Solutionbank S1

Heinemann Modular Maths for Edexcel AS and A-level

4 Binomial distribution

Exercise B, Question 1

Question:

Ropes produced in a factory are tested to a certain breaking strain. From past experience it is found that one-quarter of ropes break at this strain.
From a batch of four such ropes, find the probability that exactly two break.

Solution:

$$n = 4, p = \frac{1}{4}, \mathrm{P}(X = 2) = \binom{4}{2}\left(\frac{1}{4}\right)^2\left(\frac{3}{4}\right)^2 = 6 \times \frac{1}{16} \times \frac{9}{16} = \frac{27}{128} \text{ or } 0.2109375$$

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Exercise B, Question 2

Question:

A distorted coin, where the probability of a head is $\frac{3}{5}$, is thrown five times.

Find the probability that a head shows on exactly four of these throws.

Solution:

$$n = 5, p = \frac{3}{5}, \mathrm{P}(X = 4) = \binom{5}{4}\left(\frac{3}{5}\right)^4\left(\frac{2}{5}\right)^1 = 5 \times \frac{81}{625} \times \frac{2}{5} = \frac{162}{625} \text{ or } 0.2592$$

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4 Binomial distribution

Exercise B, Question 3

Question:

A group of 10 friends plans to each buy a present for their friend who has a birthday. The probability that they will choose to buy chocolates is 0.4 and the friends all choose their present independently.
Find the probability that only three of the 10 friends decide to buy chocolates.

Solution:

$n = 10, p = 0.4, \mathrm{P}(X = 3) = \binom{10}{3} (0.4)^3 (0.6)^7 = 120 \times 0.064 \times 0.6^7$

$= 0.215$

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Exercise B, Question 4

Question:

A bank cash dispenser has a probability of 0.2 of being out of order on any one day chosen at random. Find the probability that, out of the 10 of these machines which this bank owns, exactly three are out of order on any one given day.

Solution:

$n = 10, p = 0.2, \mathrm{P}(X = 3) = \binom{10}{3} (0.2)^3 (0.8)^7 = 120 \times 0.008 \times 0.8^7$

$= 0.201.$

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Exercise B, Question 5

Question:

The probability that Miss Brown will make an error in entering any one set of daily sales data into a database is 0.3.
Find the probability that, during a fortnight (ten working days) she makes an error exactly four times.

Solution:

$n = 10, p = 0.3, \mathrm{P}(X = 4) = \binom{10}{4} (0.3)^4 (0.7)^6 = 210 \times 0.3^4 \times 0.7^6$

$= 0.200.$

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Exercise B, Question 6

Question:

A restaurant takes bookings for 20 tables on Saturday night. The probability that a party does not turn up for their booking is 0.15.
Find the probability that only two of the parties who have made bookings do not turn up.

Solution:

$n = 20, p = 0.15, \mathrm{P}(X = 2) = \binom{20}{2} (0.15)^2 (0.85)^{18}$

$= 190 \times 0.15^2 \times 0.85^{18} = 0.229.$

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Exercise B, Question 7

Question:

A school pupil attempts a multiple-choice exam paper but has not made any effort to learn any of the information necessary. Therefore the pupil guesses the answers to all the questions.
There are five possible answers to each question and there are 30 questions on the paper. Find the probability that the pupil gets eight questions correct out of the 30 on the paper.

Solution:

$n = 30, p = 0.2, \mathrm{P}(X = 8) = \binom{30}{8} (0.2)^{8} (0.8)^{22} = 5852925 \times 0.2^{8} \times 0.8^{22}$

$= 0.111.$

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4 Binomial distribution

Exercise B, Question 8

Question:

A batch of 25 lightbulbs is sent to a small retailer. The probability that a bulb is faulty is 0.1. Find the probability that only two of the bulbs are faulty.

Solution:

$n = 25, p = 0.1, \mathrm{P}(X = 2) = \binom{25}{2} (0.1)^2 (0.9)^{23} = 300 \times 0.01 \times 0.9^{23}$

$= 0.266.$