

Sample Paper

BUSINESS STATISTICS

Level 2

Wednesday 12 November

Subject Code: 2009 SAMPLE

Time allowed: **2 hours 30 minutes**

INSTRUCTIONS FOR CANDIDATES

- Answer **4** questions.
- All questions carry equal marks.
- There is a list of formulae at the end of the paper.
- Graph paper is provided within the **answer book**.
- Write your answers in blue or black ink/ballpoint. Pencil may be used only for graphs, charts, diagrams, etc.
- All answers must be correctly numbered but need not be in numerical order.
- Workings must be shown.
- Make sure your answers are accurate and neat.
- You may use a calculator provided the calculator gives no printout, has no word display facilities, is silent and cordless. The provision of batteries and their condition is your responsibility.

QUESTION 1

The sales force of a large clothing retailer are paid on a commission only basis.

The pay received by its 80 salesmen in 2007 was:

Pay per salesman (£000)	Number of salesmen	Total pay (£000)
12-14	4	52
14-18	14	224
18-25	30	645
25-30	24	660
30-50	8	320

- (a) Use these figures to draw a Lorenz curve for the 2007 data and interpret the diagram. (11 marks)

As part of the ongoing assessment of sales performance, the Marketing manager has drawn up a table to show the value of clothing sales each quarter for the period 2005 - 2007 inclusive.

Year	Sales (£m)			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2005	3.6	2.4	2.5	3.0
2006	3.2	2.3	2.3	2.7
2007	2.8	2.1	2.0	2.5

- (b) Describe two patterns shown in the sales data over the period. (4 marks)
- (c) Find, by means of a centred moving average, the trend values for the data. (6 marks)
- (d) Briefly explain how you could have used the moving average data from (c) to provide a basis for forecasting sales in the first quarter of 2008 (further calculations **not** required). (4 marks)

(Total 25 marks)

QUESTION 2

- (a) Explain the term 'rate of inflation'.
(2 marks)
- (b) Give two reasons why it is necessary to change the base year of an inflation index periodically.
(4 marks)

Saffron Ceramics uses four materials in the manufacture of a product.

The ratio by weight (Kg) of the four materials W, X, Y, Z to produce a single product is 3 : 5 : 12 : 15

The costs per kilo of these materials in the years 2005 – 2007 were as follows:

Raw material	Cost per kilo (£)		
	2005	2006	2007
W	3.50	3.50	5.20
X	1.50	1.70	2.10
Y	6.00	6.80	7.40
Z	4.20	4.75	5.40

- (c) Calculate a weighted materials cost index for 2006 **and** 2007 with 2005 as base year.
(13 marks)

The Production manager is concerned that the material costs should not increase faster than the rate of inflation as measured by the Index of Retail Prices.

The Index of Retail Prices for the years 2005 – 2007 with January 1999 as base year is given as:

Year	Index of Retail Prices (Jan 1999 = 100)
2005	115.2
2006	119.6
2007	124.4

- (d) (i) Convert the Index of Retail Prices to a series with 2005 as base year.
(4 marks)
- (ii) Compare the increase in the Index of Retail Prices with the materials cost indices calculated in part (c).
(2 marks)

(Total 25 marks)

QUESTION 3

Numeric data can be described as either discrete or continuous.

- (a) Explain each of these terms giving a suitable business example for each to illustrate your answer. (4 marks)

A car finance company has a number of UK offices.

The manager at one of these offices records how long it takes for her staff to process a sample of 50 loan applications.

Processing times are recorded to the nearest minute.

Time, t (minutes)	Number of loans processed
1-2	2
3-6	5
7-9	6
10-12	9
13-14	13
15-20	15

- (b) Draw a histogram to represent these data. (7 marks)
- (c) Calculate estimates of the mean and standard deviation of the processing times for the sample and use these values to estimate the coefficient of variation for the data. (11 marks)

An analysis of a sample of loan processing times at another UK office gave a mean time of 16 minutes and standard deviation of 3.9 minutes.

- (d) Calculate the coefficient of variation for this data and compare your answer with that obtained in part (c). (3 marks)

(Total 25 marks)

QUESTION 4

Sladdon plc assembles engine parts at two factory sites, Liverbourne and Martrent. Staff employed at each site work in one of four departments, Production, Sales, Administration or H.R.

The numbers employed in each department at each site in January 2008 were:

Department	Number of employees	
	Liverbourne	Martrent
Production	170	219
Sales	40	18
Administration	30	48
H.R.	10	15

(a) Construct two clearly labelled percentage component bar charts to illustrate this data. (8 marks)

(b) Describe **three** differences in the departmental staffing levels between the two sites. (3 marks)

The mean age of the 250 staff employed at Liverbourne is 40.5 years.

The mean age of the Production staff at this site is 38.5 years, the mean age of the Sales staff is 43.0 years and the mean age of the H.R. staff is 44.0 years.

(c) Calculate the mean age of the Administration staff at the Liverbourne site. (6 marks)

Staff at the Martrent factory site are to be surveyed to find out their views on the introduction of new patterns of shift work.

(d) (i) Explain how the company could select a stratified random sample of 50 employees from the Martrent site for the purpose of the survey. (6 marks)

(ii) Give one advantage and one disadvantage in using this type of sampling method. (2 marks)

(Total 25 marks)

QUESTION 5

The following table shows the amount spent on advertising and the number of visitors to a theme park over an eight week period.

Week	Advertising expenditure (£00)	Number of visitors (000)
1	56	19
2	20	7
3	36	13
4	42	15
5	35	13
6	18	6
7	31	11
8	45	16

- (a) Plot the data on a scatter diagram. (3 marks)
- (b) Calculate the product moment correlation coefficient for the data. (10 marks)
- (c) Explain what the correlation coefficient measures and interpret the value obtained in part (b). (4 marks)

The least squares regression line for this data passes through the following pairs of coordinates (20,7.2 and 35,12.4)

- (d) (i) Use this information to calculate the regression equation in the form $y = a + bx$ (6 marks)
- (ii) Give a reason why this equation would be unsuitable for estimating the number of visitors for a weekly advertising spend of £1400. (2 marks)
- (Total 25 marks)**

QUESTION 6

Last year 2200 cars were serviced in a local garage.

The service record for each car shows whether it runs on unleaded, leaded or diesel fuel and whether it has a large engine size (1600cc or above) or small (below 1600cc).

- 75% of the cars were large engine size.
- 64% of the large engine cars ran on unleaded fuel, 20% on diesel fuel and the remainder on leaded fuel.
- Of the small engine cars 22% ran on diesel fuel, 8% on leaded fuel and the remainder on unleaded fuel.

(a) Use this information to draw a fully labelled tree diagram, or otherwise, to show all possible outcomes.

(6 marks)

(b) Calculate the probability that a service record chosen at random is for a car that:

(i) runs on leaded fuel and has a small engine size (2 marks)

(ii) runs on unleaded fuel. (4 marks)

(c) Three car service records are selected at random, with replacement.

Calculate the probability that one of the records is for a large engine diesel car.

(6 marks)

The owner of the garage agrees to conduct a postal survey to monitor customer satisfaction levels with the servicing of their car.

(d) Give one advantage and one disadvantage of using a postal survey in this case.

(2 marks)

(e) List **five** factors to consider when designing questions to be included in this survey.

(5 marks)

(Total 25 marks)

Median

$$l_m + \frac{c_m}{f_m} \left(\frac{n}{2} - F_{m-1} \right)$$

Where l_m , c_m and f_m are the lower boundary, width and frequency respectively of the median class, n is the total number of observations and F_{m-1} is the cumulative frequency corresponding to l_m .

Mean

$$\bar{x} = \frac{\sum fx}{\sum f}$$

Standard deviation

$$s = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2}$$

Quartile deviation

$$\frac{Q_3 - Q_1}{2}$$

Mean deviation

$$\frac{\sum f |x - \text{mean}|}{\sum f}$$

Coefficient of variation

$$\frac{s}{\bar{x}} \times 100$$

Product moment correlation coefficient

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2)}}$$

Spearman's rank correlation coefficient

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

Least squares regression line $\hat{y} = a + bx$

$$b = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$$

$$a = \frac{\sum y}{n} - \frac{b\sum x}{n}$$

Laspeyres index

$$\frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

$$\frac{\sum p_0 q_1}{\sum p_0 q_0} \times 100$$

Paasche index

$$\frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$$

$$\frac{\sum p_1 q_1}{\sum p_1 q_0} \times 100$$

Weighted index number

$$\frac{\sum WI}{\sum W}$$