



THE NCUK INTERNATIONAL FOUNDATION YEAR

IFYMB001 Mathematics Part 2 (Business) Examination

Examination Session
Semester Two

Time Allowed
2 Hours 10 minutes
(including 10 minutes reading time)

INSTRUCTIONS TO STUDENTS

SECTION A Answer ALL questions. This section carries 40% of the exam marks.

SECTION B Answer 4 questions. This section carries 60% of the exam marks.

The marks for each question are indicated in square brackets [].

Your School or College will provide a Formula Booklet and graph paper.

- **Answers must not be written during the first 10 minutes.**
- Write your NCUK ID Number clearly on the answer books in the space provided.
- Write the answers in the answer books provided. Additional sheets will be provided on request.
- Write the section letter, the question number and numbers to parts of questions attempted clearly at the start of each answer.
- **No** written material is to be brought into the examination room.
- **No electronic devices** (e.g. mobile phones, tablets, iPads) are allowed in the examination room.
- An approved calculator may be used in the examination.
- State the units where necessary.
- Show **ALL** workings in your answer booklet. Marks will be awarded for correct workings.
- Examination materials must not be removed from the examination room.
- Write your name and candidate number on all loose sheets/diagrams.

Section A

Answer ALL questions. This section carries 40 marks.

Question A1

In an experiment, the times taken in minutes to bake a cake were:

35, 38, 33, 41, 39, 39, 37, 39, 34, 35

For these times find:

- a) The mode [1]
- b) The interquartile range [3]

Question A2

A factory has two types of machine. Machine type A produces 420 items per hour and machine type B produces 450 items per hour. On day one there are six machines of type A and three machines of type B operating. [3]

What is the mean output per hour for the nine machines on that day?

Question A3

A discrete random variable Y is such that

$$E[Y] = 2.9 \quad \text{and} \quad V(Y) = 1.7$$

If the discrete random variable X is such that $X = \frac{3Y-20}{10}$ find:

- a) $E[X]$ [2]
- b) $V(X)$ [3]

Question A4

If two in every seven car drivers own a bicycle, what is the probability that out of twelve randomly selected drivers at least three of them will own a bicycle? Give your answer to **three significant figures**. [4]

In this question, 1 mark will be awarded for the correct use of significant figures.

Question A5

The probability distribution of a discrete random variable is given by

x	4	5	6	7
$p(X = x)$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{8}$	k

Find:

a) k [1]

b) $E[4X]$ [3]

Question A6

Differentiate $y = \frac{3e^{\cos x}}{(2x^4 - 9)}$ [4]

Attempt to simplify your answer.

Question A7

Express as a partial fraction $\frac{(x-2)}{(x-3)^2(x-4)}$ [4]

Question A8

The function $f(x) = |x + 2|$ is transformed by the vector $\begin{bmatrix} 3 \\ -2 \end{bmatrix}$.

a) Sketch the resulting transformation of $f(x)$, labelling the significant points. [4]

b) Describe the transformation which has taken place. [2]

Question A9

A curve C is described by the equation

$$8 = 4x + 2y + 6xy$$

Find the equation of the tangent to the curve when $x = -1$. [6]

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Section B

Answer 4 questions. This section carries 60 marks.

Question B1

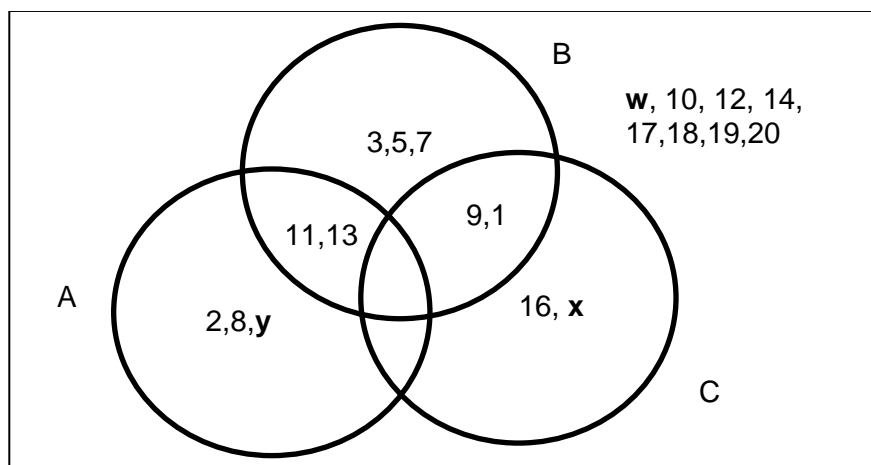
If $\varepsilon = \{\text{the natural numbers which are less than 21}\}$

$A = \{2, 8, 11, 13, 15\}$

$B = \{\text{the odd numbers between 1 and 13 including 1 and 13}\}$

$C = \{\text{the square numbers which are less than 21}\}$

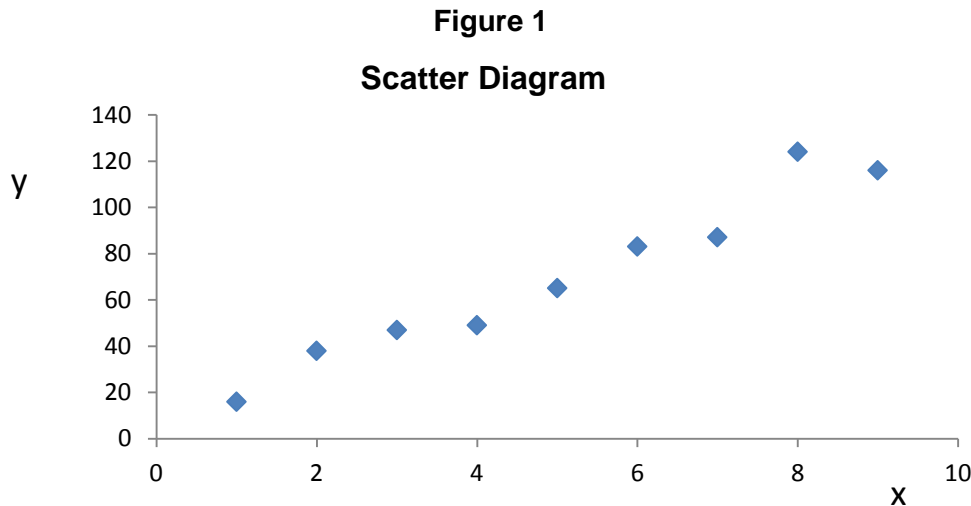
- a) Using the sets A, B and C from above, find the values of w, x and y in the Venn diagram [3]
below:



- b) Find:
- $A \cap B$ [1]
 - $B \cup C$ [2]
 - $n((B \cup C)')$ [1]
- c) The drying time for a type of paint is Normally distributed with a mean of 45 minutes.
- Given that on 90 percent of occasions the drying times are less than 52 minutes, find the value of the standard deviation, σ . [3]
 - If Helen uses some of the paint, what is the probability that the paint is still wet after one hour? [3]
 - Adding a chemical to the paint reduced the drying time. It is assumed that when the chemical is added, the drying times will still be Normally distributed and that the standard deviation will be unchanged. If in an experiment 30 drying times had a mean of 40.7 minutes, find a 95 percent confidence interval for the mean drying time when the chemical is added. [2]

Question B2

In a statistical investigation, observations were obtained on 9 pairs of values (x,y). The data is illustrated in a scatter diagram as shown in Figure 1 below:



A set of totals was obtained; these are given in the table below:

n	$\sum x$	$\sum y$	$\sum x^2$	$\sum y^2$	$\sum xy$
9	45	625	285	53825	3897

- By using the appropriate totals, find the Ordinary Least Squares regression line $y = a + bx$. **[4]**
- Explain what the value of b represents in this equation. **[1]**
- State, giving a reason, whether the equation would provide a reliable estimate of y for a value of x = 30. **[1]**
- Use the equation which you found in part (a) to estimate the value of y when x = 6. **[1]**
- One of the observed data pairs is x = 6 and y = 83. Calculate the difference between this value of y and the estimated value of y from part (d) and comment on what this difference indicates. **[2]**
- Calculate the value of Pearson's Product Moment Correlation Coefficient, r. **[3]**
- Interpret the value of r which you have found in relation to the scatter diagram in Figure 1. **[2]**
- Explain briefly why a high value of a correlation coefficient r does not “prove” that the variables are related in the sense that one is caused by the other. **[1]**

Question B3

Sales data was collected and analysed. The graph below shows the data in a time series graph and tables 1 and 2 show the time series analysis for a **multiplicative model**.

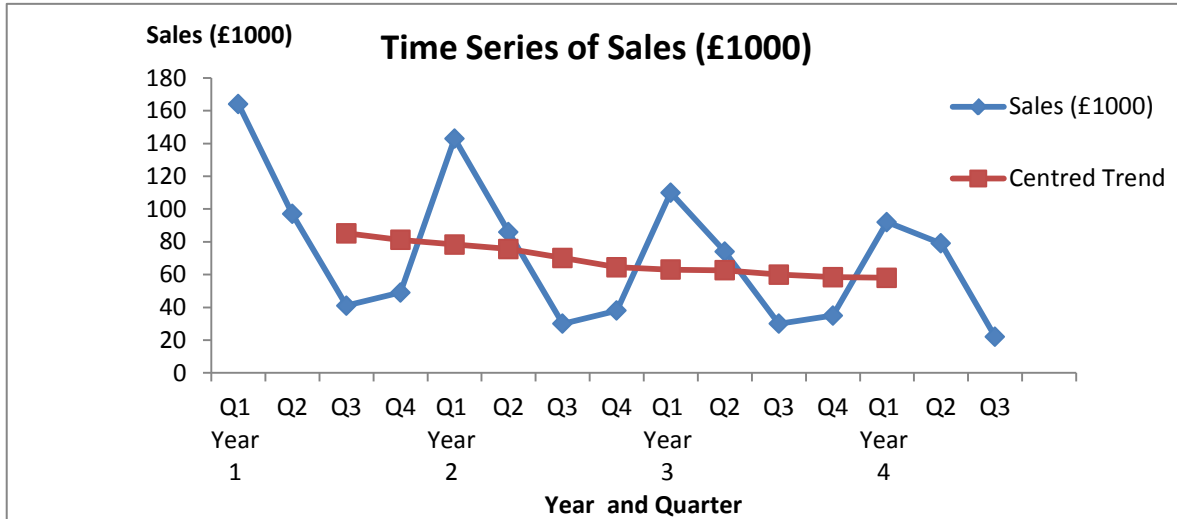


Table 1

	Sales (£1000)	4 Point Moving Average	Centred Trend	Ratio
Year 1 Q1	164			
Q2	97	87.75		
Q3	41	82.5	85.125	0.48
Q4	49	79.75	81.125	0.60
Year 2 Q1	143	77	78.375	1.82
Q2	86	74.25	75.625	1.14
Q3	30	66	70.125	0.43
Q4	38	63	64.5	0.59
Year 3 Q1	110	63	63	1.75
Q2	74	62.25	62.625	1.18
Q3	30	57.75	B	0.50
Q4	35	A	58.375	0.60
Year 4 Q1	92	57	58	C
Q2	79			
Q3	22			

Table 2
Seasonal Effects

	Q1	Q2	Q3	Q4
Year 1			0.48	0.60
Year 2	1.82	1.14	0.43	0.59
Year 3	1.75	1.18	D	0.60
Year 4	1.59			
Average	1.72	F	E	0.60

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- a) Explain why the graph indicates that a multiplicative model may be appropriate to describe the time series. **[2]**
- b) Find the **three** missing values A, B and C in table 1 and write them down in your answer booklet. **[3]**
- c) Find the **three** missing values D, E and F in table 2 and write them down in your answer booklet. **[3]**
- d) Describe the meaning of values of the seasonal effects of 1.72 for quarter 1 and 0.6 for quarter 4. **[3]**

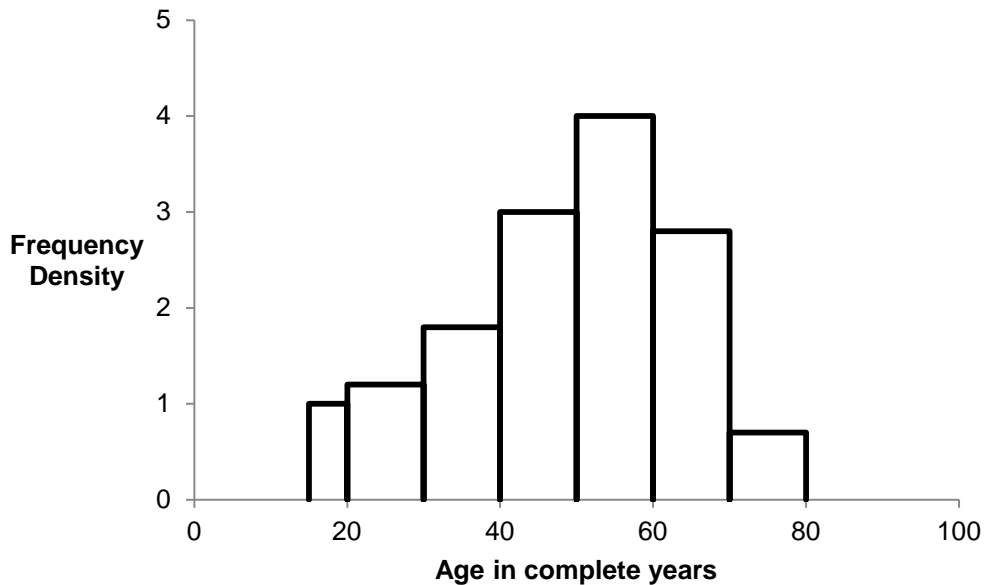
A line of best fit to estimate the trend line has been found to be, $y = -2.86x + 91.7$, where $x = 1$ represents quarter 1 of year 1, $x = 2$ represents quarter 2 of year 1 etc. and where y represents the corresponding trend value of sales.

- e) Use the equation above and an appropriate seasonal adjustment to estimate the sales in:
 - i. Quarter 1 of year 5 **[2]**
 - ii. Quarter 3 of year 5 **[2]**

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Question B4

Katherine has gathered data on the ages of people who sing in choirs. The histogram of the ages of the people in one of the choirs is shown below.



- a) Comment on the shape of the histogram. [1]
- b) Katherine has lost the file names for her data collections. Below is the frequency table for one of the choirs in her study. Construct the cumulative frequency table in your answer booklet for this data. [2]

Age in complete years	Frequency
15 to 19	5
20 to 29	12
30 to 39	18
40 to 49	30
50 to 59	40
60 to 69	28
70 to 79	7

- c) Plot the cumulative frequency polygon for this data. [5]
- d) From the cumulative frequency polygon calculate the median, the lower quartile (Q1) and the upper quartile (Q3). [3]
- e) By calculating $Q2 - Q1$ and $Q3 - Q2$ decide whether these results support Katherine's belief that the cumulative frequency data and the histogram data are from the same choir. Justify your answer. [2]
- f) Using your cumulative frequency polygon estimate the number of choir members whose ages are greater than 55 years. [2]

Question B5

a) Given the matrix $A = \begin{bmatrix} 4 & 5 & 2 \\ 1 & -1 & 3 \\ -2 & 1 & -3 \end{bmatrix}$ and its inverse $A^{-1} = \frac{1}{\Delta} \begin{bmatrix} 0 & 17 & 17 \\ -3 & a & -10 \\ b & c & -9 \end{bmatrix}$

Find:

i. The determinant of A. **[3]**

ii. The values of a, b and c. **[4]**

b) Hence solve the following set of simultaneous equations: **[4]**

$$4x + 5y + 2z = 3$$

$$x - y + 3z = 6$$

$$-2x + y - 3z = -4$$

c) Sketch the graph of $y = \tan^{-1}x$, showing clearly the domain and range of the function, **[4]**
and any other important features.

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Question B6

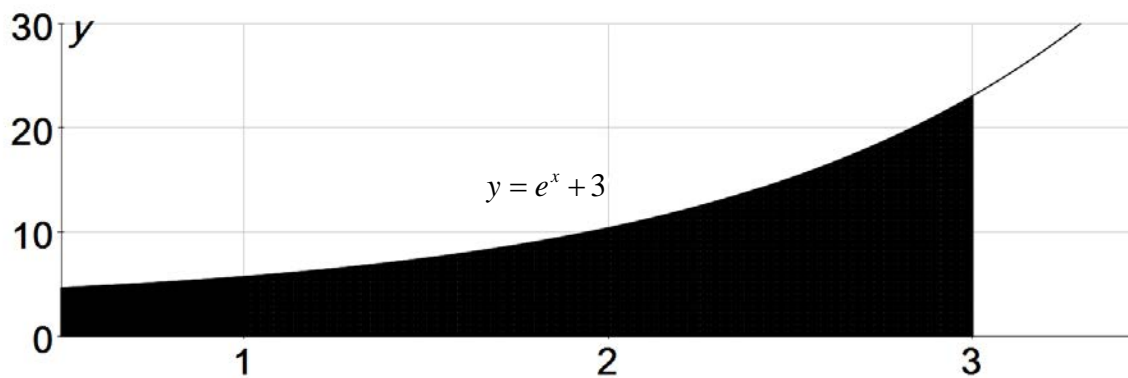
Integrate the following:

a) $\int e^x \cos x \, dx$ [4]

b) Use the substitution $u = x + 3$ to find [6]

$$\int_{-2}^0 5x(x+3)^6 \, dx$$

c) The graph below shows part of the curve $y = e^x + 3$. Calculate the volume generated when the shaded area is rotated through one complete turn about the x-axis. Give your answer in terms of π . [5]



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