Universität Duisburg-Essen
Fachbereich VWL
Lehrstuhl Ökonometrie

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Multivariate Time Series Analysis
Exercise Sheet 10

Exercise 1: Computing IRFs by hand

Consider the following VAR(1) process:

$$z_t = \begin{pmatrix} 0.5 & 0 \\ 0.25 & 0.5 \end{pmatrix} z_{t-1} + a_t \quad \text{with} \quad \Sigma_a = \begin{pmatrix} 0.25 & 0.125 \\ 0.125 & 0.3125 \end{pmatrix}$$

a) List all relationships of Granger causality in this process. Is there instantaneous causality?

b) Compute and plot the responses of a unit impulse on $a_{1,t}$ by hand for five periods.

c) Compute and plot the responses of a unit orthogonal impulse on $a_{1,t}$ by hand for five periods.

d) Explain the major differences between the results of b) and c) and why this was expected due to your findings in a).

e) Under which condition are the 'ordinary' IRFs and the orthogonal IRFs identical?

f) Based on your recent insights, sketch the IRFs of a unit 'ordinary' impulse on $a_{2,t}$.

Exercise 2: Forecast Error Variance Decomposition

Again consider the process given in Exercise 1.

a) Based on the Granger causality structure: Which $w_{ij}(h)$ (see slide 6-29) are zero for each $h > 0$?

b) Compute the forecast error variance decomposition for the process using the command *FEVdec* from the 'MTS' package for $h = \{1, \dots, 5\}$. Then reproduce the results writing your own code.

Exercise 3: Summing it up

a) Assume that there is no Granger causality. Can you make a guess about the p-value of a Ljung-Box test?

b) Again assume that there is no Granger causality. How does the forecast error variance decomposition look like?

c) Now suppose you have a new dataset, run a Ljung-Box test and the p-value is close to one. Does this result tell you anything about Granger causality in the data?

d) Next, assume the opposite case of many p-values close to zero. Which implications does this have for the IRFs?
Hint: Think about Granger causality first.

e) How does instantaneous causality show up in a Ljung-Box test?

For the next questions, please have a look at the VAR(1) depicted on slide 6-7 in the lecture slides. We focus on the coefficient matrix:

f) Sketch the impulse responses of investment after a unit impulse on consumption and vice versa for $t = 1, 2$.

g) Which $w_{ij}(h)$ from the forecast error variance decomposition are zero for $h = 1$ and $h = 2$ each?

h) Which entry has to be zero such that consumption does not Granger cause investment?

This exercise sheet will be discussed in the tutorial on Wednesday, 8 January 2020