



SEPTEMBER 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. The manufacturer of automotive components has recorded the following data on the quantities produced and the total costs incurred for a particular component over the last eight months of production:

| | | | | | | | | |
|-------------------------|----|----|----|----|----|----|----|----|
| Production (000s units) | 21 | 17 | 14 | 19 | 26 | 19 | 13 | 14 |
| Total costs (£000s) | 29 | 22 | 18 | 23 | 35 | 26 | 22 | 24 |

- a) Calculate the least square regression line of costs based on production level. [12]
- b) Forecast the costs of production when output is planned to be 25,000 units. [3]
- c) Briefly comment on the reliability of your forecast. [5]

2. a) Briefly explain the term '**level of significance**' in the context of hypothesis testing. [4]
- b) A large engineering company is concerned with the relatively large number of defective components that are being produced at some of its factories. It has decided to analyse the records of 200 defective components randomly selected from each of its five factories:

| | | | | | |
|-------------------|----|----|----|----|----|
| Factory | A | B | C | D | E |
| No. of defectives | 52 | 36 | 30 | 34 | 48 |

Use the chi-square test, at the 5% level of significance, to test the hypothesis that there is no connection between the quality of work and the factories producing that work. [16]

3. The personnel department of a large hospital has recorded the number of hours lost each week due to sickness in a particular department for the year 2015/16. The results are given below:

| | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|
| 32 | 37 | 35 | 28 | 53 | 29 | 55 | 33 | 32 | 37 |
| 55 | 41 | 40 | 43 | 53 | 44 | 43 | 56 | 46 | 44 |
| 52 | 50 | 46 | 33 | 37 | 45 | 42 | 47 | 31 | 49 |
| 39 | 48 | 42 | 46 | 33 | 56 | 45 | 50 | 40 | 47 |
| 46 | 51 | 57 | 36 | 33 | 32 | 49 | 35 | 54 | 35 |

- a) Using the class intervals $25 < 30$, $30 < 35$, $35 < 40$, etc., construct a suitable grouped frequency distribution and the corresponding ogive for this data. [10]
- b) Use your ogive to estimate the median and quartile deviation for the weekly number of hours lost. [5]
- c) The department will hire temporary staff if the hours lost is expected to exceed 47 hours. How likely is it that temporary staff will be required? [5]

4. A large builders' merchant is monitoring the quarterly sales figures (£000) for its most popular kitchen ranges. The following table shows the quarterly sales over the last three years:

| | | | | |
|------|-----|-----|-----|-----|
| Year | Q1 | Q2 | Q3 | Q4 |
| 2013 | | | 175 | 169 |
| 2014 | 187 | 174 | 173 | 166 |
| 2015 | 180 | 169 | 168 | 160 |
| 2016 | 170 | 162 | | |

- a) Draw a graph of the above time series, and comment briefly on any apparent movements. [4]
- b) Using the method of moving averages, highlight any underlying trend. [8]
- c) Assuming an additive model, calculate the seasonal component for EACH quarter. [8]

continued overleaf

5. A medium-sized business is planning to install a new management information system. The following table shows information relating to the various activities involved in this project.

| Activity | Predecessor | Time (Weeks) |
|----------|-------------|--------------|
| A | ---- | 10 |
| B | ---- | 11 |
| C | ---- | 9 |
| D | A | 8 |
| E | B | 9 |
| F | B | 11 |
| G | C | 7 |
| H | D, E | 10 |
| I | F, G, H | 6 |

- a) Construct a network diagram for this project. [10]
b) Calculate the scheduled completion time of the project and identify the critical path. [8]
c) What is the slack (float time) for ALL activities? [2]
6. A company has to decide which of two possible new products, A and B, it should invest in. A computer risk analysis package suggests that the profit that will result from product A is normally distributed with a mean of £15 million and a standard deviation of £9 million. The profit that could be generated by investing in product B is also normally distributed with a mean of £10 million and a standard deviation of £5 million.
- a) Which of the two products has a greater chance of making a profit of more than £12 million? [10]
b) Which of the two products would have the least chance of incurring a loss? [10]
7. a) A manufacturing company has estimated its costs as follows:
Fixed costs: £180,000
Variable cost: £20 per unit produced
It is proposed to set the selling price at £50 per unit, with an initial output of 40,000 units.
- i Draw a break-even chart, and from it estimate the break-even level of production. [7]
ii Calculate the margin of safety. [5]
iii Calculate the profit at the initial output. [3]
- b) If the selling price is increased by 5% and variable costs can be decreased by 8%, **calculate** the new break-even point. [5]
8. The following table shows the number of staff in each of the four departments of a large company, along with their average wages, for the years 2000 and 2015:

| | 2000 | | 2015 | |
|-------------------|-----------------|----------------|-----------------|----------------|
| | Number Employed | Average Salary | Number Employed | Average Salary |
| Sales | 120 | £17,500.00 | 97 | £24,500.00 |
| Admin. | 40 | £16,500.00 | 34 | £18,800.00 |
| Clerical | 25 | £16,000.00 | 20 | £23,200.00 |
| Management | 18 | £35,000.00 | 10 | £60,000.00 |

- a) Using 2000 as the base year, calculate the appropriate Laspeyres' index comparing salaries between 2000 and 2015. [15]
b) Interpret your answer to part (a). [5]