FINAL %	

UNISA university of south africa

ECS3706

OCTOBER / NOVEMBER 2017

ECONOMETRICS

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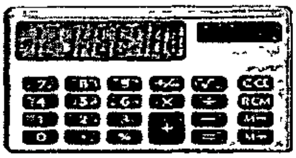

UNIVERSITEITSEKSAMENS

UNISA university of south africa

ECS3706

October/November 2017

ECONOMETRICS

Duration 2 Hours

100 Marks

EXAMINERS

FIRST	MR MJ KHUMALO
SECOND	PROF TLA LESHORO
EXTERNAL	DR LJ RAPUTSOANE

Use of a non-programmable pocket calculator is permissible

Closed book examination

This paper consists of 32 pages, including a formulae sheet (p24), 3 pages of statistical tables (pp 25 to 27), 5 pages for rough work (pp 28 to 32) plus the special front page

This paper consists of two sections

Section A:	Answer all 4 questions which together count 60 marks (15 + 15 + 15 +15)	= 60
Section B:	Answer any 2 of the 3 questions Each question counts 20 marks (2 x 20)	= 40
	Total	= 100

SECTION A (60 marks)

Answer **ALL** four questions in section A

Section A requires brief and to the point answers

In most cases simply list, or <u>briefly</u> explain what is required

It may be advantageous to use statistical notation (mathematical symbols) to explain concepts, but make sure to also explain their meaning

It is not required to re-explain concepts that have been previously dealt with If required, you may simply refer to your previous answer/s

In general, each mark represents one correct fact or correct interpretation

You have 120 minutes to earn 100 marks in the case of the complete paper, that is, 6 minutes per 5 marks

[TURN OVER]

SECTION A (60 marks)

Answer **ALL** four questions in section A

QUESTION 1 (15 marks)

(a) Briefly explain two weaknesses or shortcomings of econometrics (3)

(b) In evaluating regression estimates do you consider statistical tests to be more important than economic theory? In your answer also briefly explain why economic theory is important in econometrics (6)

(c) Briefly explain what OLS means, what the OLS method tries to achieve and the principles on which the OLS method is based Also list any three good characteristics of OLS (6)

[15]

QUESTION 2 (15 marks)

A researcher obtained the following ordinary least squares (OLS) regression results on the linear relationship between consumption Y_t (measured in rands per month) and income X_t (measured in rands)

$$\bar{X} = 60.5,\ \bar{Y} = 55\ 251,\ \sum_{t=1}^{N} X_t = 6050,\ \sum_{t=1}^{N} Y_t = 5525\ 11,\ \sum_{t=1}^{N} Y_t^2 = 232868,\ \sum_{t=1}^{N} X_t^2 = 760629$$

$$,\ \sum_{t=1}^{N} X_t Y_t = 389755,\ \sum_{t=1}^{N} x_t y_t = 2490,\ \sum_{t=1}^{N} y_t^2 = 1872\ 25,\ \sum_{t=1}^{N} x_t^2 = 3830 \quad \sum_{t=1}^{N} e_t^2 = 7489$$

(a) Using the sample information and assuming that the regression equation is of the form $Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t$, calculate the OLS estimates of the intercept $\hat{\beta}_0$ and the slope coefficient $\hat{\beta}_1$, R^2 and the explained sum of squares (ESS) (show calculations) What is the sample size of this regression? (13)

(b) What is the meaning of $\sum_{i=1}^{N} e_i^2 = 7489$ provided above? (2)

[15]

QUESTION 3 (15 marks)

A two variable regression has the following results

Source of variation	Sum of squares (SS)	Degrees of freedom (d.f.)	MSS = SS/d.f.
Due to regression(ESS)	66965	–	–
Due to residual (RSS)	–	–	–
Total (TSS)	67052	29	–

(a) What is the sample size (N)? (2)

(b) What is the value of RSS? (2)

(c) What are the degrees of freedom (d f) of the ESS and RSS? (4)

(d) What are the values of R^2 and adjusted R^2? Interpret the R^2 obtained (3)

(e) What is the value of the F-statistic? (4)

[15]

QUESTION 4 (15 marks)

Discuss the problem of serial correlation

(a) Briefly explain its nature the meaning of pure and impure serial correlation Also explain what the meaning of first-order serial correlation is (5)

(b) List the consequences of pure serial correlation (3)

[TURN OVER]

(c) Explain how serial correlation may be detected by the use of the DW-d statistic (4)

(d) Explain a situation in which heteroscedasticity can be remedied by redefining the variables (3)

[15]

SUBTOTAL SECTION A [60]

SECTION B (40 marks)

Answer **ANY TWO** of the **THREE QUESTIONS** in section B Each question counts 20 marks

- Section B mostly consists of practical problems
- Use a 5% level of significance in statistical testing, unless stated otherwise

QUESTION B1 (20 marks)

A researcher estimated the demand for rice model and found the following results The Dependent variable Rice

Variable	Coefficient	t-statistic	Other Statistics
Constant	4 2854	8 104	R^2 = 0 56
P_r	-0 0094	1 907	Durbin-Watson = 1 5736
Y	0 03917	0 841	F-statistic = 71 96
P_{PS}	4 5529	10 475	
P_{MM}	-0 2456	1 387	

Where P_R = price of energy drink
Y = Income of consumer
P_{SP} = Price of substitute product
P_{MM} = Price of maize meal

Critical t-statistic at 5% is 2 253

(a) Evaluate these results with respect to its economic meaning, overall fit, signs and significance of coefficients (16)

(b) What econometric problem(s) (if any) does this regression have? How would you solve the problem(s) associated with this model? (4)

[20]

QUESTION B2 (20 marks)

Suppose the original regression on demand for cars is given as follows The dependent variable is represented by Y

Variable →	*constant*	*$LogX_1$*	*$LogX_2$*	*$LogX_3$*	*$LogX_4$*
Coefficient	11 05	1 8504	4 6792	2.6462	-0 0395
t-statistic	(0 652)	(1 408)	(2 701)	(1 6129)	(-0 1268)

Adjusted R^2 = 0 7662, correlation coefficient between X_1 and X_2 ($X_{1,2}$) = 0 995

The critical t-statistic at 5% level of significance is 1 67

Log Y = quantity demanded for passenger cars
Log X1 = price of new car
Log X2 = inflation
Log X3 = income
Log X4 = interest rate

Two other regressions were done, first dropping X_2 and secondly, dropping X_1 and comparing the two regressions with the original regression The regressions for the two equations are

	Variable →	*constant*	*LogX₁*	*LogX₂*	*LogX₃*	*LogX₄*	*Adjusted R^2*
Regression 1	Coefficient	-22.05	-1.051		0.592	3.195	*Adj* R^2 = 0.689
	(t-statistic)	(0.652)	(-3.408)		(5.613)	(3.718)	
Regression 2	Coefficient	-27.557		0.409	-0.152	3.296	*Adj* R^2 = 0.787
	(t-statistic)	(-3.678)		(4.194)	(-4.407)	(5.562)	

(a) Which regression between the original, regression 1 and regression 2 would you prefer and why? (10)

(b) If the same variables are regressed in their original forms, that is, using a linear OLS without logs, how you would interpret the estimation results from the original equation if the coefficients were the same? (10)

[20]

[TURN OVER]

QUESTION B3 (20 marks)

A regression has been run to estimate the average hourly wages of full time workers For the purpose of this let

AHE = average hourly earnings (constant 1998=100)
University = binary variable (1 if in university, 0 if in high school)
Female = binary variable (1 if female, 0 if male)
Age = age in years
North, East, South = binary variables (1 if in region, 0 otherwise)

AHE = 3 75 + 5 44 (University) − 2 62 (Female) + 0 29 (Age) + 0 69 (North) + 0 60 (East) − 0 27 (South)

Other statistics R^2 = 0 194, n = 4000

(a) Do there appear to be important regional differences (3)

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(b) Why is the *explanatory* variable for region = West, omitted from the regression? What would happen if it was included? (3)

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(c) Joanne is a 26 year old female university graduate from the South region Alejandro is a 35 year old male from the North who never attended any post school studies Calculate the expected difference in earnings between Joanne and Alejandro (7)

(d) An economist has derived the following macroeconomic production function

$$Log(Q) = -1\ 60 + 0\ 41\ log(K) + 0\ 62 log(L) + 0\ 32 log(T)$$

Where
Q = production, K = capital input, L = technology and T = technology input

Briefly discuss this functional form, that is, explain its characteristics, and explain the major advantage of this form as well as the exact meaning of its slope coefficients (7)

[20]

Appendix 1: Formulae sheet

OLS estimates of $Y_t = \beta_0 + \beta_1 X_{1t} + \varepsilon_t$

$$\hat{\beta}_1 = \frac{\sum x_{1t} y_t}{\sum x_{1t}^2} \text{ where } \begin{Bmatrix} x_{1t} = X_{1t} - \bar{X}_1 \\ y_t = Y_t - \bar{Y} \end{Bmatrix} \text{ and } t = 1 \text{ to } n \qquad SE(\hat{\beta}_1) = \sqrt{\frac{\left(\frac{\sum e_t^2}{n-2}\right)}{\sum x_{1t}^2}}$$

$$\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}_1 \text{ where } \bar{Y} = \sum_t Y_t \Big/ n \text{ and } \bar{X}_j = \sum_t X_{jt} \Big/ n$$

TSS (Total sum of squares) = ESS (explained) + RSS (residual)

$$\sum y_t^2 = \sum \left(\hat{Y}_t - \bar{Y}\right)^2 + \sum e_t^2$$

OLS estimates of $Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \varepsilon_t$

$$\hat{\beta}_1 = \frac{\left(\sum y_t x_{1t}\right)\left(\sum x_{2t}^2\right) - \left(\sum y_t x_{2t}\right)\left(\sum x_{1t} x_{2t}\right)}{\left(\sum x_{1t}^2\right)\left(\sum x_{2t}^2\right) - \left(\sum x_{1t} x_{2t}\right)^2} \qquad \text{where } x_{2t} = X_{2t} - \bar{X}_2$$

$$\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}_1 - \hat{\beta}_2 \bar{X}_2 \qquad SE(\hat{\beta}_1) = \sqrt{\frac{\sum e_t^2 / (n-3)}{\left(\sum x_1^2\right)\left(1 - r_{X_1 X_2}^2\right)}}$$

$$r_{X_1 X_2} = \frac{\sum \left(X_{1t} - \bar{X}_1\right)\left(X_{2t} - \bar{X}_2\right)}{\sqrt{\sum \left(X_{1t} - \bar{X}_1\right)^2 \left(X_{2t} - \bar{X}_2\right)^2}}$$

Some statistical measures

$$t = \frac{\hat{\beta} - \beta_{H_0}}{SE(\hat{\beta})} \qquad DW\, d = \frac{\sum_{t=2}^{T} \left(e_t - e_{t-1}\right)^2}{\sum_{t=1}^{T} e_t^2}$$

$$F = \frac{ESS / K}{RSS / (n - K - 1)}$$

Table	Contents
1	Critical values of the t-distribution
2	Critical values of the F-distribution 5% level of significance
3	Critical values of the Durbin-Watson test statistic (DW-d) of D_L and D_U DW-d 5% one-sided and 10% two-sided level of significance

Table 1 Critical values of the t-distribution

Degrees of freedom	Level of significance					
	One-sided	10%	5%	2 5%	1%	0 5%
	Two-sided	20%	10%	5%	2%	1%
1		3 078	6 314	12 706	31 821	63 657
2		1 886	2 920	4 303	6 965	9 925
3		1 638	2 353	3 182	4 541	5 841
4		1 533	2 132	2 776	3 747	4 604
5		1 476	2 015	2 571	3 365	4 032
6		1 440	1 943	2 447	3 143	3 707
7		1 415	1 895	2 365	2 998	3 499
8		1 397	1 860	2 306	2 896	3 355
9		1 383	1 833	2 262	2 821	3 250
10		1 372	1 812	2 228	2 764	3 169
11		1 363	1 796	2 201	2 718	3 106
12		1 356	1 782	2 179	2 681	3 055
13		1 350	1 771	2 160	2 650	3 012
14		1 345	1 761	2 145	2 624	2 977
15		1 341	1 753	2 131	2 602	2 947
16		1 337	1 746	2 120	2 583	2 921
17		1 333	1 740	2 110	2 567	2 898
18		1 330	1 734	2 101	2 552	2 878
19		1 328	1 729	2 093	2 539	2 861
20		1 325	1 725	2 086	2 528	2 845
21		1 323	1 721	2 080	2 518	2 831
22		1 321	1 717	2 074	2 508	2 819
23		1 319	1 714	2 069	2 500	2 807
24		1 318	1 711	2 064	2 492	2 797
25		1 316	1 708	2 060	2 485	2 787
26		1 315	1 706	2 056	2 479	2 779
27		1 314	1 703	2 052	2 473	2 771
28		1 313	1 701	2 048	2 467	2 763
29		1 311	1 699	2 045	2 462	2 756
30		1 310	1 697	2 042	2 457	2 750
40		1 303	1 684	2 021	2 423	2 704
50		1 299	1 676	2 009	2 403	2 678
60		1 296	1 671	2 000	2 390	2 660
70		1 294	1 667	1 994	2 381	2 648
120		1 289	1 658	1 980	2 358	2 617
Normal		1 282	1 645	1 960	2 326	2 576

Table 2: **Critical values of the F-distribution 5% level of significance**

Degrees of freedom of denominator (v_2)	Degrees of freedom for numerator (v_1)											
	1	2	3	4	5	6	7	8	10	12	20	∞
1	161 0	200 0	216 0	225 0	230 0	234 0	237 0	239 0	242 0	244 0	248 0	254 3
2	18 5	19 0	19 2	19 2	19 3	19 3	19 4	19 4	19 4	19 4	19 4	19 5
3	10 13	9 55	9 28	9 12	9 01	8 94	8 89	8 85	8 79	8 74	8 66	8 53
4	7 71	6 94	6 59	6 39	6 26	6 16	6 09	6 04	5 96	5 91	5 80	5 63
5	6 61	5 79	5 41	5 19	5 05	4 95	4 88	4 82	4 74	4 68	4 56	4 36
6	5 99	5 14	4 76	4 53	4 39	4 28	4 21	4 15	4 06	4 00	3 87	3 67
7	5 59	4 74	4 35	4 12	3 97	3 87	3 79	3 73	3 64	3 57	3 44	3 23
8	5 32	4 46	4 07	3 84	3 69	3 58	3 50	3 44	3 35	3 28	3 15	2 93
9	5 12	4 26	3 86	3 63	3 48	3 37	3 29	3 23	3 14	3 07	2 94	2 71
10	4 96	4 10	3 71	3 48	3 33	3 22	3 14	3 07	2 98	2 91	2 77	2 54
11	4 84	3 98	3 59	3 36	3 20	3 09	3 01	2 95	2 85	2 79	2 65	2 40
12	4 75	3 89	3 49	3 26	3 11	3 00	2 91	2 85	2 75	2 69	2 54	2 30
13	4 67	3 81	3 41	3 18	3 03	2 92	2 83	2 77	2 67	2 60	2 46	2 21
14	4 60	3 74	3 34	3 11	2 96	2 85	2 76	2 70	2 60	2 53	2 39	2 13
15	4 54	3 68	3 29	3 06	2 90	2 79	2 71	2 64	2 54	2 48	2 33	2 07
16	4 49	3 63	3 24	3 01	2 85	2 74	2 66	2 59	2 49	2 42	2 28	2 01
17	4 45	3 59	3 20	2 96	2 81	2 70	2 61	2 55	2 45	2 38	2 23	1 96
18	4 41	3 55	3 16	2 93	2 77	2 66	2 58	2 51	2 41	2 34	2 19	1 92
19	4 38	3 52	3 13	2 90	2 74	2 63	2 54	2 48	2 38	2 31	2 16	1 88
20	4 35	3 49	3 10	2 87	2 71	2 60	2 51	2 45	2 35	2 28	2 12	1 84
21	4 32	3 47	3 07	2 84	2 68	2 57	2 49	2 42	2 32	2 25	2 10	1 81
22	4 30	3 44	3 05	2 82	2 66	2 55	2 46	2 40	2 30	2 23	2 07	1 78
23	4 28	3 42	3 03	2 80	2 64	2 53	2 44	2 37	2 27	2 20	2 05	1 76
24	4 26	3 40	3 01	2 78	2 62	2 51	2 42	2 36	2 25	2 18	2 03	1 73
25	4 24	3 39	2 99	2 76	2 60	2 49	2 40	2 34	2 24	2 16	2 01	1 71
26	4 23	3 37	2 98	2 74	2 59	2 47	2 39	2 32	2 22	2 15	1 99	1 69
27	4 21	3 35	2 96	2 73	2 57	2 46	2 37	2 31	2 20	2 13	1 97	1 68
28	4 20	3 34	2 95	2 71	2 56	2 45	2 36	2 29	2 19	2 12	1 96	1 66
29	4 18	3 33	2 93	2 70	2 55	2 43	2 35	2 28	2 18	2 10	1 94	1 64
30	4 17	3 32	2 92	2 69	2 53	2 42	2 33	2 27	2 16	2 09	1 93	1 62
40	4 08	3 23	2 84	2 61	2 45	2 34	2 25	2 18	2 08	2 00	1 84	1 51
50	4 03	3 18	2 79	2 56	2 40	2 29	2 20	2 13	2 03	1 95	1 78	1 44
60	4 00	3 15	2 76	2 53	2 37	2 25	2 17	2 10	1 99	1 92	1 75	1 39
70	3 98	3 13	2 74	2 50	2 35	2 23	2 14	2 07	1 97	1 89	1 72	1 36
120	3 92	3 07	2 68	2 45	2 29	2 18	2 09	2 02	1 91	1 83	1 66	1 25
∞	3 84	3 00	2 60	2 37	2 21	2 10	2 01	1 94	1 83	1 75	1 57	1 00

Table 3 **Critical values of the Durbin-Watson test statistics D_L and D_U**
5% one-sided and 10% two-sided level of significance

n	k'=1		k'=2		k'=3		k'=4		k'=5		k'=6		k'=7	
	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U
15	1 08	1 36	0 95	1 54	0 81	1 75	0 69	1 97	0 56	2 21	0 45	2 47	0 34	2 73
16	1 11	1 37	0 98	1 54	0 86	1 73	0 73	1 93	0 62	2 15	0 50	2 39	0 40	2 62
17	1 13	1 38	1 02	1 54	0 90	1 71	0 78	1 90	0 66	2 10	0 55	2 32	0 45	2 54
18	1 16	1 39	1 05	1 53	0 93	1 69	0 82	1 87	0 71	2 06	0 60	2 26	0 50	2 46
19	1 18	1 40	1 07	1 53	0 97	1 68	0 86	1 85	0 75	2 02	0 65	2 21	0 55	2 40
20	1 20	1 41	1 10	1 54	1 00	1 68	0 89	1 83	0 79	1 99	0 69	2 16	0 60	2 34
21	1 22	1 42	1 13	1 54	1 03	1 67	0 98	1 81	0 83	1 96	0 73	2 12	0 64	2 29
22	1 24	1 43	1 15	1 54	1 05	1 66	0 96	1 80	0 86	1 94	0 77	2 09	0 68	2 25
23	1 26	1 44	1 17	1 54	1 08	1 66	0 99	1 79	0 90	1 92	0 80	2 06	0 72	2 21
24	1 27	1 45	1 19	1 55	1 10	1 66	1 01	1 78	0 93	1 90	0 84	2 04	0 75	2 17
25	1 29	1 45	1 21	1 55	1 12	1 66	1 04	1 77	0 95	1 89	0 87	2 01	0 78	2 14
26	1 30	1 46	1 22	1 55	1 14	1 65	1 06	1 76	0 98	1 88	0 90	1 99	0 82	2 12
27	1 32	1 47	1 24	1 56	1 16	1 65	1 08	1 76	1 00	1 86	0 93	1 97	0 85	2 09
28	1 33	1 48	1 26	1 56	1 18	1 65	1 10	1 75	1 03	1 85	0 95	1 96	0 87	2 07
29	1 34	1 48	1 27	1 56	1 20	1 65	1 12	1 74	1 05	1 84	0 98	1 94	0 90	2 05
30	1 35	1 49	1 28	1 57	1 21	1 65	1 14	1 74	1 07	1 83	1 00	1 93	0 93	2 03
31	1 36	1 50	1 30	1 57	1 23	1 65	1 16	1 74	1 09	1 83	1 02	1 92	0 95	2 02
32	1 37	1 50	1 31	1 57	1 24	1 65	1 18	1 73	1 11	1 82	1 04	1 91	0 97	2 00
33	1 38	1 51	1 32	1 58	1 26	1 65	1 19	1 73	1 13	1 81	1 06	1 90	0 99	1 99
34	1 39	1 51	1 33	1 58	1 27	1 65	1 21	1 73	1 14	1 81	1 08	1 89	1 02	1 98
35	1 40	1 52	1 34	1 58	1 28	1 65	1 22	1 73	1 16	1 80	1 10	1 88	1 03	1 97
36	1 41	1 52	1 35	1 59	1 30	1 65	1 24	1 73	1 18	1 80	1 11	1 88	1 05	1 96
37	1 42	1 53	1 36	1 59	1 31	1 66	1 25	1 72	1 19	1 80	1 13	1 87	1 07	1 95
38	1 43	1 54	1 37	1 59	1 32	1 66	1 26	1 72	1 20	1 79	1 15	1 86	1 09	1 94
39	1 43	1 54	1 38	1 60	1 33	1 66	1 27	1 72	1 22	1 79	1 16	1 86	1 10	1 93
40	1 44	1 54	1 39	1 60	1 34	1 66	1 29	1 72	1 23	1 79	1 18	1 85	1 12	1 93
45	1 48	1 57	1 43	1 62	1 38	1 67	1 34	1 72	1 29	1 78	1 24	1 84	1 19	1 90
50	1 50	1 59	1 46	1 63	1 42	1 67	1 38	1 72	1 34	1 77	1 29	1 82	1 25	1 88
55	1 53	1 60	1 49	1 64	1 45	1 68	1 41	1 72	1 37	1 77	1 33	1 81	1 29	1 86
60	1 55	1 62	1 51	1 65	1 48	1 69	1 44	1 73	1 41	1 77	1 37	1 81	1 34	1 85
65	1 57	1 63	1 54	1 66	1 50	1 70	1 47	1 73	1 44	1 77	1 40	1 81	1 37	1 84
70	1 58	1 64	1 55	1 67	1 53	1 70	1 49	1 74	1 46	1 77	1 43	1 80	1 40	1 84
75	1 60	1 65	1 57	1 68	1 54	1 71	1 52	1 74	1 49	1 77	1 46	1 80	1 43	1 83
80	1 61	1 66	1 59	1 69	1 56	1 72	1 53	1 74	1 51	1 77	1 48	1 80	1 45	1 83
85	1 62	1 67	1 60	1 70	1 58	1 72	1 55	1 75	1 53	1 77	1 50	1 80	1 47	1 83
90	1 63	1 68	1 61	1 70	1 59	1 73	1 57	1 75	1 54	1 78	1 52	1 80	1 49	1 83
95	1 64	1 69	1 62	1 71	1 60	1 73	1 58	1 75	1 56	1 78	1 54	1 80	1 51	1 83
100	1 65	1 69	1 63	1 72	1 61	1 74	1 59	1 76	1 57	1 78	1 55	1 80	1 53	1 83

n=number of observations
k'=number of explanatory variables excluding the constant term

ROUGH WORK WILL NOT BE MARKED

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