STOCKHOLMS UNIVERSITET,
MATEMATISKA INSTITUTIONEN,
Avd. Matematisk statistik

Exam:
Econometric methods (MT5014)
2019-01-16
9-14

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Allowed aid: Calculator (provided by the department).

Return of exam: To be announced via the course web page or the course forum.

The exam consists of six problems. Each correctly solved problem gives 10 points.

- The reasoning should be clear and concise.
- Answers should be motivated (unless otherwise stated).
- Start every problem on a new sheet of paper.
- Clearly number each sheet with problem number and sheet order.
- Write your code number (but no name) on each sheet.

Preliminary grading:

A	B	C	D	E
54	48	42	36	30

Good luck!

Problem 1

(A) Define what weakly stationary means (for univariate time-series). (3 p)

(B) Consider an AR(1) time-series

$$r_t = 0.1 + 0.4r_{t-1} + a_t$$

with $E(a_t) = 0$ och $V(a_t) = 1$. Find $E(r_t)$ and $V(r_t)$. (5 p)

(C) Define what a random walk is by relating it to AR(1). (2 p)

Problem 2

Consider an $AR(1)$ time-series

$$r_t = 0.3 + 0.8r_{t-1} + a_t$$

with $E(a_t) = 0$ och $V(a_t) = 0.1$. Suppose $r_3 = 0.2$.

(A) Find the 1 step ahead forecast. (2 p)

(B) Find the 2 step ahead forecast and the variance of the associated forecast error. (4 p)

(C) Show that the n step ahead forecast converges to $E(r_t)$ as $n \to \infty$. (4 p)

Problem 3

Consider the regression model,

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \varepsilon_j, \quad t = 1, ..., 100.$$

Estimation over the whole time period has given the residual sum of squares (RSS) 18.3. Estimation for the first 50 time points has given the residual sum of squares 9.1. Estimation for the last 50 time points has given the residual sum of squares 4.3.

Use the Chow test of structural change to test if there is parameter constancy over the two different time periods.

(10 p)

Problem 4

Consider a two-dimensional (bivariate) VMA(1) model

$$\boldsymbol{r}_t = \boldsymbol{\theta}_0 + \boldsymbol{a}_t - \boldsymbol{\Theta}\boldsymbol{a}_{t-1}$$

where

$$\boldsymbol{\Theta} = \begin{bmatrix} \Theta_{11} & \Theta_{12} \\ \Theta_{21} & \Theta_{22} \end{bmatrix}.$$

(A) Which assumptions for the time-series $\boldsymbol{a}_t$ should be made for this to indeed be a VMA(1). (3 p)

(B) When is this time-series weakly stationary? *No argument has to be provided for your answer.* (2 p)

(C) Shortly interpret the parameter Θ_{12}. (3 p)

(D) Suppose $\Theta_{12} \neq 0$ and $\Theta_{21} \neq 0$. What kind of relationship is there between the two univariate time series that $\boldsymbol{r}_t$ consists of? *No argument has to be provided for your answer.*

(2 p)

Problem 5

Consider the regression model,

$$Y_j = \beta_0 + \beta_1 X_j + \varepsilon_j, \quad \varepsilon_j = e^{X_j}\tilde{\varepsilon}_j, \quad j = 1, ..., n$$

where $\tilde{\varepsilon}_j$ satisfies the classical (Gauss-Markov) assumptions, and $V(\tilde{\varepsilon}_j) = 1$.

(A) Which specification error is present in the model. *No argument has to be provided for your answer.* (2 p)

(B) Show whether the OLS estimator is unbiased or not. (3 p)

(C) Give a formula for the GLS estimate for this particular model. (3 p)

(D) In what sense is the GLS estimator better than the OLS estimator for this model. *No argument has to be provided for your answer.* (2 p)

Problem 6

Consider the multiple regression model,

$$\mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon}$$

without the assumption that $E[\boldsymbol{\varepsilon}|\mathbf{X}]$ is zero and where $\mathbf{X}$ has dimension $n \times k$.

(A) Show whether the OLS estimator is unbiased or not. (5 p)

(B) Suppose that you have an instrumental variable $\mathbf{Z}$ which has dimension $n \times l$, where $l > k$. Show that the GMM estimator with weighting matrix $\mathbf{W} = n(\mathbf{Z}^T\mathbf{Z})^{-1}$ gives the IV estimator

$$\hat{\boldsymbol{\beta}}_{IV,GMM} = \left(\mathbf{X}^T\mathbf{Z}\left(\mathbf{Z}^T\mathbf{Z}\right)^{-1}\mathbf{Z}^T\mathbf{X}\right)^{-1}\mathbf{X}^T\mathbf{Z}\left(\mathbf{Z}^T\mathbf{Z}\right)^{-1}\mathbf{Z}^T\mathbf{Y}.$$

(5 p)