Statistical distribution – 2021/20 GCE Statistics Mathematics A

1. Nov/2021/Paper_H240/02/No.14

The probability distribution of a random variable X is modelled as follows.

$$P(X=x)=\begin{cases}\frac{k}{x} & x=1,2,3,4,\\ 0 & \text{otherwise,}\end{cases}$$

where k is a constant.

(a) Show that $k=\frac{12}{25}$. **[2]**

(b) Show in a table the values of X and their probabilities. **[1]**

(c) The values of three independent observations of X are denoted by X_1, X_2 and X_3.

Find $P(X_1 > X_2+X_3)$. **[3]**

In a game, a player notes the values of successive independent observations of X and keeps a running total. The aim of the game is to reach a total of exactly 7.

(d) Determine the probability that a total of exactly 7 is first reached on the 5th observation. **[5]**

2. Nov/2020/Paper_H240/02/No.11

As part of a research project, the masses, m grams, of a random sample of 1000 pebbles from a certain beach were recorded. The results are summarised in the table.

Mass (g)	$50 \leqslant m < 150$	$150 \leqslant m < 200$	$200 \leqslant m < 250$	$250 \leqslant m < 350$
Frequency	162	318	355	165

(a) Calculate estimates of the mean and standard deviation of these masses. **[2]**

The masses, x grams, of a random sample of 1000 pebbles on a different beach were also found. It was proposed that the distribution of these masses should be modelled by the random variable $X \sim \mathrm{N}(200, 3600)$.

(b) Use the model to find $\mathrm{P}(150 < X < 210)$. **[1]**

(c) Use the model to determine x_1 such that $\mathrm{P}(160 < X < x_1) = 0.6$, giving your answer correct to **five** significant figures. **[3]**

It was found that the smallest and largest masses of the pebbles in this second sample were 112 g and 288 g respectively.

(d) Use these results to show that the model may not be appropriate. **[1]**

(e) Suggest a different value of a parameter of the model in the light of these results. **[2]**

3. Nov/2020/Paper_H240/02/No.15

In this question you must show detailed reasoning.

The random variable X has probability distribution defined as follows.

$$\mathrm{P}(X=x)=\begin{cases}\frac{15}{64}\times\frac{2^x}{x!} & x=2,3,4,5,\\ 0 & \text{otherwise.}\end{cases}$$

(a) Show that $\mathrm{P}(X=2)=\frac{15}{32}$. **[1]**

The values of three independent observations of X are denoted by X_1, X_2 and X_3.

(b) Given that $X_1+X_2+X_3=9$, determine the probability that at least one of these three values is equal to 2. **[6]**

Freda chooses values of X at random until she has obtained $X=2$ exactly three times. She then stops.

(c) Determine the probability that she chooses exactly 10 values of X. **[3]**