



JUNE 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
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1.
    - a) The management of a national chain of electrical retailers is examining its sales figures with the aim of remaining competitive with similar chains. In order to gain some idea of the weekly spending habits of its customers, a sample of 400 customers is randomly selected. The weekly spend of the sample had a mean of £75, and a standard deviation of £25.  
Use this sample information to estimate with 99% confidence, the true mean weekly customer spend. [5]
    - b) In the same sample, 150 of the customers indicated that they wished to buy the chain's own extended warranties on the items purchased. Estimate with 95% confidence, the true proportions of customers wishing to buy the chain's own extended warranties. [8]
    - c) How large a sample would be required if the management wished to be 95% confident that sample mean and the true mean varied by at most £3? [7]
  2. In a large supermarket, the monthly demand for a particular variety of breakfast cereal is normally distributed with a mean of 900 boxes and a standard deviation of 200 boxes.
    - a) What is the probability that in any month, the demand will be:
      - i more than 1,000 boxes? [5]
      - ii between 500 and 1,000 boxes? [10]
    - b) How many boxes should there be in stock at the beginning of the month if there is to be a risk of only 5% of running out of stock? [5]
  3. The personnel department of a large marketing organisation wishes to analyse the quarterly figures of sickness absence (hours) for all staff over the period 2012 – 2015, and the results are given in the following table:

YEAR	Q1	Q2	Q3	Q4
2012	134	174	166	128
2013	148	162	132	106
2014	116	152	122	110
2015	106	134		

    - a) Draw a graph of the above time series, and comment on its movement. [3]
    - b) Calculate the trend using appropriate moving averages. [8]
    - c) Assuming an additive model for this series, compute the seasonal variation. [7]
    - d) Briefly comment on how Time Series Analysis could be of assistance to a manager. [2]

4. The information found in the following table shows the weekly amount spent on newspapers (nearest £) at a local supermarket over a 50 day period in 2015:

458	286	390	510	349
322	297	370	189	380
445	233	402	390	269
448	362	410	466	377
367	337	464	657	376
435	244	392	382	351
216	305	651	363	383
399	366	422	338	573
532	403	542	331	284
308	389	343	500	396

- a) Use this information, and the class intervals £100-£200, £200-£300, £300-£400, etc., to produce a cumulative frequency distribution and ogive for the weekly sales. [8]
- b) Use your ogive to find:
- i the median and quartile deviation of the weekly sales [5]
  - ii the percentage of days that the weekly sales were between £380 and £500 [4]
  - iii the value below which the lowest 10% of the sales fall [3]
5. The personnel manager of a large company wishes to examine the age profile of the workers in its finance office. The following data shows the ages of a sample of 50 workers:

AGE	Frequency
<25	1
25-30	2
30-35	4
35-40	13
40-45	6
45-50	12
50-55	4
55-60	6
>60	2
TOTAL	50

- a) Construct a histogram and briefly comment on its shape. [5]
- b) Calculate the mean and standard deviation of the age distribution. [10]
- c) Discuss the suitability of the measures found in part (b) to this situation. [5]
6. a) Briefly explain the term '**margin of safety**' in the context of break-even analysis. [2]
- b) A large manufacturing firm makes the following estimates for its product:
- Fixed costs: £100,000
  - Variable costs: £8 per unit
  - Selling price: £20 per unit
  - Budget output: 20,000 units
- i Find the profit for the budgeted output [2]
  - ii Draw the break-even chart, and from it estimate the break-even production level [6]
  - iii Verify your answer to part (ii) by calculating the break-even production level [4]
  - iv Find the margin of safety [3]
- c) If selling price rises to £25 per unit, and variable cost increases to £12 per unit, calculate a new break-even point. [3]

7. The following information is extracted from a project to develop a new design of automobile component:

Activity	Immediate predecessor(s)	Duration (Weeks)
A	-	3
B	-	4
C	A	2
D	A,B	5
E	C	4
F	D	3
G	E,F	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. The following table shows, for a group of 12 production workers, the number of months experience working on a particular process that each of them had, and the number of defective items that they produced during a given week:

Worker	1	2	3	4	5	6	7	8	9	10	11	12
Rejects produced	24	18	26	14	21	16	22	24	36	20	30	23
Experience (months)	9	11	8	16	10	14	12	6	4	13	3	11

- a) Draw a scatter diagram for this data, and comment briefly on the pattern. [3]
- b) In the following table, replace the letters by the appropriate numerical value. [3]
- c) Calculate the correlation coefficient for this data, and comment on the result. [6]
- d) Determine the equation of the least squares regression line, and comment on the values. [6]
- e) Predict the number of rejects produced by an operator with 16 months experience, and briefly comment on the reliability of your prediction. [2]

Worker	Experience(X)	Rejects(Y)	X <sup>2</sup>	Y <sup>2</sup>	X.Y
1	9	24	81	576	216
2	11	18	121	324	198
3	8	26	<b>B</b>	676	208
4	16	14	256	196	<b>E</b>
5	10	21	100	441	210
6	14	16	196	256	224
7	12	22	144	484	264
8	6	24	36	576	144
9	4	36	16	<b>D</b>	144
10	13	20	169	400	260
11	3	30	9	900	90
12	11	23	121	529	253
Σ	<b>A</b>	298	<b>C</b>	6654	<b>F</b>