           |           |        |       |                      |           |
| 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  |
| 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 |
| _cons   | .0000259  | .0000233  | 1.11   | 0.266 | -.0000198            | .0000715  |

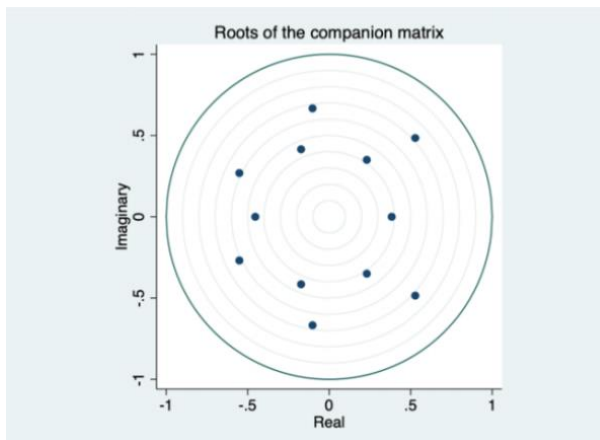
## 2.

. 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.



**From the result, all the eigenvalues lie inside the unit circle. So, VAR satisfies stability condition and is able to converge to zero.**

```
. vargranger
```

Granger causality Wald tests

| Equation | Excluded | chi2   | df | Prob > chi2 |
|----------|----------|--------|----|-------------|
| rspot    | rfuture  | 82.299 | 6  | 0.000       |
| rspot    | ALL      | 82.299 | 6  | 0.000       |
| rfuture  | rspot    | 148.42 | 6  | 0.000       |
| rfuture  | ALL      | 148.42 | 6  | 0.000       |

**For the Granger exogeneity test, the results determine that the model are interdependent. As, Prob > chi2 is less than 0.05, we would reject the null hypothesis. Hence, rspot and rfuture are exogeneity variables.**

### 3.

```
. irf create order1, order(rspot rfuture) step(6) 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

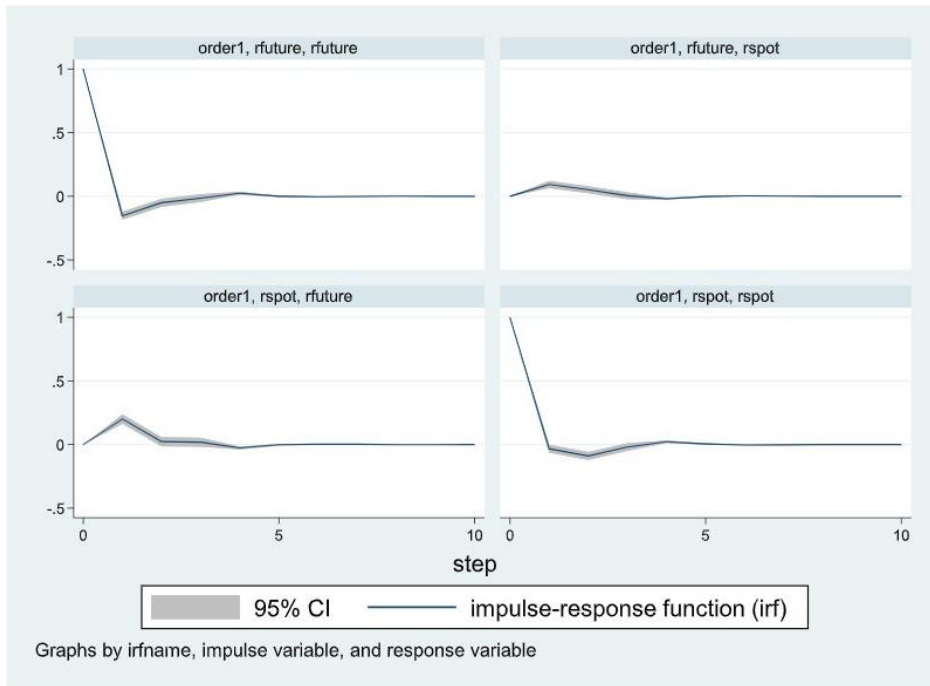
| step | (1)<br>irf | (1)<br>Lower | (1)<br>Upper | (2)<br>irf | (2)<br>Lower | (2)<br>Upper | (3)<br>irf | (3)<br>Lower | (3)<br>Upper |
|------|------------|--------------|--------------|------------|--------------|--------------|------------|--------------|--------------|
| 0    | 1          | 1            | 1            | 0          | 0            | 0            | 0          | 0            | 0            |
| 1    | -.042989   | -.074543     | -.011434     | .211774    | .175513      | .248035      | .102511    | .075055      | .129966      |
| 2    | -.101957   | -.133505     | -.070409     | .030833    | -.00561      | .067276      | .061675    | .034224      | .089126      |
| 3    | -.034997   | -.066566     | -.003428     | .030738    | -.005677     | .067153      | .018216    | -.009265     | .045697      |
| 4    | -.02148    | -.052956     | .009995      | .002714    | -.033596     | .039023      | .026291    | -.001106     | .053688      |
| 5    | -.033647   | -.06485      | -.002443     | .034962    | -.001046     | .070971      | .01553     | -.011653     | .042713      |
| 6    | -.010717   | -.041519     | .020085      | .017646    | -.017933     | .053226      | .006933    | -.01982      | .033686      |

| step | (4)<br>irf | (4)<br>Lower | (4)<br>Upper |
|------|------------|--------------|--------------|
| 0    | 1          | 1            | 1            |
| 1    | -.162359   | -.19391      | -.130809     |
| 2    | -.057352   | -.089063     | -.025641     |
| 3    | -.025324   | -.057023     | .006376      |
| 4    | -.004062   | -.035665     | .027541      |
| 5    | -.029332   | -.060699     | .002035      |
| 6    | -.003566   | -.034475     | .027344      |

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 coirf, impulse(rspot rfuture) response(rspot rfuture)
```

Results from order1

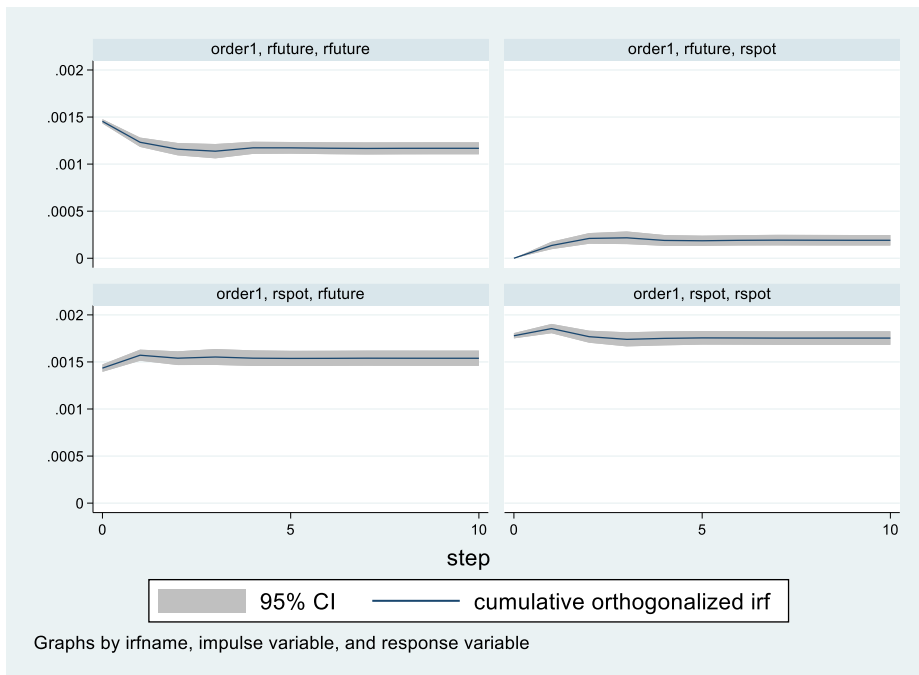
| step | (1)     |         |         | (2)     |         |         | (3)     |         |         |
|------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
|      | coirf   | Lower   | Upper   | coirf   | Lower   | Upper   | coirf   | Lower   | Upper   |
| 0    | .001775 | .001747 | .001803 | .001444 | .001404 | .001483 | 0       | 0       | 0       |
| 1    | .001847 | .001798 | .001896 | .001585 | .001527 | .001644 | .000148 | .000108 | .000187 |
| 2    | .001755 | .001691 | .001819 | .001557 | .001484 | .00163  | .000237 | .00018  | .000294 |
| 3    | .001719 | .001644 | .001794 | .001575 | .001491 | .001659 | .000263 | .000194 | .000332 |
| 4    | .001719 | .001635 | .001803 | .001574 | .00148  | .001668 | .000301 | .000223 | .000379 |
| 5    | .001682 | .001589 | .001774 | .001594 | .001491 | .001697 | .000323 | .000238 | .000409 |
| 6    | .001673 | .001573 | .001772 | .00162  | .001509 | .001731 | .000333 | .000242 | .000424 |

| step | (4)     |         |         |
|------|---------|---------|---------|
|      | coirf   | Lower   | Upper   |
| 0    | .001441 | .001419 | .001464 |
| 1    | .001207 | .001158 | .001257 |
| 2    | .001125 | .001059 | .00119  |
| 3    | .001088 | .00101  | .001166 |
| 4    | .001082 | .000995 | .00117  |
| 5    | .00104  | .000945 | .001136 |
| 6    | .001035 | .000934 | .001136 |

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 )
```



Graphs by irfname, impulse variable, and response variable

From all the graphs, directions are all positive. For magnitude, since the shaded area of *rspot* on *rfuture* is greater than *rfuture* on *rspot*, *rspot* on *rfuture* has more impact than *rfuture* on *rspot*. For duration, it might take around 10 periods to converge to zero.

In addition, from COIRF, all the values are significant since zero is not included in each interval.

#### 4.

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

Results from order1

| step | (1)<br>fevd | (1)<br>Lower | (1)<br>Upper | (2)<br>fevd | (2)<br>Lower | (2)<br>Upper | (3)<br>fevd | (3)<br>Lower | (3)<br>Upper |
|------|-------------|--------------|--------------|-------------|--------------|--------------|-------------|--------------|--------------|
| 0    | 0           | 0            | 0            | 0           | 0            | 0            | 0           | 0            | 0            |
| 1    | 1           | 1            | 1            | .500791     | .484986      | .516596      | 0           | 0            | 0            |
| 2    | .993131     | .989465      | .996798      | .496679     | .480799      | .512558      | .006869     | .003202      | .010535      |
| 3    | .990693     | .98638       | .995006      | .495972     | .480066      | .511879      | .009307     | .004994      | .01362       |
| 4    | .990483     | .986145      | .994821      | .495855     | .479951      | .51176       | .009517     | .005179      | .013855      |
| 5    | .990038     | .98565       | .994426      | .495851     | .479947      | .511756      | .009962     | .005574      | .01435       |
| 6    | .989888     | .985487      | .994289      | .495689     | .479783      | .511594      | .010112     | .005711      | .014513      |

| step | (4)<br>fevd | (4)<br>Lower | (4)<br>Upper |
|------|-------------|--------------|--------------|
| 0    | 0           | 0            | 0            |
| 1    | .499209     | .483404      | .515014      |
| 2    | .503321     | .487442      | .519201      |
| 3    | .504028     | .488121      | .519934      |
| 4    | .504145     | .48824       | .520049      |
| 5    | .504149     | .488244      | .520053      |
| 6    | .504311     | .488406      | .520217      |

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

- Variance of *rspot* caused by *rspot*
- Variance of *rfuture* caused by *rspot*
- Variance of *rspot* caused by *rfuture*
- Variance of *rfuture* caused by *rfuture*

Lastly, *rspot* has more impact to *rfuture* than *rfuture* has more impact to *rspot*. And all the values are significant since each interval does not include zero.