

ECONOMICS TRIPOS Part I

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Friday 11 June 1999                      9 to 11

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Paper 3

STATISTICS AND QUANTITATIVE METHODS

*Attempt **six** questions only from Section A, and **two** from Section B.*

*This written exam carries 60% of the marks for Paper 3. Sections A and B will each carry 30% of the marks.*

*You are permitted to use your own calculator where it has been stamped as approved by the University. Cambridge Elementary Statistical Tables, graph paper and a list of statistical formulae are provided.*

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**Section A**

- 1 Explain how the sampling distribution of a sample statistic can help us test hypotheses about a population statistic.
- 2 Describe the method of ordinary least squares estimation, making clear the conditions under which its application is appropriate.
- 3 Calculate the mean and mode incomes of the following data. What do your results tell you about the distribution of income?

Incomes £1000s	Frequency
15-19.99	41
20-24.99	78
25-29.99	60
30-34.99	29
35-40.00	5

- 4 Calculate the inter-quartile ratio and the coefficient of variation of the following data. How do you account for the differences in your results?

8	5	24	11
6	37	8	9
4	4	6	59
4	5	6	10

- 5 (a) What is the probability that if you throw an unbiased die 4 times you will obtain:
  - (i) 0 sixes? (ii) 1 six? (iii) 2 sixes? (iv) 3 sixes? (v) 4 sixes?
- (b) If you draw 2 balls from a bag containing 11 white and 6 black balls, what is the probability that you will get a black ball on each draw if you do not replace the first ball before drawing the second.

- 6 (a) If  $z$  is a normally distributed random variable with mean 0 and variance equal to 1, use your statistical table to determine the following:
- (i)  $\text{prob}(-0.15 < z < 0.2)$
  - (ii)  $\text{prob}(z > 0.9)$
  - (iii)  $x$  such that  $\text{prob}(z < x) = 0.97982$
- (b) The mean length of screws produced by a factory is distributed normally with mean 4cms and standard deviation 0.025 cms. If a customer can use only screws that are within the range 3.95 to 4.05 cms, what percentage is discarded?
- 7 The price of a specific CD by Band X is observed in 10 Cambridge stores on the same day. The data obtained given in pounds sterling, are shown below:
- 8.00; 10.40; 10.60; 10.80; 11.00; 11.00; 11.30; 11.80; 12.00; 12.00
- Assuming that Cambridge typifies the country in terms of prices, estimate the mean UK price and the variance and set up 95% confidence intervals for each.
- 8 In country  $x$ , a random sample of 800 voters over the age of 40 showed only 30% in favour of joining a currency union with a group of other countries. However, a random sample of 200 under 40 year olds showed 40% in favour. Test whether these proportions can be said to differ at the 0.5% level of significance. Comment upon your conclusions.

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- 9 Business A bought a truck for £50,000 on 1.1.96. It planned to use the truck for three years and then sell it for £20,000 on 1.1.99. Using straight line depreciation,
- Compute the depreciation provision for 1998.
  - Show how you would record the truck in the balance sheet at 31.12.98. Suppose that, when you came to sell the truck on 1.1.99, it realised only £10,000. Comment upon what this means for depreciation provisions and profit.
- 10 A researcher is interested in comparing Industry  $x$  and Industry  $y$ . He or she learns from an official source that the standard deviations of the distributions of profit rates of firms in the two industries are respectively 15% and 20%. However, the information on the means of the profit rates is not available. The researcher thus takes samples *of the same size* of profit rates of firms in the two industries. He or she has no prior expectation about whether one industry is more profitable than the other.
- If it is found that the difference between the mean profit rates in the two industries is 7% and that the hypothesis of equal mean profit rates in the two industries is just rejected at the 5% level of significance, what must the sample sizes have been?
  - If instead at the 1% level of significance the hypothesis of equal mean profit rates is rejected when the samples are each 100, what must the difference in sample mean profits have been?

**Section B**

- 11 A researcher calculates the correlation coefficient  $\rho$  for a large body of data but loses the information. He or she remembers that the value is either 0.6 or 0.9 but cannot decide which. Being lazy the researcher decides to sample from the population of data available and to test the hypothesis that the correlation coefficient is 0.6. The data used are given in the table below:

variable x	variable y
3	21
5	24
8	29
5	19
9	30
4	22
7	26
2	20
2	30
5	30
20	50

- (a) If the researcher tests the hypothesis that the value is indeed 0.6 at the 5% significance level what does he or she conclude?
- (b) Estimate a 95% confidence interval for  $\rho$
- (c) Determine whether your results are sensitive to the inclusion of the last pair of observations, i.e.,  $x = 20$ ,  $y = 50$ .
- (d) Comment on your findings.

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- 12 A researcher investigates whether earnings in a given firm are age-related. The following data are collected.

Age (Years) A	Earnings (£1000) E
20	25.0
25	32.0
30	32.0
40	35.0
48	35.8
50	36.0
55	36.4
22	29.0
44	35.5
35	34.0

- (a) Draw a scatter diagram
- (b) On the basis of your scatter diagram decide which of the following relationships is likely to be the more appropriate and estimate the parameters.

$$E_i = \alpha + \beta A_i + u_i \quad u_i \sim N(0, \sigma^2) \text{ where } \alpha, \beta, \sigma \text{ are constant parameters}$$

$$E_i = \alpha + \beta(1/A_i) + u_i \quad u_i \sim N(0, \sigma^2) \text{ where } \alpha, \beta, \sigma \text{ are constant parameters}$$

- (c) Test whether age has a significant influence on earnings.
- (d) Estimate how much a 60 year old person is likely to earn.
- (e) Plot your estimated residuals ( $u_i$ ) and comment on the pattern.
- (f) Comment on your results

- 13 Using the method of moving averages to produce a seasonally adjusted series for expenditure on alcoholic drink and tobacco.

Consumers' expenditure: Alcoholic drink & tobacco (current prices).

Date	March	June	September	December
1990	6024	7198	7556	9230
1991	6502	7880	8326	9972
1992	7628	8200	8322	9403
1993	7885	8532	8670	9688

Do you think the resulting series is free of seasonal fluctuations? What might account for your results?

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	Agriculture and Fishing	Manufacturing	Construction	Education and Health	Energy and Water
Hourly Earnings					
Summer 1994	4.6	7.61	6.5	9.64	9.52
Summer 1995	4.33	7.99	6.8	10.03	9.74
Employment (1000s)					
Summer 1994	32	205	79	547	20
Summer 1995	36	190	72	557	27

- (a) Construct Laspeyres and Paasche indices for the changes in wage rates between summer 1994 and 1995.
- (b) Draw a scatter diagram of the changes in wage rates and the changes in employment in the five sectors.
- (c) Briefly discuss the index number problem. How would you explain your results?

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15 Business C had the following trial balance at 1.1.98:

	Debit £	Credit £
Capital		1000
Cash (at bank)	1000	
	<hr/> 1000	<hr/> 1000

C had agreed with the bank an overdraft limit for 1998 of £5000. During 1998, C carried out the following transactions: It paid suppliers £6,400 for hire of equipment, etc. It sent bills totalling £7,300 to customers for services provided during 1998. None of these bills had been paid by 31.12.98. It paid bank interest of £600.

- (a) Prepare the journal, ledger and trial balance recording these transactions. Compile a profit and loss accounts for the year ended 31.12.98 and a balance sheet as at 31.12.98.
- (b) Write a brief appraisal of the financial performance of the business during 1998 and of its financial position at 31.12.98

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