



DECEMBER 2016

QUANTITATIVE METHODS FOR MANAGERS

**Instructions to candidates:**

- a) Time allowed: Three hours (plus an extra ten minutes' reading time at the start – do not write anything during this time)
  - b) Answer any FIVE questions
  - c) All questions carry equal marks. Marks for each question are shown in [ ]
  - d) Non-programmable calculators are permitted in this examination
1. a) Using an example, briefly explain the circumstances under which the median would be a more suitable measure of an average than the arithmetic mean. [5]
- b) The following frequency table shows the weights, in gms, of a sample of 50 computer components produced in a factory on a particular day:

Weight (gm)	Frequency
Less than 100	3
100 < 120	7
120 < 140	10
140 < 160	14
160 < 180	9
180 < 200	5
More than 200	2

- i Draw a histogram for this sample of component weights. [5]
  - ii Calculate the mean and standard deviation of the sample of weights. [10]
2. The quarterly sales figures for a particular model of smart TV over the period 2013 to 2015 are given in the following table:

	1	2	3	4
2013	92	108	82	50
2014	56	96	68	54
2015	50	78	70	46

- a) Draw a graph of the time series, and comment on any movements that may be present in the quarterly sales. [4]
- b) Calculate the underlying sales trend using the method of moving averages. [8]
- c) Assuming that a multiplicative model is most suitable for this case, compute the seasonal variations for each quarter's sales. [8]

3. The personnel manager of a large company wishes to estimate the mean number of days lost through sickness per employee during the last year. To do this, she examined the records of a sample of 100 employees, and found that the mean of the sample turned out to be 15.3 days, with a standard deviation of 5.1 days. She also discovered that 60 members of the sample indicated that 'stress' was one of the causes of their absence.
- Determine a 95% confidence interval estimate for the overall mean number of days lost through sickness per company employee. [8]
  - How large a sample would be required for the personnel manager to be 95% confident that her sample mean differed from the true overall mean by at most 0.5 days? [7]
  - Determine a 90% confidence interval estimate of the overall proportion of employees who blamed stress for their sickness absence. [5]

4. A company has recorded the following data on production volume and total costs of production for one of its products over the last 8 months:

Production (000s units)	26	18	14	18	22	18	12	14
Total cost (£000s)	46	30	26	38	46	42	36	34

- Draw a scatter diagram for the above data, and comment on its shape. [4]
  - Calculate the appropriate least squares regression line so that total cost (Y) may be predicted from the level of production (X). [12]
  - Predict the costs of production for next month when output is scheduled to be 30,000 units and briefly comment on the reliability of your prediction. [4]
5. A large builders' merchant has analysed the monthly amount spent by its trade customers, and it has found that it is normally distributed with a mean of £2,000 and a standard deviation of £500.
- Estimate the percentage of customers that will have a monthly spend of:
    - over £2,250 [5]
    - less than £1,500 [5]
    - between £1,250 and £1,750 [5]
  - The store wishes to reward the highest spending 5% of its customers with free gift vouchers. At what level of spend should the store offer this incentive? [5]

6. The sales department of a national automobile distributor wishes to analyse its weekly sales figures. The following table shows the total sales of a particular model of car over a period of 50 weeks:

57	53	56	75	46
47	43	54	43	51
62	41	73	65	45
72	50	59	68	56
71	52	58	79	60
77	38	54	59	65
38	54	80	54	56
57	55	67	67	82
70	61	83	56	42
49	56	53	68	52

- Using the class intervals 30-40, 40-50, 50-60, etc. produce a cumulative frequency distribution of the weekly sales. [5]
- Draw a correctly labelled ogive. [5]
- From the ogive, estimate the median and quartile deviation of the weekly sales. [5]
- Estimate the proportion of time that the weekly sales fall between 65 and 80 cars. [5]

7. The following information is extracted from a project to install a new office computer system:

Activity	Immediate predecessor(s)	Duration (Days)
A	-	4
B	A	5
C	A	3
D	B,C	6
E	B	5
F	E	4
G	D	2
H	F,G	1

- a) Construct a network for the project. [8]
- b) Calculate the scheduled completion time and identify the critical path. [7]
- c) Calculate the slack (float time) for ALL activities. [5]

8. A company manufactures two products, A and B. One unit of each product is made up of three raw materials, in the following quantities:

Raw Materials (kg)

Product	Material 1	Material 2	Material 3
A	0.4	0.2	0.6
B	0.3	0.5	0.2

During a production run, supplies of material 1 and material 2 are limited to a maximum of 2,200 and 2,500kg respectively. There is no limit to the availability of material 3.

Each unit of product A makes a contribution to profit of £5.50, while each unit of product B makes a contribution of £6.50, and the company wishes to maximise total profits.

- a) Formulate this information as a Linear Programming model. [10]
- b) Use a graphical or mathematical method to determine the optimal production plan. [10]