NCUK

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

The table below shows the number of driving test attempts made by 35 people until they passed.

Number of attempts	Number of people
1	6
2	17
3	8
4	4
Total	**35**

a) Find the mode of the number of attempts taken to pass the test. **[1]**

b) Find the median of the number of attempts taken to pass the test. **[2]**

Question A2

A machine prints pictures onto drinking glasses, but it has an undetected fault, meaning that every tenth glass is not printed. Each day approximately 4,000 glasses go through this printing process. The glasses are packed randomly into boxes of six.

a) Find the probability that there are more than **two** glasses in a box that do not have pictures on them. **[3]**

b) If you buy **four** boxes of the glasses, what is the expected number of glasses in total that will not have been printed? **[2]**

Question A3

The mean travel time for 45 employees to get to work on any day is 39 minutes. Two new employees join the company and their travel times are 35 minutes and 1 hour. **[2]**

Calculate the mean travel time for the 47 employees.

Question A4

A, B and C are events such that

$p(A) = 0.1,\ p(A \cup B) = 0.7\ ,\ p(B|A) = 0.3\ , p(C) = 0.2,$

$p(C|A) = 0\ and\ p(C|B) = 0$

Find:

a) $p(A \cap B)$ **[2]**

b) $p(A \cup B \cup C)$ **[2]**

Question A5

The probability distribution of a discrete random variable is given by

x	4	5	6	7
$p(X = x)$	$\frac{3}{5}$	$\frac{1}{10}$	k	$\frac{1}{10}$

Find:

a) The value of k **[1]**

b) $\mathrm{E}[3\mathrm{X} + 2]$ **[4]**

c) $\mathrm{p}(4 \leq \mathrm{X} \leq 5.7)$ **[1]**

Question A6

If $f(x) = e^{2x}$ and $g(x) = x^2 + 3$ express $g(f(x))$ as a single function $h(x)$. **[5]**

Evaluate $h(3)$ to **three significant figures.**

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

Question A7

Find the inverse of $f(x) = \dfrac{4}{x+2}$ **[3]**

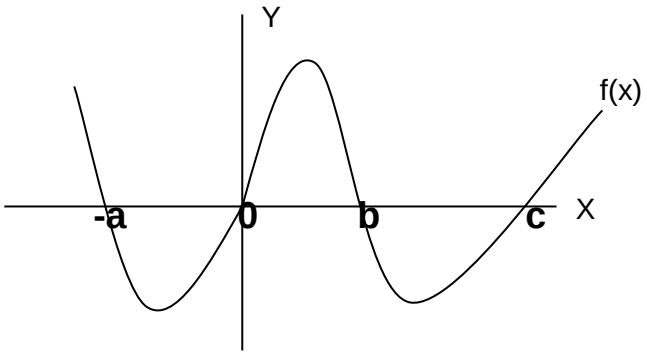
Section A continues on the following page.

Question A8

a) Show that function $f(x) = x(x-3)$ is **neither** an even **nor** an odd function. **[3]**

b) Sketch the curve and comment on why its shape supports your argument that it $f(x) = x(x-3)$ is neither even nor odd. **[3]**

Question A9



Using the information above, sketch the following:

a) $y = | f(x) |$ **[2]**

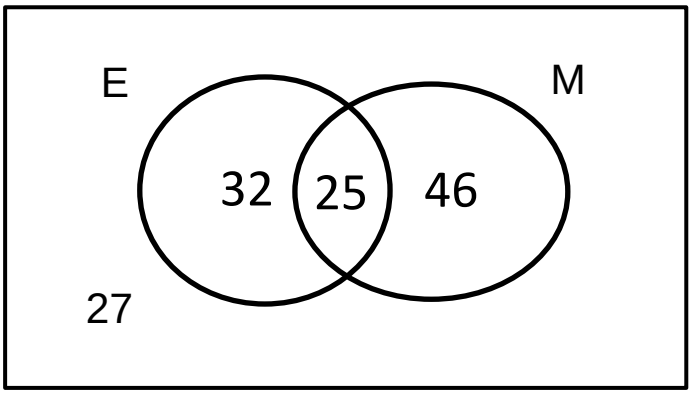
b) $y = f(|x|)$ **[2]**

c) $y = | f(|x|) |$ **[2]**

Section B
Answer 4 questions. This section carries 60 marks.

Question B1

The Venn diagram below illustrates some results found in a survey.
E represents "the set of employed people" and M represents "the set of males".



a) Use the venn diagram to find:

i. $n(M)$ **[1]**

ii. $n(\bar{E} \cap M)$ **[1]**

iii. $n(\bar{E} \cup M)$ **[1]**

b) Use set notation to describe:

i. The set of males who are employed. **[1]**

ii. The people who are unemployed who are not male. **[1]**

iii. The set of either males who are unemployed or people who are employed. **[2]**

c) A company grows a particular type of carrot. It is expected that the lengths of these carrots will follow a Normal distribution with a mean of 125mm and a variance of 20 mm. A quality control procedure is to reject any carrot which has a length smaller than a specified quantity, K mm, because it is too small.

i. If 3 per cent of carrots selected at random are rejected for being too small, find the value of K. **[4]**

ii. What is the probability that a randomly selected carrot has a length which is at least 130mm? **[2]**

Question B1 continues on the following page.

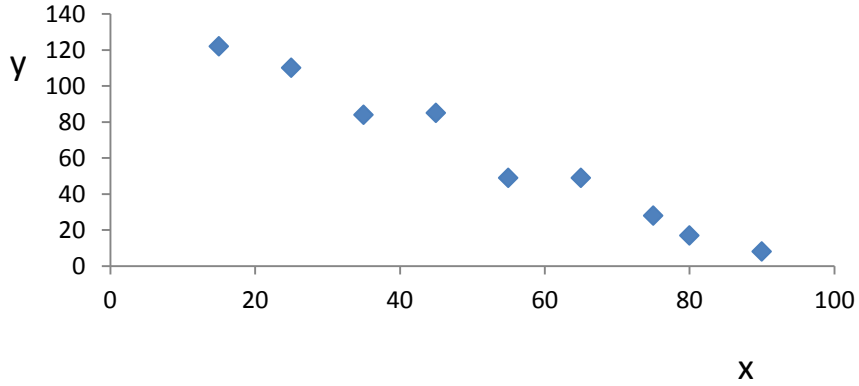
iii. In an experiment, a different variety of carrot is grown. The weights of these carrots are Normally distributed N(μ,16)grams. In a random sample of 25 carrots, the mean of the weights is 68 grams. Find a 95 per cent confidence interval for μ the mean weight of a carrot of this variety. **[2]**

Question B2

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

Figure 1

Scatter Diagram



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

n	∑x	∑y	∑x²	∑y²	∑xy
9	485	552	31475	47204	21405

a) By using the appropriate totals, find the Ordinary Least Squares regression line $y = a + bx$. **[4]**

b) Explain what the value of b represents in this equation. **[1]**

c) State, giving a reason, whether the equation would provide a reliable estimate of y for a value of x = 140. **[1]**

d) Use the equation which you found in part (a) to estimate the value of y when x = 55. **[1]**

e) One of the observed data pairs is x = 55 and y= 49. 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]**

f) Calculate the value of Pearson's Product Moment Correlation Coefficient, r. **[3]**

g) Interpret the value of r which you have found in relation to the scatter diagram in Figure 1. **[2]**

h) If x represents the number of reported burglaries in a town and y represents the loans of music CDs from libraries in the town as measured over the years 2000 to 2008, comment on the value of the correlation coefficient obtained. **[1]**

Section B continues on the following page.

Question B3

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

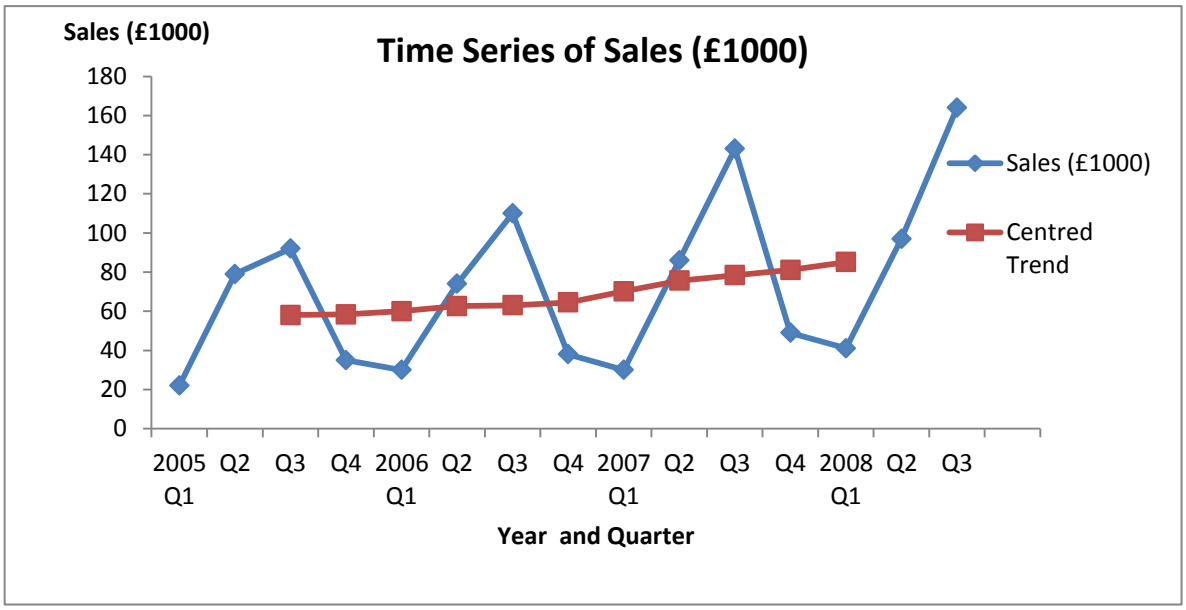


Table 1

Year and Quarter	Sales (£1000)	4 Point Moving Average	Centred Trend	Ratio
2005 Q1	22			
Q2	79	57		
Q3	92	59	58	1.59
Q4	35	57.75	58.375	0.60
2006 Q1	30	62.25	60	0.50
Q2	74	63	62.625	1.18
Q3	110	63	63	1.75
Q4	38	66	64.5	0.59
2007 Q1	30	74.25	70.125	0.43
Q2	86	77	75.625	1.14
Q3	143	79.75	**B**	1.82
Q4	49	**A**	81.125	0.60
2008 Q1	41	87.75	85.125	**C**
Q2	97			
Q3	164			

Question B3 continues on the following page

Table 2
Seasonal Effects

	Q1	Q2	Q3	Q4
2005			1.59	0.60
2006	0.50	1.18	1.75	0.59
2007	0.43	1.14	**D**	0.60
2008	0.48			
Average	0.47	**F**	**E**	0.60

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 the seasonal effects values of 0.47 for quarter 1 and 0.6 for quarter 4. **[3]**

e) A line of best fit to estimate the trend line has been found to be, $y = 2.86x + 45.9$, where x =1 represents quarter 1 of 2005, x = 2 represents quarter 2 of 2005 etc. and where y represents the corresponding trend value.

Use the equation and an appropriate seasonal adjustment to forecast the sales in:

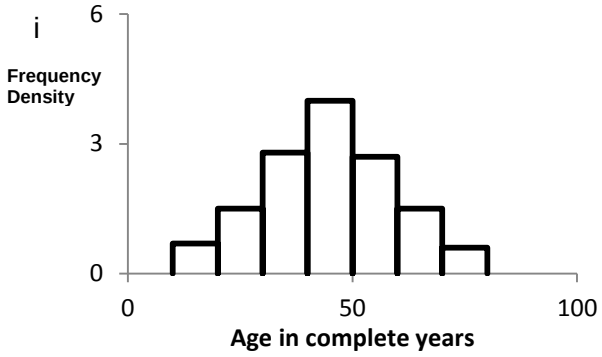
i. Quarter 1 of 2009 **[2]**

ii. Quarter 3 of 2009 **[2]**

Section B continues on the following page

Question B4

i



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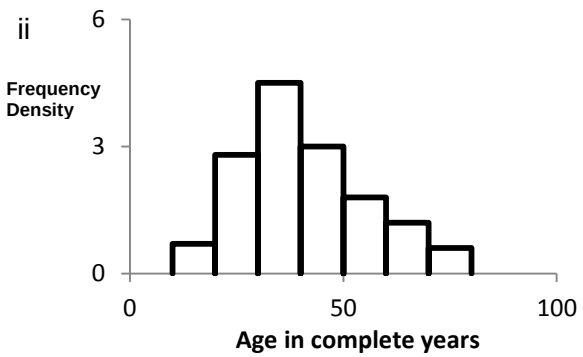

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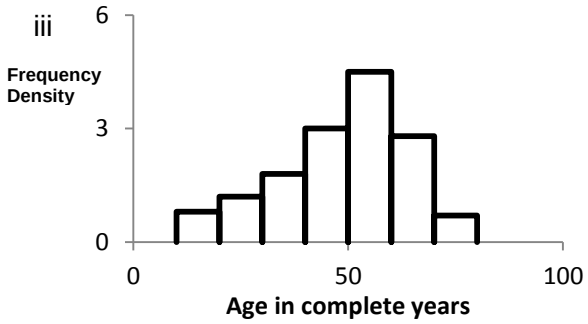

a) Comment on the shapes of each of the three histograms (i, ii and iii) above. **[2]**

b) Emma has collected data on the ages of choir members in various groups. 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	10
20 to 29	12
30 to 39	18
40 to 49	30
50 to 59	45
60 to 69	28
70 to 79	7

c) Plot the cumulative frequency polygon for this data on the graph paper provided. **[4]**

d) From the cumulative frequency polygon calculate the median, Q1 and Q3. **[3]**

e) Using your graph calculate (Q2 – Q1) and (Q3 – Q2) and decide which of the above three histograms would best represent the frequency data. 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 $A = \begin{bmatrix} 2 & 1 & 2 \\ -1 & 3 & 2 \\ -2 & 1 & 3 \end{bmatrix}$ and its inverse $A^{-1} = \frac{1}{\Delta}\begin{bmatrix} 7 & -1 & -4 \\ -1 & a & -6 \\ b & c & 7 \end{bmatrix}$

Find:

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

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

iii. Hence solve the following set of simultaneous equations: **[4]**

$2x + y + 2z = 2$
$-x + 3y + 2z = 1$
$-2x + y + 3z = 9$

b) i. Sketch the graph of $y = cos^{-1}x$, clearly labelling the values of the domain and range of the function. **[3]**

ii. Find the value of the $cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$ in terms of π. **[1]**

Section B continues on the following page

Question B6

a) Integrate

$$\int \frac{x^3 - 3x - 5}{(x+2)(x-1)}\, dx$$ **[6]**

b) Use the substitution $u = 2 - 3x^2$ to find $\int xe^{2-3x^2} dx$ **[4]**

c) The graph below shows part of the curve $y = \frac{1}{cosx}$

Calculate the volume generated when the shaded area is rotated through one complete turn about the x-axis. **[5]**