MANAGEMENT STUDIES TRIPOS
DIPLOMA IN MANAGEMENT STUDIES

Tuesday 30 April 2002 1.30 to 4.30

Paper M2

QUANTITATIVE METHODS AND OPERATIONS MANAGEMENT

*Answer not more than **four** questions, **two** from Section **A** and **two** from Section **B**.*

All questions carry the same number of marks.

Answers to questions in each section should be tied together and handed in separately.

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SECTION A

1 (a) Explain what is meant by the terms paired data, independent data, ordinal data and interval data. [6]

(b) The Table below shows data obtained from the 2001/2 MST/Diploma Survey of Cambridge undergraduate students. Respondents were asked what religion, if any, they followed, and whether they supported the bombing of Afghanistan by the US as a response to the events of September 11th 2001. For the latter question, respondents were asked to reply on a scale of 1 (strongly against the bombing) to 5 (strongly support the bombing). The two religion groups shown in the Table are:

CJ: followers of Christianity or Judaism;
BHI: followers of Buddhism, Hinduism or Islam.

Cambridge undergraduate students

Religion group	Extent of support for bombing of Afghanistan	Number of Respondents
CJ	1	30
BHI	1	9
CJ	2	50
BHI	2	4
CJ	3	24
BHI	3	4
CJ	4	34
BHI	4	1
CJ	5	7
BHI	5	1

Using a non-parametric test, test the null hypothesis that, within the population concerned, there is no difference between the two religion groups in the extent of support for the bombing against the alternative hypothesis that there is a difference. Use a significance level of 5%. [10]

(c) Would it be possible for a test of the kind you have used in (b) to reject the null hypothesis with the sample of respondents from the 2001/2 Survey if one of the two religion groups had only one member in the sample? Explain your answer. [9]

2 (a) Write brief notes on the basic principles of the design of charts when conveying quantitative data. [15]

(b) Describe, with justifications, the changes you would make if you had the opportunity to redo the survey described in question 1. The broad topic of the survey should remain the same. You may wish to consider changes to the questionnaire, the way that the survey was carried out, or different hypotheses that you would wish to test. [10]

3 (a) Explain briefly what is meant by the terms simple random sampling, multi-stage sampling, and the design effect. [6]

(b) A company wishes to estimate the average number of meals a household in Great Britain eats out at a restaurant per year. In order to estimate the size of the sample they will eventaully need, they select a preliminary sample of 40 households. This is done by first randomly choosing 40 out of the two hundred or so area telephone directories for Great Britain and then randomly choosing one telephone number from each of these. The first person to answer the telephone at that number is asked to estimate how many meals out at a restaurant their household ate in the last month. The mean response is 10.2 and the standard deviation of individual responses is 2.9. Making clear any assumptions you make, and explaining the ways in which you feel your calculation is limited, calculate how many respondents would be needed in a full survey in order to estimate with 95% confidence the average number of meals eaten out at restaurants per household to within plus or minus five per year. You should assume the full survey has a design effect of 2.0. [12]

(c) Consider now a different survey, where the sample size is a significant fraction of the population size. Show that the two definitions of the design effect (one based on the standard errors for a given sample size and one based on the sample sizes necessary to achieve a given precision) are not equivalent. In such situations, which of the two definitions do you think is more appropriate to use when calculating a confidence interval? [7]

4 (a) Explain the differences between parametric and non-parametric statistical hypothesis tests. [6]

(b) The 2001/2 MST/Diploma Survey of Cambridge undergraduate students included a question on whether respondents were for or against UK support for the US responses to the events of September 11th 2001. Respondents were asked to reply on a scale of 1 (very much against support) to 5 (very much for support). The Table below shows the data obtained from the subset of all respondents who would normally vote for the Conservative Party.

Cambridge undergraduate students

Response	Number of Respondents
1	1
2	9
3	18
4	12
5	9

Source: 2001/2 MST/Diploma Survey

Using a non-parametric two-tailed test, test the null hypothesis that, within the population of Conservative-voting Cambridge undergraduate students, there are as many people for UK support for the US responses, as there are against it. Use a significance level of 5%. [6]

(c) In principle, one could repeat the test in (b) with other political parties or groups of political parties, using the data obtained in the Survey. Explain why this might be misleading, and how you could adapt the methodology you used in (b) to alleviate the possible problem. [6]

(d) The Central Limit Theorem states that the sum of a set of n values, each of which is taken from the same distribution, tends towards a Normal distribution as n becomes very large. Explain how this Theorem could in principle be applied to the problem in (b), and the reasons why it is preferable to use a non-parametric test instead. (Note that you are not expected to carry out the calculation itself.) [7]

SECTION B

5 Suppose that you have just started in your new position. Your boss has hired you because she/he is very concerned about customer satisfaction and feels that your knowledge of scheduling will be helpful in achieving this.

Your boss has provided you with the following six jobs to schedule on a piece of equipment. She/he has also given you the additional information that each job fully occupies the equipment for the job specified:

Job	Duration
A	6 days
B	4 days
C	2 days
D	8 days
E	1 day
F	5 days

(a) In scheduling the order of the jobs, what is the minimum average completion time that can be obtained? [8]

(b) Suppose each job makes a batch of products that is placed into stock. If the demand for these products and current stock levels are as follows, what schedule would be best? Explain your answer. [17]

Job	Demand	Current Stock
A	10	260
B	15	195
C	40	880
D	2	20
E	5	75
F	80	1280

6 Sgwrs Ltd. Is a firm based in Cardiff that produces mobile phones. The production manager has developed the following chart that breaks down the production process into fifteen operations, and provides the immediate predecessors of each operation and each operation time in minutes.

Operation	Immediate Predecessors	Operation Time (mins.)
1	None	6
2	1	3
3	2	9
4	2	5
5	3	8
6	2	10
7	4	7
8	4	4
9	5, 6	9
10	6, 7	8
11	8	4
12	9	12
13	11	7
14	10, 12	3
15	13, 14	5

The production manager informs you to assume a cycle of 30 minutes.

(a) Determine the minimum number of stations that could be achieved, and use the ranked positional weights technique to achieve a balance for this number of stations. [7]

(b) Is there a solution with the same number of stations you used above, but with a lower cycle time? If there is such a solution, what is the minimum cycle time that gives a balance with the same number of stations you found above? [7]

(c) Finally, for the three stations, find a balance with the smallest possible cycle time.

7 It is exactly five years in the future, and you have just received a phone call from a Cambridge friend who had been unsuccessful in getting on to the Management Studies Tripos course back in 2001. Your friend now works in a windowless office as an assistant purchasing agent for an industrial firm called Millennium Lighting, which is located in a larged, domed structure in Greenwich. Millennium Lighting installs lighting fixtures in posh offices throughout the Souteast. Although you are now a handsomely paid management consultant with a luxurious office overlooking the City, you are willing to take 45 minutes to help out an old friend with some free advice. Your friend needs to place an order for halogen light bults and must choose one exclusive supplier from amongst the three lighting suppliers who are authorised vendors to Milennim Lighting. Your friend informs you that Millennium Lighting has an annual requirement for 20 000 halogen bulbs and this demand is expected to remain constant into the indefinite future. Millennium Lighting top management has made it very clear to your friend that it must never find itself out of stock of halogen bulbs

Supplier 1 has a 'simple' pricing policy: halogen light bulbs cost £2.50 per bulb. Supplier 2 has a 'large order' policy: bulbs cost only £2.40 each, but Supplier 2 will not consider any order of fewer than 3000 bulbs at a time. Supplier 3 follows a 'bumper order policy': bulbs are sold at the very competitive price of £2.30 each,but supplier 3 will not accept orders of size less than 4000. Just prior to your friend ringing you, the sales manager from Supplier 1 had rung your friend offering a £2000 'annual cash-back': each year that Millennium Lighting promises to purchase at least 3000 bulbs over the year from Supplier 1, it will receive a £2000 refund from Suppleir 1.

Millenium Lighting estimates a cost of £100 for placing an order, exclusive of purchase cost, and estimates a 20% annual cost of holding inventory.

(a) Which supplier should your friend choose so as to incur the minimum cost? Justify your answer.

(b) What order size should your friend use?

(c) When your friend attempts to place the order with the least-cost supplier, your friend is shocked to learn that it has suddenly gone out of business. Which supplier should your friend order from now and what is the annual cost associated with ordering with this firm?

8 British Consumer Goods Ltd. (BCG) operates a chain of 40 chemists shops throughout England and Wales. From a main warehouse in Birmingham, it supplies the individual chemists' shops with nearly a thousand products. The company's historical inventory policy has involved monthly orders placed directly with the manufacturers of the various products and held at its main warehouse. As its product line has grown, BCG's tope managers have expressed concern about the increasing inventory levels and the associated high inventory costs.

As a results, BCG's inventory manager has been asked to make a detailed cost analysis of the items carried in inventory to see if a better inventory policy can be established. The inventory manager has selected one of BCG's top-selling products, a cold remedy called 'LimeSip', for an initial study. LimeSip is sold to the consumer in packages of 24 tablets. BCG purchases LimeSip from the manufacturer in cases of 10 at a cost of £12 per case.

The demand for cases of LimeSip over the past six months has been as follows:

Month	1	2	3	4	5	6	Total
Demand (in cases)	2025	1950	2100	2050	1975	1900	12 000

Although demand per month is not constant, the month-to-month difference is small enough that inventory planning with a constant rate of 12,000/6 = 2000 per month is viewed as acceptable. Specifically, BCG places orders monthly of size Q = 2000.

BCG estimates its annual cost of insurance, taxes, breakage, shrinkage, and warehouse overhead to total approximately 6% of the value of the inventory. The cost of capital is 12%. The cost for placing an order, which includes the salaries of the purchasing agents and support staff, as well as transportation costs and miscellaneous costs, is estimated to be £38, independent of the size of the order.

(a) If BCG were to change to an EOQ ordering policy, what order size would they use? [6]

(b) What would be the percentage reduction in annual cost (excluding purchase cost) achieved by BCG changing from their current ordering policy to the EOQ policy? [12]

(c) The manufacturer of LimeSip guarantees a 3-day delivery time on all orders placed by BCG. Taking into account weekends and holidays, BCG operates 250 days per year. At what inventory level should BCG order a new shipment of LimeSip from the manufacturer? State any additional assumptions if you make them. [7]

END OF PAPER

MANAGEMENT STUDIES TRIPOS
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Thursday 2 May 2002 9 to 12.00

Paper M3

ECONOMICS AND FINANCE

*Answer not more than **four** questions, **two** from Section **A** and **two** from Section **B**.*

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SECTION A

1 Discuss the ways in which entry barriers can be said to determine the degree of concentration in a market. [25]

2 'No one theory of the growth of the firm is entirely satisfactory. However taken together there are a number of theories which do give a satisfactory picture of why firms grow.' Discuss. [25]

3 'There are three typical effects of mergers. First, share prices rise. Second, profits fall. Third, costs go down.' Explain and discuss. [25]

4 With reference to at least **three** industries, illustrate how government policy towards industry can attempt to increase societal welfare. [25]

SECTION B

5 A company produces three products R, S and T:

	R	S	T
	£	£	£
Materials (£2 per kg)	5.00	6.00	4.50
Labour (£3 per hour)	4.50	3.00	6.00
Variable overheads (£1 per hour)	1.50	1.00	2.00
	11.00	10.00	12.50
Selling price	16.00	15.80	17.30
Contribution	5.00	5.80	4.80

Due to a sudden shortage the company's supplier informs them that for July only 4500kg of raw material will be available.

The Managing Director (who once read a book on marginal costing) says that, because product S makes the largest contribution, all the material should be used to produce S. However, the Finance Director is unsure about this policy and feels that an alternative strategy might be better.

You are required to:

(a) (i) Calculated the budgeted contribution for July if the Managing Director's policy is implemented and establish if any other plan would be better. [9]

Some time later it becomes apparent that the supplier was wrong and that the raw material will not be in short supply, but due to a labour dispute only 2000 hours can be working during July. The market research department has also informed the Finance Director that only 900 units of S can be sold and due to product dependency the other two products must be made in the ratio of 2Ts for every 1R.

(ii) Establish the optimum production plan and the budgeted contribution under these new conditions. [9]

Part (b) need not relate to part (a)

(b) (i) 'The balance sheet shows how much a business is worth. Discuss. [4]

(ii) What is the convention of consistency? Does this convention help users in making more valid comparisons between businesses? [3]

6 The Fulke Leisure Group plc is a regional brewer and national hotelier. Accounts for the year to 31 December 19X8 showed:

Balance Sheet as at 31 December 19X8

	19X8		19X7	
	£000	£000	£000	£000
Fixed Assets (note 1)		1559960		134970
Current Assets	12500		12200	
Stock	16700		15300	
Debtors	48500		2000	
Short-term deposits	120		125	
Bank	77820		29625	
Current Liabilities				
Taxation	4100		3500	
Trade Creditors	1180		10000	
Overdrafts	920		4600	
Dividends	4400		3200	
Sundry Creditors & accruals	14780		13400	
	36000		34700	
Net current assets (liabilities)		41820		(5075)
		197780		129895
Long-term loans		40000		18615
		157780		111280
Ordinary shares of £1		14800		112800
Share premium		65280		27280
Retained profits		77700		71200
		157780		111280

Profits and loss account for the year ended 31 December 19X8

Turnover	171700	163500
Operating Costs	150900	145900
	20800	17600
Income from short-term deposits	1300	200
	22100	17800
Interest payable	2800	2300
Profit before tax	19300	15500
Taxation	6500	5300
Profit after tax	12800	10200
Dividends	6300	4800
Retained profit for the year	6500	5400

cont….