

Cambridge International AS & A Level

Mathematics

9709/52

Paper 5 Probability & Statistics 1

May/June 2025

Question No (2)

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Question No (2)

In Millford, 70% of the residents own a bicycle. A random sample of 160 residents is selected.

Use a suitable approximation to find the probability that more than 120 of these residents own a bicycle.

Solution:

number of residents, $n = 160$

own a bicycle, $p = 70\% = 0.7$

$$q = 1 - p$$

$$= 1 - 0.7 = 0.3$$

let X be the random variable who own a bicycle.

$X \sim \text{Binomial}(n=160, p=0.7)$

we need to find

$$P(X > 120)$$

$$\text{As } np = 160 \times 0.7 = 112$$

$$nq = 160 \times 0.3 = 48$$

$$np > 5, nq > 5$$

we can use the normal approximation to binomial.

$$X \approx N(\mu, \sigma^2)$$

$$\begin{aligned}\mu &= np \\ &= 160 \times 0.7 = 112\end{aligned}$$

$$\begin{aligned}\sigma^2 &= npq = 160 \times 0.7 \times 0.3 \\ &= 33.6\end{aligned}$$

$$\sigma = \sqrt{33.6} \approx 5.796$$

applying the continuity correction for $P(X > 120)$, we have

$$P(X > 120.5) \quad \text{Here } X \sim N(\mu, \sigma^2)$$

$$P\left(Z > \frac{120.5 - 112}{5.796}\right) = P(Z > 1.47)$$

By standardize

$$P(Z > 1.47) = 1 - P(Z < 1.47)$$

$$= 1 - \Phi(1.47)$$

$$= 1 - 0.9292$$

$$= 0.0708$$

By normal table

$$\text{Hence } P(X > 120) \approx 0.071$$

