



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.

- **Answers must not be written during the first 10 minutes.**
- Write your Candidate 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** mobile phones are allowed in the examination room.
- An approved calculator may be used in the examination.
- State the units where necessary.
- Full marks will only be given for **full and detailed answers**.

Section A

Answer ALL questions. This section carries 40 marks.

Question A1

The times taken in minutes for a group of people to complete a task were:

27, 15, 35, 29, 30, 22, 32, 30, 25

Find the mean and the standard deviation. Give your answers to one decimal place. **You must show which formulae you have used.** [4]

Question A2

Given that $f: x \rightarrow x + 3$, $g: x \rightarrow e^x$, and $h: x \rightarrow x^2$

- a) i. Find an expression for $hgf(x)$. [2]
- ii. Calculate $hgf(0.5)$ to **three significant figures**. [2]

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

Question A3

If ten people are selected at random, what is the probability that **fewer than three** of them were born on a Friday? State any assumptions you have made in calculating your answer. [5]

Question A4

Given that the inverse of $A = \begin{bmatrix} 3 & -2 & 0 \\ -1 & 2 & 1 \\ -2 & 3 & 1 \end{bmatrix}$ is $A^{-1} = \begin{bmatrix} 1 & -2 & 2 \\ 1 & a & 3 \\ b & c & -4 \end{bmatrix}$, [4]

find a, b and c.

Question A5

If the mean and variance of $3X + 10$ are given respectively by:

$$E[3X + 10] = 45.6 \quad \text{and} \quad \text{Var}[3X + 10] = 3.2$$

Find:

- a) $E[X]$ [2]
- b) $\text{Var}[X]$ [2]

Question A6

Express as a partial fraction $\frac{x+5}{(x+2)^2(x-4)}$ [4]

Question A7

Differentiate $y = \frac{e^{4x}}{x^3 \cos(x)}$, simplify your answer if possible. [4]

Question A8

Evaluate $\int_1^2 2xe^{x^2} dx$. [3]

Question A9

In an engineering company 10% of employees are unskilled, 20% are semi-skilled and the rest are skilled. Unskilled workers earn £250 per week, semi-skilled workers earn £310 per week and skilled workers earn £430 per week.

Find a weighted average for the weekly earnings of **all** employees in the company, giving your answer to the nearest £10. [4]

Question A10

The random variable X has a normal distribution with a mean of μ and a variance of 16. A random sample of ten observations of X has a mean of 9.2.

a) Find a 95% symmetric confidence interval for μ . [3]

b) Which one of the following statements is true regarding the confidence interval in a)? [1]

A 95% of the distribution is to the left of μ .

B 95% of such intervals would contain μ .

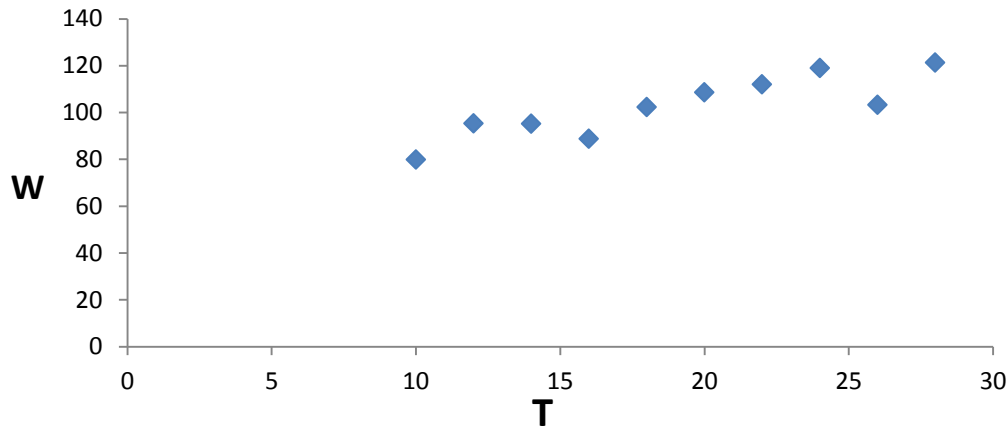
C There is a 95% chance that the mean of the 25 items is in the interval.

Section B

Answer 4 questions. This section carries 60 marks.

Question B1

In a statistical investigation observations were made on variables T and W. The scatter diagram graph of W against T is shown below.



- a) Giving your reasons, explain briefly whether the graph indicates that it would be appropriate to use a linear model to describe the relationship between W and T. [1]

The following totals were calculated from the raw data:

$$\sum T = 190, \quad \sum W = 1025, \quad \sum TW = 20103, \quad \sum T^2 = 3940, \quad \sum W^2 = 106666 \quad \text{and } n = 10$$

- b) Write down the formula or formulae required to find the ordinary least squares (OLS) regression equation $W = a + bT$. By substituting the appropriate values, find this regression equation, giving your values of a and b to an accuracy of **one decimal place**. [5]
- c) State which variable is the independent variable in the model $W = a + bT$. Give your reason. [1]
- d) The value of the product moment correlation coefficient is found to be $r = 0.87$. What does this indicate about the relationship between W and T? [2]
- e) Use the regression equation to obtain an estimate of the value of W when:
- i. $T = 19$ [2]
 - ii. $T = 40$ [2]
 - iii. Comment on the reliability of each of these estimates [2]

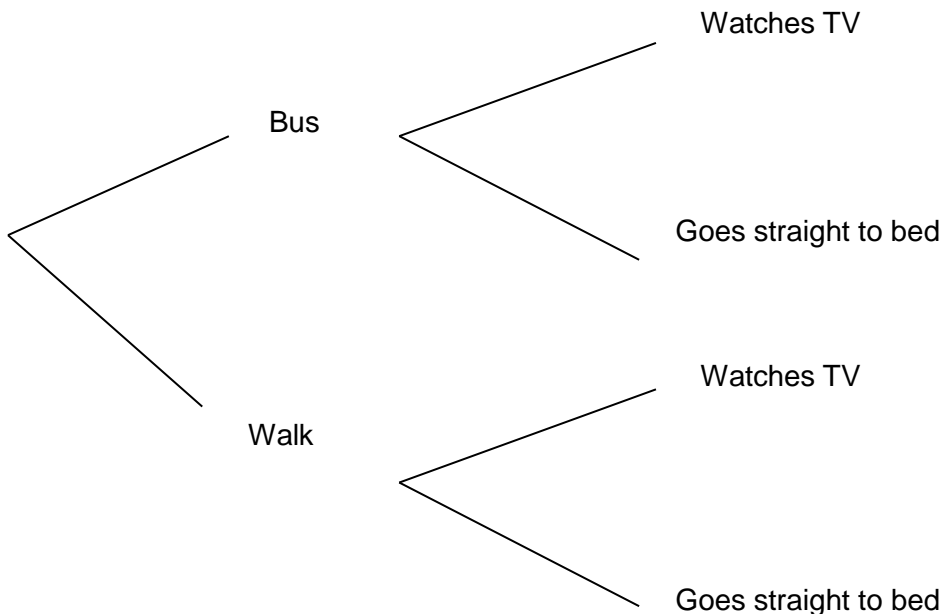
Question B2

A discrete random variable X has a probability distribution as given in the table below:

| | | | | | |
|------------|-----|-----|-----|-----|-------|
| x | 2 | 3 | 4 | 5 | Total |
| $P(X = x)$ | 0.3 | 0.4 | 0.2 | 0.1 | 1 |

Find:

- a) i. $P(X = 3)$ **[1]**
 - ii. $P(X > 3)$ **[1]**
 - iii. $E[X]$ **[2]**
 - iv. $P(X = 3 \text{ given that } X > 2)$ **[3]**
- b) Farid doesn't finish work until 10pm. Two times out of three he goes home by bus, otherwise he walks. When he gets home he either watches television or he goes straight to bed. When he travels home by bus, then three times out of four he goes straight to bed. If he walks home then he always goes straight to bed.
- i. Copy and complete the tree diagram below representing this information about Farid by filling in all the relevant probabilities: **[3]**



- ii. Calculate the probability that on a night after finishing work he travels home by bus then watches TV. **[2]**
- iii. Given that he goes straight to bed, what is the probability that he went home by bus. **[3]**

Question B3

A business makes its sales during Monday to Friday. The Marketing department have provided the latest sales figures. The data has been prepared in order to carry out a Time Series analysis as shown in Table 1 below. Table 2 shows the calculations for the seasonal deviations.

Table 1

| Week and Day | | Sales(£000) y | Totals of 5 | Moving Average a | Residual Difference y-a |
|--------------|-----|------------------|----------------|------------------------|-------------------------------|
| Week 1 | Mon | 9.5 | - | - | - |
| | Tue | 11.6 | - | - | - |
| | Wed | 11.4 | 59.5 | 11.9 | -0.5 |
| | Thu | 15 | 61.5 | 12.3 | 2.7 |
| | Fri | 12 | 63 | 12.6 | -0.6 |
| Week 2 | Mon | 11.5 | 63 | 12.6 | -1.1 |
| | Tue | 13.1 | 63.5 | 12.7 | 0.4 |
| | Wed | 11.4 | 65 | 13 | -1.6 |
| | Thu | 15.5 | 66 | 13.2 | 2.3 |
| | Fri | 13.5 | 66 | 13.2 | 0.3 |
| Week 3 | Mon | 12.5 | 67 | 13.4 | -0.9 |
| | Tue | 13.1 | 67.5 | 13.5 | -0.4 |
| | Wed | 12.4 | 69 | | |
| | Thu | 16 | 56.5 | - | - |
| | Fri | 15 | 43.4 | - | - |

Table 2 Seasonal Deviations

| | Mon | Tue | Wed | Thu | Fri |
|---------|------|------|------|-----|------|
| Week 1 | - | - | -0.5 | 2.7 | -0.6 |
| Week 2 | -1.1 | 0.4 | -1.6 | 2.3 | 0.3 |
| Week 3 | -0.9 | -0.4 | | - | - |
| Total | -2.0 | 0.0 | | 5.0 | -0.3 |
| Average | -1.0 | 0.0 | | 2.5 | -0.1 |

Question B3 continues on the next page.

- a) Write down in your answer booklet:
- i. The **two** missing values in table 1 for Wednesday of week 3 which represent the moving average and the residual difference. [2]
 - ii. The **three** missing values regarding the seasonal deviations for Wednesday in table 2. [2]
- b) i. On **GRAPH PAPER**, plot a Time Series graph showing the sales data from table 1. Do **not** plot the trend values from the table. [7]
- ii. By sight (not by calculation) draw a line to approximate the trend. [1]
 - iii. Use the line you drew in ii. and an appropriate seasonal adjustment to forecast the sales on Wednesday of week 4. [3]

Question B4

William believes that the female students live closer to his college than the male students. He carried out a survey and the results are shown below. The minimum and maximum distances in table 1 are from the raw data and the other statistics provided are from grouped data.

Table 1

| Females | km | | Males | km |
|----------------|------|--|----------------|------|
| Min. Distance | 0.5 | | Min. Distance | 0.6 |
| Max Distance | 15 | | Max Distance | 19.3 |
| Median | 7.6 | | Median | |
| Lower Quartile | 3.5 | | Lower Quartile | |
| Upper Quartile | 10.9 | | Upper Quartile | |
| IQR | 7.4 | | IQR | |

The grouped data from the **male** survey is shown below:-

Table 2

| Distance travelled in km | Frequency |
|--------------------------|-----------|
| 0 - 3 | 10 |
| 3 - 6 | 19 |
| 6 - 9 | 11 |
| 9 - 12 | 16 |
| 12 - 15 | 12 |
| 15 - 18 | 9 |
| 18 - 21 | 3 |

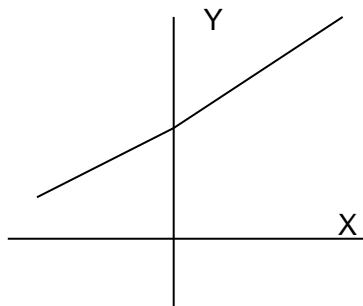
Question B4 continues on the following page

- a) In your answer booklet create the cumulative frequency table for the distance travelled to college by the male students. [2]
- b) Plot the cumulative frequency polygon of (a). You **must** use the **GRAPH PAPER** provided. [5]
- c) Use your cumulative frequency polygon to find the values of the **four** missing results in Table 1. Write the four values in your answer booklet. [4]
- d) Discuss both sets of results and determine if William's belief has been shown to be correct. [4]

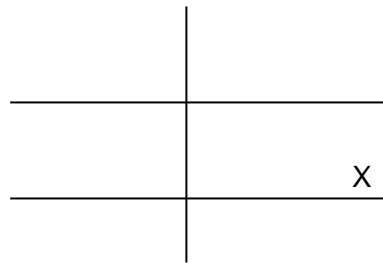
Question B5

In your answer booklet identify the types of mappings in the following diagrams: [4]

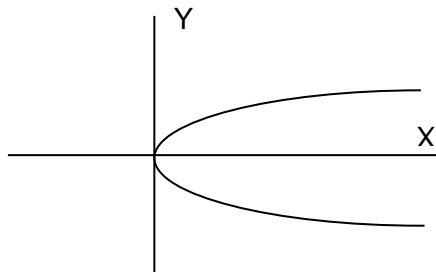
a) i.



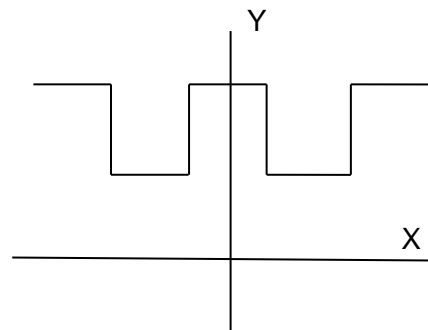
ii.



iii.



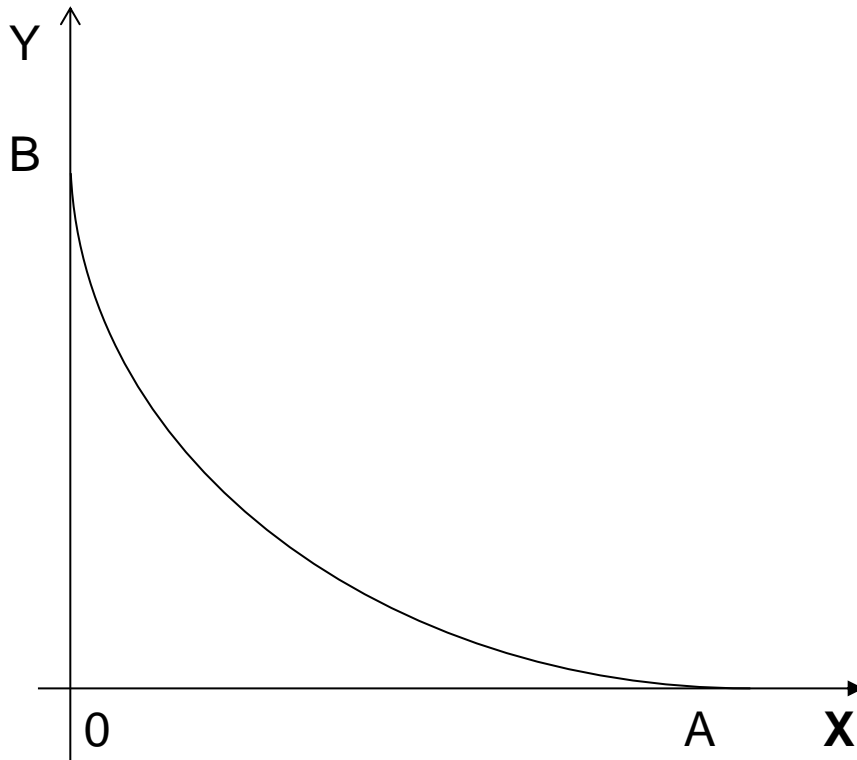
iv.



- b) i Sketch in your answer booklet the function $f(x) = |4x - 5|$. Label the y-intercept and the vertex. [3]
- ii. On the same diagram sketch a second function $g(x) = -f(x) + 3$. Label the y-intercept and the vertex of $g(x)$. [3]
- iii. Solve $g(x) = f(x)$. [5]

Question B6

The diagram below represents the equation $x^{\frac{2}{3}} + y^{\frac{2}{3}} = 6$, for positive values of x and y .



- a) i. Find the coordinates of the point A which is on the x-axis. Leave your answer in surd form. **[2]**
- ii. Find the volume generated by completely rotating the shape B0A about the x-axis. **[7]**
- b) For the following equation $y^2 + 2y - 3x^3 \sin y = 2x + 1$
- i. Find the values of y when $x = 0$. Give exact answers. **[2]**
- ii. Find the equation of the tangent at the point where $x = 0$, and y is the positive value from b i) above. **[4]**

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