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UNISA university of south africa

ECS3706

OCTOBER / NOVEMBER 2016

ECONOMETRICS

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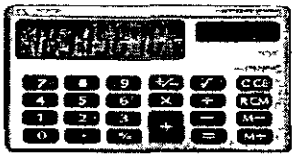

UNIVERSITEITSEKSAMENS

UNISA university of south africa

ECS3706

October/November 2016

ECONOMETRICS

Duration 2 Hours

100 Marks

EXAMINERS .

FIRST	MR MJ KHUMALO
SECOND	MR K LELAKA
EXTERNAL	MR SM MILLARD

Use of a non-programmable pocket calculator is permissible

Closed book examination

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This paper consists of 28 pages, including a formulae sheet (p20), 3 pages of statistical tables (pp 21 to 23), 5 pages for rough work (pp 24 to 28) 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

[TURN OVER]

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 briefly 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.

SECTION A (60 marks)

Answer **ALL** four questions in Section A

QUESTION 1 (15 marks)

(a) Economic theory is very crucial in determining whether a given variable belongs in a regression equation Theory alone is not sufficient to warrant the inclusion of a variable in an equation What other criteria are considered relevant when determining if a variable belongs to an equation? Explain how each criteria is used (5)

(b) Briefly explain/identify the following

i Estimated regression equation

ii The Six Steps in Applied Regression Analysis

iii Ordinary Least Squares (OLS) (5)

(c) Carefully distinguish between the stochastic error term and the residual as used in econometrics by defining both terms, stating the similarities/differences and give equations that contain the stochastic error term and the residual (if any) (5)

[15]

QUESTION 2 (15 marks)

(a) Distinguish between multicollinearity and serial correlation as applied in econometrics How can you resolve the problem of multicollinearity in regression? (10)

(b) What is the meaning of the intercept term in a regression? Why is it almost always included in a regression equation but almost never tested for statistical significance? (5)

[15]

QUESTION 3 (15 marks)

(a) Discuss the problem of heteroscedasticity and list the consequences of heteroscedasticity (6)

(b) Explain how pure heteroscedasticity may be detected by using the Park test What is the main problem of this test? Provide a practical example of how this problem may be overcome (9)

[15]

QUESTION 4 (15 marks)

(a) Given that $\sum_{t=1}^{N} y_t^2 = 5513$, $\sum_{t=1}^{N} x_t^2 = 150$, $\sum_{t=1}^{N} x_t y_t = 58$, $RSS = 1198$ Compute OLS estimate of $\hat{\beta}_1$ and calculate the value of the explained sum of squares (ESS) What is the value of R^2? Interpret the R^2 obtained Show all equations and workings (10)

(b) If $\bar{X}$ = 6 and $\bar{Y}$ = 15, what would the OLS estimate of $\hat{\beta}_0$ be? (3)

(c) What is a dummy variable and why do we use dummy variables in regression analysis? (2)

[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)

The results below were obtained from a regression using OLS estimation of the following model Dependent variable M

Variable	Coefficient	Standard error
Constant term	-228	57
RGDP	1 2	0 5
RGDP(-1)	4 0	1 2
CPI	160	53
IR	-102	510

R^2=0 946, Durbin-Watson=1 461, F-statistic=94 4
The correlation coefficient $R_{GDP, GDP(-1)}$=0 896
Annual data 1956 to 2015 was used (59 observations)

The variables are as follows

M M3 money stock (nominal value) at the end of each period

RGDP Annual real gross domestic product (Income) at constant 2000 prices

RGDP(-1) Real GDP lagged one year

CPI Index of consumer prices, 2000=100

IR Interest rate (%)

According to monetary theory the major determinants of the demand for money are the volume of transactions, the price level and the interest rate

Perform all statistical tests at the 5% level of significance (unless stated otherwise)

(a) Hypothesise signs and state appropriate null and alternative hypotheses for the coefficients based on theoretical considerations (provide reasons for your choice) Then test the individual coefficients for statistical significance (10)

(b) Discuss the assumptions for the validity of the Durbin Watson d-test Test for first order autocorrelation using Durbin-Watson's d-statistic at the 5% level of significance (5)

(c) What is your overall evaluation of this model? What can be done to overcome the problems in the model? (5)

[20]

QUESTION B2 (20 marks)

A researcher with a financial institution wanted to establish the link between the rate of savings by households in South Africa and the estimation revealed the results below The dependent variable is S (Savings rate)

Variable	Coefficient	Standard
Constant	-0 897	0 513
X_1	0 498	0 015
X_2	-0 995	0 264
D_1	0 127	0 0133
D_2	0 078	0 0144
D_3	-0 085	0 008

Method Ordinary Least Squares, Number of observations in sample 40, R^2 = 0 964, Durbin-Watson statistic = 1 35, F = 30 4 The variables used are as follows

X_1 = Income

X_2 = Inflation

D_1, D_2 and D_3 are dummy variables for the seasons of the year in South Africa

(a) Give an interpretation of the estimated coefficients of X_1 and X_2 Do the results conform to theoretical expectation? (3)

(b) What is the name given to the dummy variables used in this analysis and why is only three dummy variables used (2)

(c) Hypothesise signs and test the appropriate null hypotheses at the 5% level of significance Please use a table to present your results (12)

(d) Identify a major shortcoming of this regression and explain what can be done to correct it (3)

[20]

QUESTION B3 (20 marks)

Consider the following regression equation for Country X (standard errors in parentheses)

$$\widehat{C}_t = 4.00 - 0.020P_{pt} + 0.040P_{bt} + 0\ 30\mathrm{Y}_{dt}$$
$$(0.006) \quad (0.030) \quad (0.05)$$
$$\bar{\mathrm{R}}^2 = 0.97 \qquad \mathrm{n} = 35$$

Where C_t = per capita kilograms of pork consumed in time period t
P_{pt} = the price of pork in time period t
P_{bt} = the price of beef in time period t
Y_{dt} = per capita disposable income in time period t

(a) Hypothesise signs and specify the appropriate null and alternative hypotheses for the coefficients of each of these variables (8)

(b) State your decision rules and then test your hypotheses on the above results using the *t*-test at a 5% level of significance (9)

(c) If you could add one variable to the regression, what variable would you add? Motivate your answer (3)

[20]

Appendix 1: Formulae sheet

OLS estimates of $Y_i = \beta_0 + \beta_1 X_{1i} + \varepsilon_i$

$$\hat{\beta}_1 = \frac{\sum x_{1i} y_i}{\sum x_{1i}^2} \text{ where } \begin{cases} x_{1i} = X_{1i} - \bar{X}_1 \\ y_i = Y_i - \bar{Y} \end{cases} \text{ and } i=1 \text{ to } n$$

$$SE(\hat{\beta}_1) = \sqrt{\frac{\left(\frac{\sum e_i^2}{n-2}\right)}{\sum x_{1i}^2}}$$

$$\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}_1 \text{ where } \bar{Y} = \sum_i Y_i / n \text{ and } \bar{X}_j = \sum_i X_{ji} / n$$

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

$$\sum y_i^2 = \sum \left(\hat{Y}_i - \bar{Y}\right)^2 + \sum e_i^2$$

OLS estimates of $Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \varepsilon_i$

$$\hat{\beta}_1 = \frac{\left(\sum y_i x_{1i}\right)\left(\sum x_{2i}^2\right) - \left(\sum y_i x_{2i}\right)\left(\sum x_{1i} x_{2i}\right)}{\left(\sum x_{1i}^2\right)\left(\sum x_{2i}^2\right) - \left(\sum x_{1i} x_{2i}\right)^2}$$

where $x_{2i} = X_{2i} - \bar{X}_2$

$$\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}_1 - \hat{\beta}_2 \bar{X}_2$$

$$SE(\hat{\beta}_1) = \sqrt{\frac{\sum e_i^2 / (n-3)}{\left(\sum x_1^2\right)\left(1 - r_{X_1 X_2}^2\right)}}$$

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

Some statistical measures

$$t = \frac{\hat{\beta} - \beta_{H_o}}{SE(\hat{\beta})}$$

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

$$DW\ d = \frac{\sum_{t=2}^{T} (e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2}$$

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	∞
	161	200	216	225	230	234	237	239	242	244	248	254
1	0	0	0	0	0	0	0	0	0	0	0	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 1 3	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

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