



Business Mathematics

SAMPLE TIME CONSTRAINED ASSESSMENT

Section A	Answer ALL questions from this section.
Section B	Answer any THREE (3) questions from this section. Clearly cross out surplus answers. Failure to do this will result in only the first THREE (3) answers being marked.

Time: 4 hours

The maximum mark for this paper is 100.

Any reference material brought into the examination room must be handed to the invigilator before the start of the examination.

A formula sheet is provided at the beginning of the question paper.

Candidates are allowed to use a scientific calculator during this examination.

Graph paper will be provided by the centre.

You must show your workings.
Marks are awarded for these in all sections.

1. Solution of quadratic equations

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2. Measures of location

Population mean

Ungrouped data:

$$\mu = \frac{\sum x}{N}$$

Ungrouped frequency table:

$$\mu = \frac{\sum fx}{N} = \frac{\sum fx}{\sum f}$$

Grouped frequency table:

$$\mu = \frac{\sum fm}{N} = \frac{\sum fm}{\sum f}$$

Sample mean

Ungrouped data:

$$\bar{x} = \frac{\sum x}{n}$$

Ungrouped frequency table:

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

Grouped frequency table:

$$\bar{x} = \frac{\sum fm}{n} = \frac{\sum fm}{\sum f}$$

3. Measures of dispersion

Population variance

Ungrouped data:

$$\sigma^2 = \frac{\sum (x - \mu)^2}{N}$$

Population standard deviation

Ungrouped data:

$$\sigma = \sqrt{\frac{1}{N} \left[\sum (x - \mu)^2 \right]} = \sqrt{\frac{1}{N} \left[\sum x^2 - \frac{(\sum x)^2}{N} \right]}$$

Ungrouped frequency table:

$$\sigma = \sqrt{\frac{1}{N} \left[\sum f(x - \mu)^2 \right]} = \sqrt{\frac{1}{\sum f} \left[\sum fx^2 - \frac{(\sum fx)^2}{\sum f} \right]}$$

Grouped frequency table:

$$\sigma = \sqrt{\frac{1}{N} \left[\sum f(m - \mu)^2 \right]} = \sqrt{\frac{1}{(\sum f)} \left[\sum fm^2 - \frac{(\sum fm)^2}{\sum f} \right]}$$

Sample variance

Ungrouped data:

$$s^2 = \frac{\sum (x - \bar{x})^2}{n - 1}$$

Sample standard deviation

Ungrouped data:

$$s = \sqrt{\frac{1}{n - 1} \left[\sum (x - \bar{x})^2 \right]} = \sqrt{\frac{1}{n - 1} \left[\sum x^2 - \frac{(\sum x)^2}{n} \right]}$$

Ungrouped frequency table:

$$s = \sqrt{\frac{1}{n - 1} \left[\sum f(x - \bar{x})^2 \right]} = \sqrt{\frac{1}{(\sum f) - 1} \left[\sum fx^2 - \frac{(\sum fx)^2}{(\sum f)} \right]}$$

Grouped frequency table:

$$s = \sqrt{\frac{1}{n - 1} \left[\sum f(m - \bar{x})^2 \right]} = \sqrt{\frac{1}{(\sum f) - 1} \left[\sum fm^2 - \frac{(\sum fm)^2}{\sum f} \right]}$$

4. Exponential forecasting

$$F_{t+1} = F_t + \alpha(x_t - F_t)$$

Section A	
Answer ALL questions from this section	

Question 1

Simplify the ratio 12:9

1

Question 2Calculate: $60 - 20 \times 2$

1

Question 3Round 4025 to ONE (1) *significant figure*.

1

Question 4Express 54203 in *standard form*.

1

Question 5

Write TWO (2) days as a fraction of a week.

1

Question 6

Calculate 2% of \$430

1

Question 7State the *gradient* of the line $10x - 9$

1

Question 8State the *y-intercept* of the line $y = 3x + \frac{1}{2}$

1

Question 9Simplify: $m^5 \times m^3$

1

Question 10Write $\frac{17}{3}$ as a mixed number.

1

Question 11

Calculate the THREE (3) 4-point moving averages for the following data:

3

101 152 147 136 104 124

Question 12

Find:

3

$$\frac{4}{5} \times \frac{3}{4} + \frac{2}{3} \div \frac{1}{5}$$

Show your workings fully.

Question 13

Make b the subject of the following equation:

3

$$\frac{\sqrt{ab}}{d} = e$$

Question 14

A savings account offers interest at a rate of 2.3% compounded annually. If Manisha opens an account with £240 and leaves it for EIGHT (8) years, calculate how much will be in the account at the end of EIGHT (8) years. Give your answer to the nearest pound (£).

3

Question 15

Solve these *simultaneous equations* algebraically:

3

$$5x - 3y = 27$$

$$11x + 9y = -3$$

Question 16

Solve the following equation by *completing the square*:

3

$$x^2 + 6x = -7$$

You may leave your answer in surd form or round your answer to TWO (2) decimal places.

Question 17

200 people were asked to state their preferred brand of toothpaste. The results are below:

3

	Bright Smile	Fresh 'n' Minty	Smiths	Natural Smile
Frequency	98	62	12	28

A pie chart of the data is drawn to illustrate the results. Calculate the angles of the sectors for 'Bright Smile', 'Fresh 'n' Minty' and 'Natural Smile'.

You are not required to construct a pie chart.

Question 18

A shop sells phone cases. It has 120 phone cases in stock. $\frac{3}{4}$ of the phone cases are large and the rest are small. 80 of the phone cases are patterned and the rest are plain. If ONE (1) phone case is selected at random, calculate the probability that it will be a small, plain phone case. Assume that size is independent of whether phone case is patterned or plain.

3**Question 19**

Calculate the *mean*, *median* and *mode* of the following data set:

3

30 27 25 32 27 25 30 31 30 26

Question 20

The number of customers booking holidays online increased by 2% in 2018 and 5% in 2019. Calculate the overall *percentage change* in the number of customers booking holidays online.

3**Total 40 Marks**

Section B
Answer any THREE (3) questions from this section

Marks

Question 21

- a)** An electrician charges £ C for a job depending on h (amount of time in hours) according to the relationship:

$$C = 45h + 50$$

- i) Complete the following table for the graph $C = 45h + 50$

3

h	0	3	6	9	12
C	50			455	

- ii) Plot the graph of $C = 45h + 50$ for $0 \leq h \leq 12$

4

- iii) Use the graph to find out how much it would cost for a job that takes FOUR (4) hours.

1

- iv) Use the graph to find out how many hours a job costing £297.50 takes.

1

- v) Explain why a job cannot cost less than £50.

2

- b)** Another electrician charges a £60 call out fee plus £35 per hour. Write this information as a *linear equation*.

2

- c)** A company records the number of sick days taken by its employees over the past three months. The data is recorded below.

0	3	2	2	0
8	5	5	3	1
1	8	2	7	2
2	1	6	1	2
4	4	5	1	3
0	0	4	3	1
2	3	5	6	1
4	0	0	4	0
2	3	6	1	2

- i) State the number of employees recorded.

1

- ii) Construct a suitable *frequency table* for the data.

2

- iii) Calculate the *sample mean* of the data.

4

Total 20 Marks

Question 22

- a) In an experiment, Reena rolls a seven-sided spinner, numbered 1 to 7, 630 times. The results are recorded in the table below.

Score	1	2	3	4	5	6	7
Frequency	65	64	80	140	73	155	53

- Calculate the *relative frequency* of the spinner landing on a 7. **1**
 - Calculate the *relative frequency* of the spinner landing on a 2 **or** a 7. **2**
 - Find the *theoretical probability* of a fair, seven-sided spinner landing on a 7. State the number of times you would expect a fair, seven-sided spinner to land on a 7 in a trial of 630 spins. **2**
 - State whether you think that the spinner used in Reena's experiment is fair. Give a reason for your answer. **2**
- b) A courier company records the number of parcels, in thousands (000s), carried over a two year period.

Year	2019				2020			
Quarter	1	2	3	4	1	2	3	4
Number of parcels (000s)	485	381	470	525	501	405	492	580

- Draw a *time series graph* for this data using the graph paper provided. **6**
- The first three four-point averages for the data are 465.25, 469.25 and 475.25 Calculate the fourth and fifth four-point moving averages. **2**
- Plot the moving averages on the time series graph constructed in i) and draw the trendline. **3**
- Use the graph to comment upon *seasonality* and *trend*. **2**

Total 20 Marks

Question 23

- a) A factory produces 50 laptops . FIVE (5) of the laptops are faulty. TWO (2) laptops are selected at random without replacement.
- Draw a tree diagram to show all the possible outcomes. **4**

Marks

- | | |
|---|---|
| ii) Calculate the probability that the first laptop selected is faulty and the second laptop selected is not. | 2 |
| iii) Calculate the probability that both laptops are faulty. | 2 |
| iv) Calculate the probability that both laptops selected are either faulty or not faulty. | 3 |
| v) Calculate the probability that at least one of the laptops selected will not be faulty. | 2 |
| d) Using the quadratic formula, find the exact solutions of: | 3 |

$$2x^2 - 5x + 1 = 0.$$

Then, give your answers to 2 d.p.

Total 20 Marks

- | | |
|---|---|
| b) <i>Factorise</i> completely:
$x^2 - 14x + 45$ | 2 |
| c) <i>Expand and simplify</i> :
$(x + 4)(x + 3)$ | 2 |

Questions continue on the next page

Question 24

- a) An online company want to know how frequently customers purchase products up to £250. Data is recorded in the table below.

Price range, p , £	Frequency
$0 \leq p < 50$	13
$50 \leq p < 100$	16
$100 \leq p < 150$	24
$150 \leq p < 200$	29
$200 \leq p < 250$	18

- i) Complete the *cumulative frequency* column for the data.

2

Price range, p , £	Frequency	Cumulative frequency
$0 \leq p < 50$	13	
$50 \leq p < 100$	16	
$100 \leq p < 150$	24	
$150 \leq p < 200$	29	
$200 \leq p < 250$	18	

- ii) Plot a cumulative frequency graph for the data using the graph paper provided. 5
- iii) Use your cumulative frequency graph to estimate the *median*. You should show how you found the *median* on your graph. 2
- iv) Use your cumulative frequency graph to estimate the values of the *lower quartile* and the *upper quartile*. You should show how you have found the *lower quartile* and *upper quartile* on your graph. 4
- v) Calculate the *interquartile range*. Show your workings. 1

b) State whether the data collected in part (a) is *quantitative* or *qualitative*. Briefly explain your answer. **2**

c) A cafe records the number of customers each day. The results for the past two weeks are shown in the table below:

	Week 1						Week 2					
Day	M	Tu	W	Th	F	S	M	Tu	W	Th	F	S
No. of customers	65	58	69	***	78	91	63	61	72	75	82	90

i) Explain why it is appropriate to calculate a six-point moving average for this data. **1**

ii) The value of the first six-point moving average is 72. Calculate the number of customers on Thursday of week ONE (1). **3**

Total 20 Marks

End of paper