UNIVERSITY OF NEWCASTLE UPON TYNE

SCHOOL OF MATHEMATICS & STATISTICS

SEMESTER 2
2004–2005

MAS187

Quantitative Methods for Business Management

Time allowed: 2 hours

Credit will be given for ALL answers to questions in Section A, and the best TWO answers to questions in Section B. No credit will be given for other answers and students are strongly advised not to spend time producing answers for which they will receive no credit.

There are FIVE questions in Section A and THREE questions in Section B. Marks allocated to each question are indicated.

SECTION A

A1. The number of new orders received by a company over the last 12 working days were recorded as follows:

8	15	24	20	25	12
16	18	21	10	12	10

Calculate the mean, median and standard deviation of these data.

[7 marks]

A2. A new Mercedes-Benz car franchise forecasts that it will sell around three of its most expensive model each day.

(a) What probability distribution might be reasonable to use to model the number of cars sold each day?

(b) What is the expected number and standard deviation of the number of cars sold per day?

(c) What is the probability that no cars are sold on a particular day?

[9 marks]

A3. The weekly demand for a liquid oil-based product that is marketed by a company is normally distributed with a mean of 2000 gallons and a standard deviation of 500 gallons.

(a) The company holds 2750 gallons in stock at the start of the week. Assuming that no further supplies of the product are available during the week, what is the probability that the company will run out of stock in a particular week?

(b) How many gallons of the product must the company hold in stock at the start of the week to have only a 0.06 probability of running out of stock?

[9 marks]

A4. (a) "Fandango Holidays" is an internet travel agency specialising in cheap flights to Southern Spain. From a random sample of 12 customers with Fandango, the mean price of flights to Granada in July was found to be £217, with a standard deviation of £30.10. Obtain a 95% confidence interval for the average price of flights to Granada with Fandango.

(b) Another internet travel agency, "Cortijo Andalucia", also offer cheap flights to Granada. From a random sample of 10 customers with Cortijo Andalucia, the mean price of flights to Granada was £238 with a standard deviation of £39.90. Is there any difference in the average price of flights to Granada between the two travel agencies? Hint: the pooled standard deviation is $s = £34.85$ and test at the 5% level of significance.

[13 marks]

A5. The Personnel Manager of a company believes that monthly paid staff take more time off work through sickness than those staff who are paid weekly (and do not belong to the company sickness scheme). To test this theory, the sickness records for 531 randomly selected employees who have been in continuous employment for the past year were analysed. These have been summarised in the table below.

	Number of days off sick			
	Less than 5	5 to 10	More than 10	**Total**
Monthly paid	85	41	11	137
Weekly paid	136	152	106	394
Total	221	193	117	531

Is there evidence of an association between type of employee and number of days off sick? Test at the 1% level of significance.

[12 marks]

SECTION B

B6. Pizza Classic is a family-run pizza delivery company that have been in the Newcastle area for over twenty years. In their current 3-year business plan they have estimated the probability of high and low demand for their pizzas a 0.55 and 0.45 respectively. They have also estimated that the net value of income will be £750,000 if the demand is high and £375,000 if the demand is low.

The company are now considering setting up an internet site where customers could order their pizzas. The start-up costs of this venture would be £20,000. It is believed that an internet site would increase the amount spent per customer and therefore net income from both high and low demand would increase to £1,100,000 and £600,000 respectively. If the company decided to go ahead with the plan it could employ consultants to conduct a marketing campaign. The consultants would charge £30,000 and they believe that there is an 80% chance that their campaign will be a success and customers would approve the plan. If the campaign is a success it is believed the probability of high demand would increase to 0.65. If the consultants conclude that customers are not likely to use the site, the company will abandon the idea of an internet site.

(a) Draw a decision tree for the problem.

(b) Calculate the *Expected Monetary Value* for all possible decisions the company may take and hence determine the optimal decision for the company.

[25 marks]

B7. The Elves Toy Company makes toy trains and dolls' prams, which use the same wheels and logo stickers. Each train requires 8 wheels and 2 logo stickers. Each pram requires 8 wheels and 3 logo stickers. The company has 7200 wheels and 2200 logo stickers available. The company is to make at least 300 of each type of toy. The company sells each train for £20 and each pram for £25. The company makes and sells x trains and y prams.

(a) Formulate the company's situation as a linear programming problem.

(b) Draw a suitable diagram to enable the problem to be solved graphically, indicating the feasible region and the direction of the objective line.

(c) Use your diagram to find the company's minimum and maximum total income, £T.

[25 marks]

B8. The manager of the Dog and Duck pub believes that monthly sales of lager are influenced by the average temperature in that month. To investigate, he records the average monthly temperature (x, in degrees celsius), and total monthly sales of lager (y, in thousands of pounds), over a one year period. His results are shown below.

x	4	4	7	8	12	15	17	22	19	11	7	5
y	4.5	5.2	5.1	6.3	7.2	11.8	13.6	17.5	13.4	10.3	5.6	11.2

(a) Produce a scatterplot for these data, and comment on the relationship between average temperature and sales of lager.

(b) The following summaries have been obtained for the above data:

$$\sum x = 131 \qquad \sum y = 111.7$$

$$\sum x^2 = 1843 \qquad \sum y^2 = 1237.7 \qquad \sum xy = 1467.6$$

Using these summaries,

i) calculate the sample correlation coefficient, and comment;

ii) perform a linear regression analysis, and obtain the linear regression equation. Plot this regression line on your scatter diagram in part (a).

(c) If the average temperature this July has been forecasted as 20°C, predict the sales of lager the manager of the Dog and Duck might expect.

(d) A heatwave is expected across the U.K. later on this summer, with average temperatures in August and September expected to reach 25°C. Why should we be cautious about using the regression equation obtained in part (b) (ii) to predict sales of lager during the heatwave?

[25 marks]