Question 2 **(25 marks)**

A survey of 100 shoppers, randomly selected from a large number of Saturday supermarket shoppers, showed that the mean shopping spend was €90·45. The standard deviation of this sample was €20·73.

(a) Find a 95% confidence interval for the mean amount spent in a supermarket on that Saturday.

(b) A supermarket has claimed that the mean amount spent by shoppers on a Saturday is €94. Based on the survey, test the supermarket's claim using a 5% level of significance. Clearly state your null hypothesis, your alternative hypothesis, and your conclusion.

(c) Find the *p*-value of the test you performed in part **(b)** above and explain what this value represents in the context of the question.

Question 2 **(25 marks)**

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(a) Find a 95% confidence interval for the mean amount spent in a supermarket on that Saturday.

$$\frac{\sigma}{\sqrt{n}} = \frac{20 \cdot 73}{\sqrt{100}} = 2 \cdot 073$$

$$\text{C. I.} = \bar{x} \pm 1 \cdot 96 \frac{\sigma}{\sqrt{n}} = 90 \cdot 45 \pm 4 \cdot 06$$

We can be 95% confident that the mean amount spent was in the range
€86·39 $< \mu <$ €94·51

(b) A supermarket has claimed that the mean amount spent by shoppers on a Saturday is €94. Based on the survey, test the supermarket's claim using a 5% level of significance. Clearly state your null hypothesis, your alternative hypothesis, and your conclusion.

H_0 : Mean spend is €94

H_1 : Mean spend is not €94

METHOD 1:
$\bar{x} = 90 \cdot 45, \quad \sigma = 20 \cdot 73, \quad \mu = 94, \quad n = 100$

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{90 \cdot 45 - 94}{2 \cdot 073} = -1 \cdot 71$$

$-1 \cdot 71 > -1 \cdot 96$

Fail to reject null hypothesis (Not enough evidence to reject the null hypothesis)

or

METHOD 2:
M€94 is inside the confidence interval for the mean spend in the population
€86·39 $< \mu <$ €94·51 worked out in part **(i)** etc.
Fail to reject null hypothesis (Not enough evidence to reject the null hypothesis)

Or

METHOD 3:
C.I. based on a sample of 100 based on the claim is:
$$89 \cdot 94 < \bar{x} < 98 \cdot 06$$
€90·45 is inside this interval.
Fail to reject null hypothesis (Not enough evidence to reject the null hypothesis)

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(c) Find the *p*-value of the test you performed in part **(b)** above and explain what this value represents in the context of the question.

$$P(z < -1\cdot 71) = 1 - P(z < 1\cdot 71)$$
$$= 1 - 0\cdot 9564$$
$$= 0\cdot 0436$$

p-value: $= 0\cdot 0436 \times 2 = 0\cdot 0872$

Meaning: If the mean amount spent really was €94, then the probability that the sample mean would be €90·45 by chance is 8·72%. It is because this is more than a 5% chance that we do not reject the null hypothesis.

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Question 2 (25 marks)

(a) **Scale 10C (0, 4, 8, 10)**
  Low *Partial Credit:*
  - Relevant formula with or without substitution
  - $\dfrac{1}{\sqrt{n}}$ with further work

  High Partial Credit
  - $1\cdot96\,\dfrac{\sigma}{\sqrt{n}}$ evaluated

(b) **Scale 10D (0, 2, 5, 8, 10)**
  Low Partial Credit:
  - One relevant step e.g. null hypothesis or alternative hypothesis stated
  - Some work towards finding z
  - Mention of $\pm\,1\cdot96$

  Mid Partial Credit:
  - z calculated
  - Either null or alternative hypothesis stated and relevant work towards finding z
  - Confidence interval from (a) and either null or alternative hypothesis stated
  - Confidence interval based on 100 (i.e. $89\cdot94,\ 98\cdot06$) and either null or alternative hypothesis stated.

  High Partial Credit:
  - z calculated and compared to $\pm\,1\cdot96$ but:
    o Not stating null hypothesis and / or alternative hypothesis correctly
    o Not accepting or rejecting hypothesis
    o Incorrect conclusion for hypothesis

  - Incorrect use of 94 and confidence interval
  - Incorrect use of $90\cdot45$ and confidence interval

(c) **Scale 5C (0, 2, 4, 5)**
  Low *Partial Credit:*
  - Effort at finding $P(z<-1\cdot71)$

  High Partial Credit:
  - p value correct
  - Not contextualising answer correctly