C | A | U Christian-Albrechts-Universität zu Kiel	Wirtschafts- und Sozialwissenschaftliche Fakultät

Exam for the lecture

"Econometrics I“

for students in the M.Sc. programmes
winter term 2019/20

03.02.2019

Please fill in using block letters:

Seat location:

Name: *Surname*		Vorname: *Name*	
Studiengang *Course of study:*		Geburtsort: *Place of birth*	
Matrikelnummer: *Student ID*		Bachelor University:	

Declaration:

PLEASE SIGN!!!
I hereby declare that I am able to be examined. ______________________________ Signature:

Preliminary remarks:

- Write down your name and enrolment/matriculation number on all paper sheets provided for answers by the examiner.
- To write down your answers, use only the paper provided by the examiner.
- **You may use the formulary without any notations!**

Result: (TO BE FILLED IN ONLY BY THE EXAMINER!)

Problem	1	2	3	Home Assignment	Σ
Points earned					
Grade					

Kiel,

____

Professor Dr. Kai Carstensen

Prof. Dr. Kai Carstensen
Chair of Econometrics

Examination in Econometrics I

(Winter Term 2019/20)

$\boxed{\textbf{Examination regulation}}$

February 3, 2020, 14:00

Preliminary remarks:

1. Please read these instructions carefully!
2. At the beginning of the exam, fill in the cover sheet and hand in after the exam is finished!
3. You are permitted to use the following auxiliary tools:
   (a) a non–programable pocket calculator,
   (b) **the formulary for Econometrics I without notes!**
4. Write your name and enrollment (matriculation) number on every sheet of paper!
5. Don't use a pencil!
6. The exam problems are printed on 4 pages. Check your exam for completeness!
7. **Round your solutions to 4 decimal places.**
8. For all tests use a significance level of 5%, if nothing else is specified.
9. You have 60 minutes in total to answer the exam questions.

Good luck!

Problem 1 (17 points)

Consider the following model for the relation between the amount of private investment (PI) and income (INC):

$$\ln(PI_i) = \beta_0 + \beta_1 \ln(INC_i) + u_i, \quad i = 1, \dots, N.$$

Based on a random sample of $N = 50$ households you obtain the following sample moments:

$$\left(\sum_{i=1}^{N} x_i' x_i\right)^{-1} = \begin{pmatrix} 0.18 & -0.04 \\ -0.04 & 0.01 \end{pmatrix}, \qquad \sum_{i=1}^{N} x_i' y_i = \begin{pmatrix} 300 \\ 1310 \end{pmatrix}$$

$$\sum_{i=1}^{N} \hat{u}_i^2 x_i' x_i = \begin{pmatrix} 60 & 200 \\ 200 & 950 \end{pmatrix}, \qquad \sum_{i=1}^{N} y_i' y_i = 1993, \qquad \sum_{i=1}^{N} \hat{u}_i^2 = 72$$

1. **(4P)** State the OLS assumptions and discuss briefly how they relate to the properties of the OLS estimator.
2. **(3P)** Calculate and interpret the OLS estimator of β_1.
3. **(7P)** Calculate the asymptotic standard error of $\hat{\beta}_1$ both under homoskedasticity and heteroskedasticity. Which one would you trust more? Explain briefly.
4. **(3P)** Test the hypothesis of the income coefficient being not larger than 1 on a 5% level under heteroskedasticity.

Problem 2 (23 points)

Suppose you are given the following structural model for a random sample of $N = 50$ U.S. firms operating in local markets:

$$\ln(rev) = \delta_{10} + \gamma_{12}\ln(advert) + \delta_{11}\ln(pcost) + \delta_{12}extrahour + \delta_{13}\ln(avinc) \quad (1)$$
$$\ln(advert) = \delta_{20} + \gamma_{21}\ln(rev) + \delta_{21}nempl + \delta_{22}newsp \quad (2)$$

where $\ln(rev)$ denotes the log of monthly revenue (in 1000 EUR), $\ln(advert)$ is the log of expenditures on advertisement (in 1000 EUR), $\ln(pcost)$ is the log of production costs (in 1000 EUR), $extrahour$ is the monthly amount of extra hours worked, $\ln(avinc)$ is the average income in the firm's location (in 1000 EUR), $nempl$ is the number of employees on social media, and $newsp$ is a dummy variable for whether the firm appeared in a local newspaper in the corresponding month.

Consider the following 2SLS estimation output:

$$\ln(rev) = 45.2 + 1.39\ln(advert) - 0.87\ln(pcost) + 0.06extrahour + 2.40\ln(avinc)$$
$$\ln(advert) = -32.7 + 0.53\ln(rev) - 1.03nempl - 0.003newsp$$

1. **(4P)** Discuss identification for each equation.
2. **(11P)** What is the structural effect and what is the total effect of a 5 percent increase in production cost, *pcost*, on revenue? Calculate and interpret.
3. **(4P)** A colleague has observed that firms spend more on advertisements in rich locations than in poor ones and claims your model is necessarily wrong because, according to equation (2), $\ln(advert)$ does not depend on average local income, *avinc*. Do you think this claim is true? Explain your answer.
4. **(4P)** Suppose the estimated effect of average local income, *avinc*, on revenues, *rev*, shown in the estimation output above is not significantly different from zero at the 10 percent level. If you were to advise one of those firms in their sales planning, would you recommend to take *avinc* into account or not?

Problem 3 (20 points)

1. The so-called ridge estimator of the linear model $y_i = \mathbf{x}_i\boldsymbol{\beta} + u_i$, $i = 1, \ldots, N$, is an extension of the OLS estimator in that it minimizes the objective function

$$S(\hat{\boldsymbol{\beta}}) = \sum_{i=1}^{N} \left(y_i - \mathbf{x}_i\hat{\boldsymbol{\beta}}\right)^2 + \lambda \sum_{j=1}^{K} \hat{\beta}_j^2,$$

where K is the number of regressors (and thus the length of the vector $\boldsymbol{\beta}$), and $\lambda \geq 0$ is a fixed coefficient to be chosen by the user.

   (a) **(5P)** How does adding the term $\lambda \sum_{j=1}^{K} \hat{\beta}_j^2$ to the OLS objective function affect the estimator? To answer this question, consider the polar cases $\lambda = 0$ and $\lambda \to \infty$. (You do not need to calculate here. Argue!)

   (b) **(5P)** Find the ridge estimator, i.e., derive a closed form solution of the estimator that minimizes the objective function. Hint: it can be helpful to rewrite $S(\hat{\boldsymbol{\beta}})$ in matrix notation.

2. Consider the 2SLS estimator of the linear model $y = \mathbf{x}\boldsymbol{\beta} + u$ using instruments $\mathbf{z}$ (assumptions 2SLS.1 and 2SLS.2 are fulfilled).

   (a) **(5P)** Show that the 2SLS estimator is biased even if the assumption $E(u|\mathbf{z}) = 0$ holds.

   (b) **(5P)** What are weak instruments and which problems arise when we use them for 2SLS?