inkMaths

ANSWER BOOK

The binomial distribution

Statistics · Year 12–13

6 questions · 20 marks

NAVY EDITION

SECTION A · Warm-up

A1 A fixed number of trials, each with exactly two outcomes, a constant probability of success, and independence between trials. All four matter; the one exam questions test is independence. [2]

A2 $P(X = 2) = {}^8C_2 \times 0.25^2 \times 0.75^6 = 28 \times 0.0625 \times 0.178 = 0.311$. The three ingredients: ways of placing the successes, the successes' probability, the failures' probability, multiplied in one line. [3]

SECTION B · Standard

B1 $P(X = 3) = {}^{12}C_3 \times 0.2^3 \times 0.8^9 = 220 \times 0.008 \times 0.134 = 0.236$. $P(X = 0) = 0.8^{12} = 0.0687$: no coefficient needed, since there is only one way to fail every time. The sense check: $np = 2.4$, so three successes should be common, and it is the near-modal value. [4]

B2 $P(X \geq 4) = 1 - P(X \leq 3)$. Calculators sum from zero upwards, so every 'at least' question converts to one minus an 'at most', with the boundary dropped by one. The off-by-one in that last step is the main hazard of the topic. [3]

B3 $P(X \leq 1) = P(0) + P(1) = 0.9^{10} + 10 \times 0.1 \times 0.9^9 = 0.349 + 0.387 = 0.736$. Two point probabilities, added: with a boundary this low, summing by hand beats the calculator's cumulative function for showing the working. [4]

SECTION C · Stretch

C1 Friends attend parties together: one student's yes makes their friends' yeses more likely, so the trials are not independent, and independence is a binomial condition. The model fits twenty separate coin-like trials: unrelated items off a production line, or twenty spins of the same spinner, where no trial hears about any other. [4]