UNIVERSITY OF OULU

YLEISEN TENTIN TENTTILOMAKE - GENERAL EXAM FORM

Opiskelija täyttää / Student fills in

Opiskelijan nimi / Student name:	**Opiskelijanumero / Student number:**
Click here to enter text.	Click here to enter text.

Opettaja täyttää / Lecturer fills in

Opintojakson koodi / The code of the course: 721066S	
Opintojakson (tentin) nimi / The name of the course or exam: Principles of Econometrics	
Opintopistemäärä / Credit units: 6 Mikäli kyseessä on välikoe, opintopistemääräksi täytetään 0 op. 0 ECTS Credits is used for mid-term exams.	
Tiedekunta / Faculty: OyKKK / OBS	
Tentin pvm / Date of exam: 20.3.2019	**Tentin kesto tunteina / Exam in hours: 3 h**
Tentaattori(t) / Examiner(s): Sanna Huikari	**Sisäinen postiosoite / Internal address:** 6 OyKKK
Tentissä sallitut apuvälineet / The devices allowed in the exam:	
☒ Funktiolaskin / Scientific calculator ☒ Ohjelmoitava laskin / Programmable calculator ☒ Muu tentissä sallittu materiaali tai apuvälineet. Tarkenna alla. / Other material or devices, allowed in the exam. Specify below. **Two-sided hand-written A4-sheet, which must be included into the answer sheet** ☐ Tentissä ei ole sallittua käyttää apuvälineitä / The devices are not allowed in the exam	
Muut tenttiä koskevat ohjeet opiskelijalle (esimerkiksi kuinka moneen kysymyksen opiskelijan tulee vastata) / Other instructions for students e.g. how many questions he/she should answer: Answer in all questions. Remember to show your work. No credit for answers if you do not show your work.	

1. Briefly answer or define. (8 p.)

a) A researcher is interested in the effect on test scores of computer usage. Using school district data like that used in course book, he/she regresses district average test scores on the number of computers per student. Will $\hat{\beta}_1$ be an unbiased estimator of the effect on test scores of increasing the number of computers per student? Why or why not? If you think that $\hat{\beta}_1$ is biased, is it biased up or down? Why?

b) A standard "money demand" function used by macroeconomists has the form $\ln(m) = \beta_0 + \beta_1 \ln(GDP) + \beta_2 R$, where *m* is the quantity of (real) money, *GDP* is the value of (real) gross domestic product, and *R* is the value of the nominal interest rate measured in percent per year. Suppose that $\beta_1 = 1.0$ and $\beta_2 = -0.02$. What will happen to the value of *m* if *GDP* increases by 2%? What will happen to *m* if the interest rate increases from 4% to 5%?

2. (6 p.) You set out to test whether or not more attractive individuals receive higher grades at college. You happen to have access to individuals at two highly selective liberal arts colleges nearby. One of these specializes in Economics and Government and incoming students have an average SAT (scores on college admission test) of 2,100; the other is known for its engineering program and has an incoming SAT average of 2,200. Conducting a survey, where you offer students a small incentive to answer a few questions regarding their academic performance, and taking a picture of these individuals, you establish that there is no relationship between grades and beauty. Write a short essay using some of the concepts of internal and external validity to determine if these results are likely to apply to universities in general.

3. (26 p.) One of the big questions in economics is: What are the determinants of economic growth? In this problem set, some basic relationships between growth, trade, physical capital, and human capital are quantified. The data are a cross-sectional sample of n = 64 non-Communist countries. Data consists of average growth rates over 1960-1995, along with variables that are potentially related to growth. The variables that are used are defined in Table 1:

Table 1. Variables and their average values in the dataset.

Variable	Definition	Average
growth	Average annual percentage growth of real per capita Gross Domestic Product (GDP) from 1960 to 1995.	1.87
rgdp60	The value of GDP per capita in 1960, converted to 1960 US dollars	3131
tradeshare	The average share of trade in the economy from 1960 to 1995, measured as the sum of exports plus imports, divided by GDP	0.542
school60	Average years of schooling in total population in 1960.	3.95
rev_coups	Average annual number of revolutions, insurrections (successful or not) and coup d'etats in that country from 1960 to 1995	0.170
assassinations	Average annual number of political assassinations in that country from 1960 to 1995 (per million population)	0.281
oil	= 1 if oil accounted for at least half of exports in 1960 = 0 otherwise	0

Table 2 contains results from six estimated regressions. The dependent variable in all regressions is growth. Use the results to answer the following questions. You can treat n as 'large'.

a) Explain in words what the value of the coefficient on *school60* means in reg(1). Is the effect statistically significant? (3 p.)

b) Construct a 95% confidence interval for the slope coefficient of *school60* in reg(1). Interpret. (3 p.)

c) What is the coefficient of determination of reg(1)? What does its value mean? (2 p.)

d) Economic theory predicts that *tradeshr*, *school60*, and *capstock60* all are determinants of economic growth. Use reg(2) to test that hypothesis. (2 p.)

e) Explain why the coefficient on *school60* is so different in regressions (1) and (2). (3 p.)

f) Figure 1. presents a scatterplot of *growth* on *school60*. Does the relationship look linear or nonlinear? Explain. Use the plot and regression results to explain whether reg(3) fits better than reg(1). (2 p.)

g) In 1960, a country contemplated an education policy that would increase average years of schooling from 4 years to 6 years. Use reg (1) to predict the increase in *growth*. Use reg (3) to predict the increase in *growth*. (3 p.)

h) Use the reg(4) to predict the annual growth rate for a country that has average values of all regressors (average values given in Table 1). (2 p.)

i) Using reg(5), is there evidence that the effect of *tradeshare* on *growth* depends on the level of education in the country? (2 p.)

j) Using reg(6), is there evidence of a nonlinear relationship between *tradeshare* and *growth*? (2 p.)

k) Why is *oil* omitted from all of the regressions? What would happen if it were included? (2 p.)

Table 2. Growth Regression Results
Dependent variable: *Growth*

Regressor	reg(1)	reg(2)	reg(3)	reg(4)	reg(5)	reg(6)
tradeshare	2.331 (0.596)	1.82 (0.826)	2.173 (0.555)	1.288 (0.516)	1.830 (1.341)	-5.334 (3.231)
tradeshare^2	—	—	—	—	—	7.776 (4.299)
tradeshare^3	—	—	—	—	—	-2.366 (1.433)
school60	0.250 (0.076)	0.501 (0.143)	—	—	—	—
ln(school60)	—	—	1.031 (0.201)	2.183 (0.383)	2.404 (0.653)	2.136 (0.408)
capstock60	—	-0.137 (0.059)	—	—	—	—
Rev_coups	—	—	—	-2.318 (0.919)	-2.356 (0.924)	-2.039 (0.950)
Assassinations				0.255 (0.323)	0.266 (0.329)	0.102 (0.365)
ln(RGDP60)				-1.642 (0.429)	-1.664 (0.433)	-1.588 (0.453)
*tradeshare*ln(school60)*	—	—	—	—	-0.398 (0.783)	—
Intercept	-0.370 (0.585)	-0.33 (0.67)	-0.416 (0.468)	11.785 (3.279)	11.662 (3.303)	12.904 (3.168)
F-statistics testing the hypothesis that the coefficients on the indicated regressors are all zero:						
tradeshare, school60, capstock60	—	5.56 (0.002)	—	—	—	—
Rev_coups and Assassinations	—	—	—	3.38 (0.04)	—	—
tradeshare^2*, tradeshare*^{3}	—	—	—	—	—	2.20 (0.12)
Regression summary statistics						
$\overline{R}^2$	0.211	0.223	0.329	0.464	0.456	0.464
SER	1.685	1.641	1.553	1.389	1.399	1.388

Notes: Heteroskedasticity-robust standard errors are given in parentheses under estimated coefficients, and *p*-values are given in parentheses under *F*-statistics.

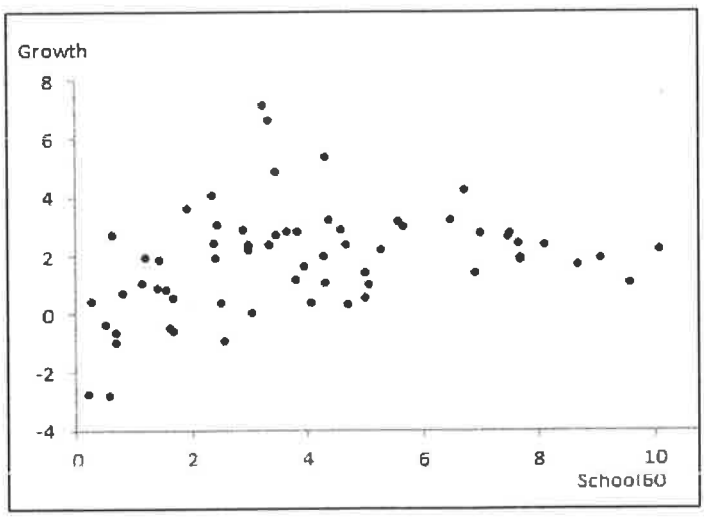

Figure 1. Scatterplot of Growth on School60

Large-Sample Critical Values for the t-statistic from the Standard Normal Distibution

	Significance Level		
	10%	5%	1%
2-Sided Test (≠)			
Reject if $\|t\|$ is greater than	1.64	1.96	2.58
1-Sided Test (>)			
Reject if t is greater than	1.28	1.64	2.33
1-Sided Test (<)			
Reject if t is less than	−1.28	−1.64	−2.33

TABLE 3 Critical Values for the χ^2 Distribution

	Significance Level		
Degrees of Freedom	10%	5%	1%
1	2.71	3.84	6.63
2	4.61	5.99	9.21
3	6.25	7.81	11.34
4	7.78	9.49	13.28
5	9.24	11.07	15.09
6	10.64	12.59	16.81
7	12.02	14.07	18.48

Large-Sample Critical Values for the F-statistic from the $F_{m,\infty}$ Distribution

Reject if F > Critical Value

	Significance Level		
Degrees of Freedom (m)	10%	5%	1%
1	2.71	3.84	6.63
2	2.30	3.00	4.61
3	2.08	2.60	3.78
4	1.94	2.37	3.32
5	1.85	2.21	3.02
6	1.77	2.10	2.80
7	1.72	2.01	2.64