SAMPEL PERCUMA

Kertas Trial STPM Semester 3 Mathematics T Sarawak 2024

Set penuh: Kertas Percubaan STPM

Semester 3 · 10 subjek (2024)

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Sampel bermula di muka surat sebelah

Section A [45 *marks*]

Answer **all** *questions in this section*

1. The table below shows the marks obtained by a group of students in a test.

Marks	1	2	3	4	≥ 5
Number of students	5	10	15 – m	6	5

Given that the modal mark is 2, find the range of values of m. [2 *marks*]

For the students who obtained more than 4 marks, the mean mark is 6.4, By using the smallest value of m, calculate the Pearson's coefficient of skewness.

Hence, state the shape of the frequency curve obtained. [5 *marks*]

2. Janice is playing a computer game. She has to complete level 1 and level 2 to finish the game. She is allowed at most two attempts at any level.
   - For level 1, the probability that Janice completes it at the first attempt is 0.6. If she fails at her first attempt, the probability that she completes it at the second attempt is 0.3.
   - If Janice completes level 1, she immediately moves on to level 2.
   - For level 2, the probability that Janice completes it at the first attempt is 0.4. If she fails at her first attempt, the probability that she completes it at the second attempt is 0.2.

   (a) Show that the probability that Janice moves on to level 2 is 0.72. [1 *mark*]

   (b) Find the probability that Janice finishes the game. [3 *marks*]

   (c) Find the probability that Janice fails exactly one attempt, given that she finishes the game. [4 *marks*]

3. (a) The lengths, in centimetres, of two types of insect, A and B, are modelled by the random variables $X \sim N(6.2, 0.36)$ and $Y \sim N(2.4, 0.25)$ respectively. Find the probability that the length of a randomly chosen type A insect is greater than the sum of the lengths of 3 randomly chosen type B insects. [4 *marks*]

   (b) The independent random variables X and Y have distributions Po(2) and $B \sim (20, \frac{1}{4})$ respectively.

   (i) Find the mean and standard deviation of $X - 3Y$. [4 *marks*]

   (ii) Find $P(Y = 15X)$. [3 *marks*]

4. Leaves from a certain type of tree have lengths that are normally distributed with standard deviation 3.2cm. A random sample of 250 of these leaves is taken and the mean length of this sample is found to be 12.5 cm.

   (a) Calculate a 99% confidence interval for the population mean length. [3 *marks*]

   (b) State the probability that the whole of a 99% confidence interval will lie below the population mean. [1 *mark*]

5. In the past, the mean time for Jenny's morning run was 28.2 minutes. She does some extra training and she wishes to test whether her mean time has been reduced. After the training Jenny takes a random sample of 40 morning runs. She decides that if the sample mean run time is less than 27 minutes she will conclude that the training has been effective. You may assume that, after the training, Jenny's run time has a standard deviation of 4.0 minutes.

   (i) State suitable null and alternative hypotheses for Jenny's test. [1 *mark*]

   (ii) Find the probability that Jenny will make a Type I error. [3 *marks*]

   (iii) Jenny found that the sample mean run time was 27.2 minutes. Explain briefly whether it is possible for her to make a Type I error or a Type II error or both. [2 *marks*]

6. It is thought that there is an association between the colour of a person's eyes and the reaction of the person's skin to ultraviolet light. In order to investigate this, each of a random sample of 120 persons is subjected to a standard dose of ultraviolet light. The degree of the reaction for each person is noted, "-" indicating no reaction, "+" indicating a slight reaction and "++" indicating a strong reaction. The results are shown in the table below.

Reaction \ Eye colour	Blue	Grey or green	Brown
-	7	8	18
+	29	10	16
++	21	9	2

Test whether the data provide evidence, at the 5% significance level, that the colour of a person's eyes and the reaction of the person's skin to ultraviolet light are independent. [9 *marks*]

Section B [15 *marks*]

Answer any **one** *questions in this section*

7. The continuous random variable X has cumulative distribution function

$$F(x)=\begin{cases}0, & x<0,\\ \frac{1}{3}x^2(4-x^2), & 0\le x\le 1,\\ 1 & x>1.\end{cases}$$

(a) Find $P(X>0.7)$. [2 *marks*]

(b) Find the probability density function $f(x)$ of X. [2 *marks*]

(c) Calculate $E(X)$ and show that, to 3 significant figures, $\mathrm{Var}(X) = 0.0573$. [6 *marks*]

(d) One measure of skewness is $\dfrac{\text{Mean} - \text{Mode}}{\text{Standard deviation}}$.

Solve $f'(x) = 0$, hence evaluate the skewness of the distribution of X.
Comment on the result [5 *marks*]

8. A random sample of 48 mushrooms is taken from a farm. The diameter x, in centimetres, of each mushroom is measured. The results are summarised by

$$\sum_{i=1}^{48} x_i = 300.4 \quad \text{and} \quad \sum_{i=1}^{48} x_i^2 = 2011.01.$$

(a) Calculate unbiased estimates of the population mean and variance of the diameters of the mushrooms. [3 *marks*]

(b) Determine a 90% confidence interval for the mean diameter of the mushrooms. [4 *marks*]

(c) Test, at the 10% significance level, the null hypothesis that the mean diameter of the mushrooms is 6.5cm. [6 *marks*]

(d) Relate the confidence interval obtained in (b) with the result of the test in (c). [2 *marks*]

The Paper End

☺☺☺ All the best ☺☺☺

TAMAT SAMPEL

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