Universität Duisburg-Essen
Fachbereich VWL
Lehrstuhl Ökonometrie

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Dr. Yannick Hoga Thilo Reinschlüssel

Multivariate Time Series Analysis
Exercise Sheet 1

Exercise 1: Matrix Operations

Prove properties 3,4 and 5 from Proposition 1.2 (Slide 1-11). Are there any requirements regarding the matrix dimensions?

Exercise 2: Bivariate Functions

Find the extrema of the following functions (using pen and paper). Determine whether these points constitute minima, maxima or saddle points:

a) $f(x, y) = (x - 2)^2 + (y - 5)^2 + xy$

b) $g(x, y) = (x - 1)^3 - (4y + 1)^2$

Exercise 3: Stationarity

a) Are weakly stationary processes always strictly stationary? Construct an example to support your argument

b) Is weak stationarity a necessary condition for strict stationarity? Bring an example.
Hint: How many moments does a distribution require?

Exercise 4: Covariance Matrices under Stationarity

Referring to Remark 1.13: Show that $\Gamma_l = \Gamma_{-l}^\top$ holds for all weakly stationary processes.
(Two dimensions suffice)

Exercise 5: Ljung-Box Test in R

Load the package *MTS* and open the associated data pool 'mts-examples' (Slide 1-8). We are interested in the time series 'GS', 'MS' and 'JPM' from the dataset 'tenstocks':

a) First apply the Ljung-Box test on each time series individually. What do the results imply?

b) Now apply the multivariate Ljung-Box test on all three time series together. Compare the results with those from the univariate test and comment on it.

This exercise sheet will be discussed in the exercise course on Monday, 23 October 2019