Universität Duisburg-Essen
Fachbereich VWL
Lehrstuhl Ökonometrie

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Multivariate Time Series Analysis
Exercise Sheet 2

Exercise 1: Moments and Simulation of a VAR(1) Process

Take the model from Example 2.4 on Slide 2-6:

a) Derive a formula to obtain the population cross-covariance matrices for the lags 1 to 10 and compute them using R.
Hint: A glance at the slides and a loop might save you some time.

b) Based on your results, compute the cross-correlation matrices.

c) Draw a corresponding innovation sequence a_t for 300 periods from a (multivariate) Gaussian distribution and simulate the given VAR(1) process without any further built-in functions.
Hint: 'mvrnorm' and 'for' are still allowed

d) Plot the multivariate time series you have just created. Does it look stationary?

e) Estimate the sample cross-covariance and cross-correlation matrices. Compare these with the population moment matrices from task a).

Exercise 2: Checking VAR(1) Stationarity

Recall the conditions to check if a VAR(1) process is stationary. Now assume the VAR(1) model $z_t = \phi_1 z_{t-1} + a_t$ with a_t as a sequence of i.i.d innovations:

a) Do you need to make further assumptions on the cross-correlations of a_t to ensure stationarity?

b) Which of the following processes are stationary? $\phi_1 = \dots$

i) $\begin{pmatrix} 0.2 & 0.3 \\ -0.6 & 1.1 \end{pmatrix}$ ii) $\begin{pmatrix} 0.5 & 0.3 \\ 0 & -0.3 \end{pmatrix}$ iii) $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ iv) $\begin{pmatrix} 1 & -1 \\ 1 & -1 \end{pmatrix}$ v) $\begin{pmatrix} 1 & -0.5 \\ -0.5 & 0 \end{pmatrix}$

This exercise sheet will be discussed in the exercise course on Wednesday, 30 October 2019