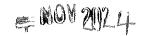**Bindura University of Science Education**

≈ NOV 2024

Faculty of Science Education

Department of Science and Mathematics Education

Programme: Diploma in Science Education (Mathematics & Geography)

Course: DM006/MT006 Inferential Statistics   Duration: Three hours

Semester Examinations

Instructions to candidates

(i)   Answer all questions in Section A and two questions from Section B.

(ii)   Begin each question on a fresh page.

Section A [40 marks]

Answer all questions from this section being careful to number them **A1** to **A4**.

A1. If the random variable X is such that $X \sim Bin(10, p)$ where $p < \frac{1}{2}$ and $Var(X) = 1\frac{7}{8}$.

   Find (a) p.   [3]

      (b). $E(X)$.   [3]

      (c). $P(X = 2)$.   [4]

A2 (a). If $X \sim Po(2)$.   Find:

      (a) $P(X = 4)$ [4]

      (b) $P(X \geq 3)$.   [6]

A3. Perform a Chi-square test to investigate whether the following data were drawn from a binomial distribution with $p = 0.3$.

x	0	1	2	3	4	5
f	12	39	27	15	4	3

Use a 5% level of significance.   [10]

A4. The time taken by a milkman to deliver milk to a High Street is normally distributed with mean 12 minutes and standard deviation of 2 minutes. He delivers milk everyday. Determine estimates for the number of days when he takes:

    (a) more than 17 minutes.   [5]

    (b) between 9 and 13 minutes.   [5]

Section B:[60 marks]

Answer **two** questions from this section being careful to number them **B5** to **B7**.

B5. (a). The lengths of metal bars produced by a particular machine are normally distributed with mean length 420cm and standard deviation of 12cm. The machine is serviced, after which a sample of 100 bars gives a mean length of 423cm.

    (i)   Is there evidence, at 5% level, of a change in in the mean length of the bars produced by the machine?   **[10]**

    (ii)   State one assumption in performing hypothesis testing.   **[2]**

(b). (i) Distinguish between type 1 and type errors in hypothesis testing.   **[6]**

(ii) Explain consequences of making type 1 and type 2 errors.   **[4]**

(c). A random variable X is the distance, in metres, that an inexperienced tight rope walker has moved along a given tight rope before falling off. It is given that $P(X > x) = 1 - \frac{x^2}{64}$, $0 \leq x \leq 4$.

(i). Show that $E(X) = 3$.   **[3]**

(ii). Determine the standard deviation of X.   **[5]**

B6. A random sample of 250 adult men undergoing medical inspection had their heights $(x\ cm)$ measured to the nearest centimetre, and the following data were obtained: $\sum x = 43205$, $\sum x^2 = 7469107$.

(i). Calculate an unbiased estimate for the population variance.   **[6]**

(ii). Find the 95% confidence interval for the population mean.   **[6]**

(b). A large college claims that it admits equal numbers of men and women. A random sample of 500 students at the college gave 271 males. Is there evidence at the 5% level of significance that the college is not evenly divided into males and females.   **[10]**

(c). The continuous random variable X has a probability density function given by
$f(x) = kx(1 - x^2)$, $(0 \leq x \leq 1)$ and $f(x) = 0$ elsewhere, k being a constant.

Find the value of k and $Var(X)$.   **[8]**

B7. (a). If $X \sim N(45, \sigma^2)$ and $P(X > 51) = 0.288$.   Find σ. [7]

(b). The marks in an examination were distributed with mean, μ and standard deviation σ. 10% of the candidates had more than 75 marks and 20% had less than 40 marks. Find μ and σ. [8]

(c). A random sample of 120 measurements taken from a normal population gave the following data.

$$\sum x = 1008, \quad \sum (x - \bar{x})^2 = 172.8$$

Find a 99% confidence interval for the population mean, μ, [7]

(d), A random sample of size 100 is taken from a normal population with variance, $\sigma_1^2 = 40$. The sample mean $\bar{x}_1 = 38.3$. Another random sample of size 80, is taken from a normal population with variance, $\sigma_2^2 = 30$. The sample mean, $\bar{x}_2 = 40.1$. Test at 5% level of significance whether there is a significant difference in the population means μ_1 and μ_2. [8]

END OF PAPER