SAMPEL PERCUMA

Kertas Trial STPM Semester 3 Mathematics T Melaka 2024

Set penuh: Kertas Percubaan STPM

Semester 3 · 10 subjek (2024)

Sampel ini: 4 muka surat. Set penuh ada:

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- Semester 1: kertas percubaan (trial) negeri, subjek yang dipilih + skema
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4. A random sample of 100 mangoes is taken from a farm. The mass x, in g, of each mango is weighed. The results are summarized by $\sum x = 3425$ and $\sum x^2 = 124025$.

(a) Calculate unbiased estimates for the population mean and variance of the masses of the mangoes in the farm. [3m]

(b) Determine a 95% confidence interval for the mean mass of the mangoes in the farm. Interpret your answer. [5m]

No	Solution	Mark	Remark
4a	$\overline{x} = \frac{3425}{100}$ $= 34.25$	M1	
	$\hat{\sigma^2} = \frac{1}{100-1}\left[124025 - \frac{(3425)^2}{100}\right] = 67.866$ OR $\frac{100}{99}\left[\frac{124025}{100} - \left(\frac{3425}{100}\right)^2\right] = \frac{26875}{396} = 67.866$	M1A1	
4b	$By\ CLT, \overline{X} \sim N(34.25, \frac{67.866}{100})$	B1	
	95% confidence interval for the mean mass of the mangoes in the farm $= \left(34.25 \pm 1.96 \times \sqrt{\frac{67.866}{100}}\right)$	B1	For 1.96
	$= (32.635,\ 35.865)$	M1A1	
	It can be 95% confident that the mean mass of the mangoes in the farm is between 32.635g and 35.865g.	A1	
Q4	Total	8	

5. An institute conducts a study of annual number of kilowatt-hours used by various homes appliances. It is claimed that an air conditioner uses an average of 520 kWh of electricity per year. A random sample of 50 homes indicates that an air conditioner uses an average of 495 kWh of electricity per year with a standard deviation of 132 kWh. At the 5% level of significance, test whether an air conditioner's annual electrical usage is less than 520 kWh considering that it is normally distributed. [7m]

No	Solution	Mark	Remark
5	$H_0: \mu = 520$ $H_1: \mu < 520$	B1	Both
	By CLT: $\bar{X}$ ~ N $(520, \frac{132^2}{50})$		
	$\hat{\sigma^2} = \frac{50}{49}(132^2)$	M1	
	Test statistic: $Z = \frac{495-520}{\sqrt{\frac{\frac{50}{49}(132^2)}{50}}} = \frac{-25}{\frac{132}{\sqrt{49}}}$	M1	
	$= -1.3258$	A1	
	Critical Region: At $\alpha = 0.05$, reject H_0 if $z < -1.645$	B1	
	Since Z = -1.3258 > -1.645, do not reject H_0.	M1	
	There is insufficient evidence to conclude that the annual electrical usage is less than 520kWh at 5% level of significance.	A1	
Q5	Total	7	

6. In the Mendel's peas experiments, the results of a sample of 768 pea plants produced in the lab are observed and recorded. The colours and the shapes of the pea are grouped in the table below.

Round and Yellow	Wrinkled and Yellow	Round and Green	Wrinkled and Green
418	153	142	55

According to Mendel's Genetcs theory, the expected figures follows the ratio 9 : 3 : 3 : 1.

Perform a χ^2 goodness-of-fit test, at the 10% significance level whether the sample supports the claim. [9m]

No	Solution	Mark	Remark
6	H_0 : The sample follows the ratio of 9 : 3 : 3 : 1 H_1 : The sample does not follow the ratio of 9 : 3 : 3 : 1	B1	Both
	<table><tr><td></td><td></td><td></td><td></td><td></td><td>Total</td></tr><tr><td>O_i</td><td>418</td><td>153</td><td>142</td><td>55</td><td>768</td></tr><tr><td>E_i</td><td>432</td><td>144</td><td>144</td><td>48</td><td>768</td></tr><tr><td>$\frac{(O_i - E_i)^2}{E_i}$</td><td>0.4537</td><td>0.5625</td><td>0.0278</td><td>1.0208</td><td>2.0648</td></tr></table>	M1A1 M1A1	
	$v = 4 - 1 = 3$	M1	
	$\chi^2_{0.1,3} = 6.2514$	M1	
	Since $\chi^2_{\text{cal}} = 2.0648 < 6.2514$, so do not reject H_0.	M1	
	At the 1% significance level, the sample follows the ratio 9:3:3:1	A1	
Q6	Total	9	

7. A continuous random variable, X has the following probability density functions.

$$f(x)=\begin{cases} kx & , \quad 0\le x<2 \\ \frac{k}{2}(6-x) & , \quad 2\le x<6 \\ 0 & , \quad \text{otherwise} \end{cases}$$

a) Calculate the value of k. [3m]

b) Find the mean of X. [3m]

c) If P($X \le m$) = $\frac{5}{8}$, determine the value of m. [5m]

d) By using the value of m obtained in (c), show that P($|X - m| > 2$) = $\frac{1}{8}$. [4m]

No	Solution	Mark	Remark
7a	$\int_0^2 kx\,dx+\int_2^6 \frac{k}{2}(6-x)\,dx=1$ $k\left[\frac{x^2}{2}\right]_0^2+\frac{k}{2}\left[6x-\frac{x^2}{2}\right]_2^6=1$ $k\left[\frac{2^2}{2}-0\right]+\frac{k}{2}\left[\left(6(6)-\frac{(6)^2}{2}\right)-\left(6(2)-\frac{(2)^2}{2}\right)\right]=1$ $2k+\frac{k}{2}(8)=1$ $k=\frac{1}{6}$ $f(x)=\begin{cases} \frac{1}{6}x & , \quad 0\le x<2 \\ \frac{1}{12}(6-x) & , \quad 2\le x<6 \\ 0 & , \quad \text{otherwise} \end{cases}$	M1 M1 A1	
7b	$E(x)=\int_{-\infty}^{\infty} x\,f(x)\,dx$ $E(x)=\int_0^2 x\left(\frac{1}{6}x\right)dx+\int_2^6 x\left[\frac{1}{12}(6-x)\right]dx$ $E(x)=\frac{1}{6}\int_0^2 x^2\,dx+\frac{1}{12}\int_2^6 6x-x^2\,dx$ $=\frac{1}{6}\left[\frac{x^3}{3}\right]_0^2+\frac{1}{12}\left[3x^2-\frac{x^3}{3}\right]_2^6$ $=\frac{1}{6}\left[\frac{(2)^3}{3}-0\right]+\frac{1}{12}\left[\left(3(6)^2-\frac{(6)^3}{3}\right)-\left(3(2)^2-\frac{(2)^3}{3}\right)\right]$ $=\frac{4}{9}+\frac{1}{12}\left(\frac{80}{3}\right)=\frac{8}{3}=2\frac{2}{3}$	M1 M1 A1	

TAMAT SAMPEL

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