



MARCH 2017

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 following frequency table shows the weekly demand for a particular model of smartphone, over the last 50 weeks, at a local branch of Phones 4 U:

Weekly Demand	Frequency
30–50	2
50–70	3
70–90	6
90–110	9
110–130	16
130–150	7
150–170	4
170–190	3
Total	50

- a) Draw a histogram for the above data, and comment on its shape. [4]
 - b) Calculate the mean weekly demand for the phone. [4]
 - c) Calculate the standard deviation for the weekly demand. [7]
 - d) Last year, the relative variability of the weekly demand for the phone, as measured by the coefficient of variation, was 32%. Using your results in parts (b) and (c), compare the relative variability of the weekly demand for the two years. [5]
2. A company is producing a new model of washing machine, and estimates that the monthly demand for the new product in the first year will be approximately normally distributed with a mean of 2,000 machines and a standard deviation of 600 machines. What is the probability that during the first year, the monthly demand will be:
- a) more than 2,500 machines [6]
 - b) less than 1,700 machines [6]
 - c) between 1,700 machines and 2,500 machines [8]

3. The Duty Free shop at an international airport has found that the weekly sales of a particular brand of perfume (nearest £) over 50 weeks of 2016 were as follows:

363	317	360	599	226
246	197	355	206	298
429	178	561	464	217
553	282	389	508	356
543	307	377	630	396
607	145	338	389	403
137	331	636	337	361
371	351	503	481	663
531	416	685	354	190
269	356	321	490	311

- a) Using the class intervals £100–£200, £200–£300, £300–£400, etc., produce a cumulative frequency distribution and ogive for the weekly sales of the perfume. [8]
- b) Use the ogive produced in part (a) to:
- obtain the median and quartile deviation of the weekly sales [5]
 - estimate the percentage of weeks that the sales were between £350 and £450 [4]
 - estimate the value below which the lowest 15% of the sales fall [3]
4. 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
Defectives produced	28	22	30	18	25	20	25	27	39	23	33	26
Experience (months)	6	8	5	13	7	11	9	4	1	10	2	7

- a) Replace the letters by the appropriate numerical values: [5]

Worker	Experience(X)	Defects(Y)	X^2	Y^2	X.Y
1	6	28	36	A	168
2	8	22	64	484	176
3	5	30	25	900	150
4	13	18	169	324	234
5	7	25	49	625	B
6	11	20	121	400	220
7	9	25	81	625	225
8	4	27	16	729	108
9	1	39	1	1521	39
10	10	23	C	529	230
11	2	33	4	1089	66
12	7	26	49	676	182
Σ	83	D	715	E	F

- b) Calculate the correlation coefficient for this data, and comment on the result. [6]
- c) Determine the equation of the most appropriate least squares regression line. [6]
- d) Predict the number of defective items produced by an operator with 6 months' experience, and comment on the reliability of your prediction. [3]

5. a) Briefly explain the term '**break-even point**'. [2]
 b) A large manufacturing firm makes the following estimates for its product:
 Fixed costs: £25,000
 Variable costs: £10 per unit
 Selling price: £20 per unit
 Budget output: 20,000 units
 i Find the profit for the budgeted output. [3]
 ii Draw the break-even chart, and from it estimate the break-even production level. [7]
 iii Find the margin of safety. [3]
 c) If selling price rises to £24 and variable costs rise to £12, calculate a new break-even point in units produced, and determine the profit that would be made by producing and selling the budgeted output. [5]

6. A builders' merchant has recorded the following quarterly sales figures (£000) for a particular brand of laminate flooring, over the period 2014–2017:

YEAR	Q1	Q2	Q3	Q4
2014	23	27	26	22
2015	24	26	23	20
2016	21	25	22	20
2017	20	23		

- a) Draw a graph of the above time series, and comment on its movement. [5]
 b) Calculate the underlying trend in sales using appropriate moving averages. [8]
 c) Assuming an additive model for the series, calculate the seasonal variations. [7]
7. The following information is extracted from a project to install a new office computer system:

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

- a) Construct a network for the project. [8]
 b) Calculate the scheduled completion time for the project and identify the critical path. [7]
 c) Calculate the total float time for the non-critical activities. [5]
8. A manufacturer produces two models of laptop computer, A and B. Each unit of A will contribute a profit of £80, while each unit of B will contribute a profit of £50. The manufacturing process for the products requires machine time and finishing time. Each unit of A requires 3 hours of machine time and 2 hours of finishing time, while each unit of B requires 2 hours of machine time and 1 hour of finishing time. Each day there are 12 hours of machine time and 10 hours of finishing time available.
 a) Formulate this problem as a linear programme with the objective of maximising total profit. [7]
 b) Graph the problem and clearly identify the feasible region. [7]
 c) How many of each product should be made each day in order to maximise the total profit? [4]
 d) What will be the maximum profit? [2]