AS Level Mathematics B (MEI)

H630/02 Pure Mathematics and Statistics

Question Set 2

1 Doug has a list of times taken by competitors in a 'fun run'. He has grouped the data and calculated the frequency densities in order to draw a histogram to represent the information. Some of the data are presented in Fig. 1.

Time in minutes	15 –	20 –	25 –	35 –	45 – 60
Number of runners	12	23	59	71	21
Frequency density	2.4	4.6	5.9	7.1	1.4

← 15×1.4

$\frac{23}{5}$ **Fig. 1**

(i) Write down the missing values in the copy of Fig. 1 below. **[2]**

Time in minutes	15 –	20 –	25 –	35 –	45 – 60
Number of runners	12	23	59	71	21
Frequency density	2.4	4.6	5.9	7.1	1.4

Fig. 1

(ii) Doug labels the horizontal axis on the histogram 'time in minutes' and the vertical axis 'number of minutes per runner'. State which one of these labels is incorrect and write down a correct version. **[1]**

Vertical axis – should be
number of runners

2 The probability distribution of the discrete random variable X is given in Fig. 2.

r	0	1	2	3	4
$P(X = r)$	0.2	0.15	0.3	k	0.25

Fig. 2

(i) Find the value of k. $\sum P(X=r)=1$ $0.9+k=1$ $k=0.1$ **[2]**

X_1 and X_2 are two independent values of X.

(ii) Find $P(X_1 + X_2 = 6)$. 2,4 4,2 3,3

$0.3 \times 0.25 \times 2 + (0.1)^2 = 0.16$ **[3]**

3 Rose and Emma each wear a device that records the number of steps they take in a day. All the results for a 7-day period are given in Fig. 3.

Day	1	2	3	4	5	6	7
Rose	10014	11262	10149	9361	9708	9921	10369
Emma	9204	9913	8741	10015	10261	7391	10856

Fig. 3

The 7-day mean is the mean number of steps taken in the last 7 days. The 7-day mean for Rose is 10112.

(i) Calculate the 7-day mean for Emma. $= \frac{66381}{7} = 9483$ **[1]**

At the end of day 8 a new 7-day mean is calculated by including the number of steps taken on day 8 and omitting the number of steps taken on day 1. On day 8 Rose takes 10259 steps.

(ii) Determine the number of steps Emma must take on day 8 so that her 7-day mean at the end of day 8 is the same as for Rose. [4]

Rose's New total (Day2 - Day8)
$= 71029$

$$\frac{\text{Total Emma}}{7} = \frac{\text{Total Rose}}{7} \rightarrow$$

Total Emma = Total Rose
$57177 + x = 71029$
$x = 13852$

Number of steps taken by Emma
on day 8 = 13852

In fact, over a long period of time, the mean of the number of steps per day that Emma takes is 10341 and the standard deviation is 948.

(iii) Determine whether the number of steps Emma needs to take on day 8 so that her 7-day mean is the same as that for Rose in part (ii) is unusually high. [3]

$X \sim N(10341, 948^2)$

$P(X > 13852) = 2.12 \times 10^{-4}$ ∴ unusually high

4

In this question you must show detailed reasoning.

Research showed that in May 2017 62% of adults over 65 years of age in the UK used a certain online social media platform. Later in 2017 it was believed that this proportion had increased. In December 2017 a random sample of 59 adults over 65 years of age in the UK was collected. It was found that 46 of the 59 adults used this online social media platform.

Use a suitable hypothesis test to determine whether there is evidence at the 1% level to suggest that the proportion of adults over 65 in the UK who used this online social media platform had increased from May 2017 to December 2017. [7]

$H_0: p = 0.62$
$H_1: p > 0.62$

$p =$ the proportion of adults over 65 in the UK who use the online social media platform

$X \sim B(59, 0.62)$

$P(X \geqslant 46)$

$1 - P(X \leq 45) = 0.00681$

$0.00681 < 0.01$
The result is significant.
Sufficient evidence to reject H₀, would suggest that the proportion of adults over 65 in the UK platform is bigger than 62%.

5

The pre-release material contains data concerning the death rate per thousand people and the birth rate per thousand people in all the countries of the world. The diagram in Fig. 5.1 was generated using a spreadsheet and summarises the birth rates for all the countries in Africa.
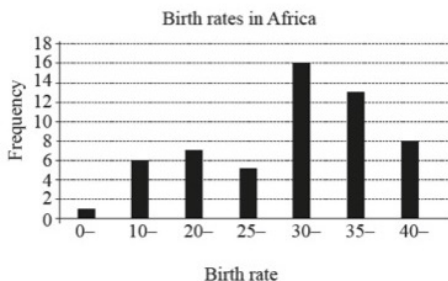
Birth rates in Africa

Fig. 5.1

(i) Identify **two** respects in which the presentation of the data is incorrect. [2]

y axis should be death rate

should be a graph not bar chart

Fig. 5.2 shows a scatter diagram of death rate, y, against birth rate, x, for a sample of 55 countries, all of which are in Africa. A line of best fit has also been drawn.

Scatter diagram of death rate against birth rate in African countries
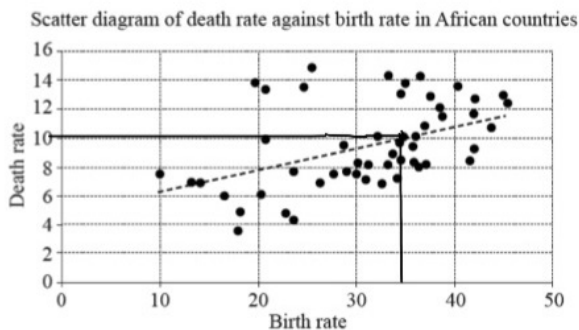
Fig. 5.2

(ii) (A) What does the diagram suggest about the relationship between death rate and birth rate? [1]

Positive Correlation

(B) The birth rate in Togo is recorded as 34.13 per thousand, but the data on death rate has been lost. Use the equation of the line of best fit to estimate the death rate in Togo. *10* [1]

(C) Explain why it would not be sensible to use the equation of the line of best fit to estimate the death rate in a country where the birth rate is 5.5 per thousand. [1]

Extrapolation as there is no data for below than 10

(D) Explain why it would not be sensible to use the equation of the line of best fit to estimate the death rate in a Caribbean country where the birth rate is known. *The line is for African countries* [1]

(E) Explain why it is unlikely that the sample is random. *Likely to be from 1 area in the country* [1]

Including Togo there were 56 items available for selection.

(iii) Describe how a sample of size 14 from this data could be generated for further analysis using systematic sampling. [2]

. List countries by letter and number

. Use random number generator to get a number between 1-4

. Start with country with this number and then look at every 4th country

Total Marks for Question Set 2: 32 marks