UNIVERSITY OF LONDON

279 0076 ZA

BSc degrees in Economics, Management, Finance and the Social Sciences, the Diploma in Economics and Access Route for Students in the External Programme

Management Mathematics

Thursday, 13 May 2004 : 2.30pm to 5.30pm

Candidates should answer **FIVE** of the following **EIGHT** questions. All questions carry equal marks.

Graph paper is provided. If used, it must be securely fastened inside the answer book.

New Cambridge Statistical Tables (second edition) are provided.

A hand held non-programmable calculator may be used when answering questions on this paper. The make and type of machine must be stated clearly on the front of the answer book.

PLEASE TURN OVER

1.(a) Define an Ideal Index, explain why it might be useful and state how you might calculate one. **(6 marks)**

(b) Workers in a company are from four different ethnic groups (labelled A,B,C and D). During a three year period the number of workers employed by the Emensy company in each group and their average weekly earnings (per person) are:

	Year 1		Year 2		Year 3	
Ethnic Group	Number	Earnings	Number	Earnings	Number	Earnings
A	182	505	225	531	232	584
B	103	245	66	268	71	293
C	7	908	9	873	18	821
D	45	125	55	133	60	143

Use suitable indices (Base year 1) for the three years to show the changes in each of the following:

i. Total earnings paid by Emensy,

ii. Average earnings for their workers as a whole, and

iii. The total number of workers employed. **(6 marks)**

(c) The following table shows the price of four daily newspapers sold in a particular city.

	Daily Planet	The Times	The News	The Globe
Year 1	90	65	80	80
Year 2	105	85	90	80
Year 3	120	90	105	90
Year 4	150	100	120	50

i. Find the simple aggregate price index and average price relative index for each year . (Use Year 1 as a base throughout). **(6 marks)**

ii. How could you improve the above analysis if your aim was to assess the general cost of newspapers in year 4 as opposed to year 1 ? **(2 marks)**

1

2. In order to study the computer awareness of its personnel a company assessed 500 of its workers. Each worker was tested to see if they were competent with Wordprocessing (W), Spreadsheets (S) or Database Systems (D). It was discovered that amongst the assessed workers there were 250 competent with W, 380 with S and 280 with D. 50 people were particularly capable as they were competent in all three computer skills. The survey further suggested that 190 workers were competent with S and D. A similar total of 190 workers were competent with S and W but as many as 250 were competent with both D and W.

i. Try to produce a Venn diagram for the above situation and hence show that there must be an error in the survey data. **(4 marks)**

ii. If one (and only one) of the above figures is incorrect determine which ones it could possibly be and, in each case, find a maximum and minimum value which the correct value might be. **(12 marks)**

iii. Show the following set on a Venn diagram, describe it in words and determine the maximum and minimum order of it:

$$W \cup (D^c \cap S)$$

(4 marks)

3.(a) You are given the following difference equation for y

$$y_t + 4y_{t-2} = 22 + 5t$$

with $y_0 = 1$ and $y_1 = 3$.

Solve the above difference equation for y, graph the solution and describe the graph in words.

(12 marks)

(b) Solve the following second order linear difference equation

$$\frac{d^2 y}{dx^2} - 7\frac{dy}{dx} + 12y = xe^{4x}$$

if y = 1 and dy/dx = 3 when x = 0.

(8 marks)

2

4.(a)   Why is it wise to carry out an initial simple analysis of the data when performing large surveys for market research ?   **(7 marks)**

(b)   Briefly discuss how graphical methods can help in some of the initial analysis referred to in (a) above.   **(3 marks)**

(c)   Construct a box and whisker diagram for the following data and comment upon what it shows:

x	1	2-12	13	14	15	16	17	18	19	20-43	44
Frequency	2	7	16	23	16	8	5	0	1	0	1

(10 marks)

5.(a) i. Use Simpson's rule with five ordinates to evaluate

$$\int_{\pi/3}^{2\pi/3} \cot\left(\frac{\theta}{2}\right) d\theta$$

(6 marks)

ii.   Evaluate the integral precisely and compare your answers   **(5 marks)**

(b)   The complex number u = - 7 + 8i.

i.   Show the complex number u on an Argand diagram.   **(2 marks)**

ii.   Find the complex number v which satisfies uv = -29 + 17i   **(4 marks)**

iii.   Evaluate | v - u | .   **(3 marks)**

UL04/495

6.(a). Briefly explain each of the following terms:

i. A Random Walk Process
ii. A Queue's Service Mechanism **(4 marks)**

(b) Derive the Poisson distribution from the assumptions of the Poisson process.
(5 marks)

(c) Matrices P_1, P_2 and P_3 below are transition matrices for Markov chains between states A, B, C and D.

$$P_1 = \begin{pmatrix} \frac{1}{3} & \frac{1}{6} & 0 & \frac{1}{2} \\ 0 & 0 & 0 & 1 \\ 0 & \frac{1}{4} & 0 & \frac{3}{4} \\ 0 & \frac{1}{2} & 0 & \frac{1}{2} \end{pmatrix}, \qquad P_2 = \begin{pmatrix} \frac{1}{2} & 0 & 0 & \frac{1}{2} \\ 0 & \frac{1}{4} & \frac{1}{2} & \frac{1}{4} \\ 0 & 0 & 1 & 0 \\ \frac{1}{3} & 0 & \frac{1}{3} & \frac{1}{3} \end{pmatrix}$$

$$P_3 = \begin{pmatrix} \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \end{pmatrix}$$

i. Identify all absorbing states, and determine which of the Markov chains are absorbing. [Note: A Markov chain is said to be absorbing if it has at least one absorbing state and if it is possible to go from every state to an absorbing state (not necessarily in one step)].
(6 marks)

ii. Draw a network diagram for each transition matrix (with probabilities on the arcs) to illustrate the possible movements. **(3 marks)**

iii. If, for transition matrix P_3 one is in state D at time t = 0, what is the probability that you will not reach state B at or before t = 3 ? **(2 marks)**

4

7. Certain characteristics of six companies are summarised below.

Company	1	2	3	4	5	6
Head office in USA (1), not (0)	1	0	1	0	1	1
Turnover more than $20bn (1), not (0)	0	1	1	1	1	0
Grew by more than 20% last year (1), not(0)	0	0	1	1	1	0
In the Banking Sector (1), not (0)	0	0	0	0	1	1
Exports more than 30% of products (1), not (0)	1	0	1	1	1	1
Has subsidiaries in South America (1), not (0)	0	0	0	1	0	0

A company analyst needs to group the companies for investment purposes into those which have the highest proportion of common characteristics.

i. Compute a similarity matrix for these companies. **(5 marks)**

ii. Perform a hierarchical clustering of these companies using a) single, and b) complete linkage methods. **(10 marks)**

iii. Draw graphical representation of the product groupings for each clustering method and comment upon your results. **(5 marks)**

UL04/495

8.(a) i. In forecasting, what does the term 'leadtime' refer to? **(2 marks)**

ii. How can a moving average forecast be made less responsive to recent data?

(2 marks)

iii. How can exponential smoothing be made less responsive to recent data? **(2 marks)**

iv. What is meant by the terms 'fitted region' and 'forecast region' in the derivation of a forecasting model? **(2 marks)**

The monthly demand for a product for 2003 is as follows:

Month in 2003	Demand
January	580
February	500
March	1300
April	2400
May	2500
June	2100
July	1480
August	1520
September	1500
October	1490
November	860
December	

(b) Find the forecast demand for December 2003, by using exponential smoothing and using an initial forecast for January 2003 of 600. Choose your smoothing constant appropriately from $\alpha = 0.1$, $\alpha = 0.3$, or $\alpha = 0.4$ and state the reason for your choice. **(6 marks)**

(c) Find the forecast demand for December 2003 by using a moving average. Choose either a 3 month or 5 month moving average depending upon whichever you think is most appropriate. State the reason for your choice of moving average period.

(6 marks)

END OF PAPER