

**Binomial Distribution Exam Questions (From OCR 4732)**

**Q1 (Jan 2006, Q7)**

Past experience has shown that when seeds of a certain type are planted, on average 90% will germinate. A gardener plants 10 of these seeds in a tray and waits to see how many will germinate.

- (i) Name an appropriate distribution with which to model the number of seeds that germinate, giving the value(s) of any parameters. State any assumption(s) needed for the model to be valid. [4]
- (ii) Use your model to find the probability that fewer than 8 seeds germinate. [2]

Later the gardener plants 20 trays of seeds, with 10 seeds in each tray.

- (iii) Calculate the probability that there are at least 19 trays in each of which at least 8 seeds germinate. [4]

**Q2 (Jun 2010, Q4) [Modified]**

- (i) The random variable  $W$  has the distribution  $B(10, \frac{1}{3})$ . Find
  - (a)  $P(W \leq 2)$ , [1]
  - (b)  $P(W = 2)$ . [2]
- (ii) The random variable  $X$  has the distribution  $B(15, 0.22)$ .
  - (a) Find  $P(X = 4)$ . [2]

**Q3 (Jun 2011, Q3) [Modified]**

- (i) A random variable,  $X$ , has the distribution  $B(12, 0.85)$ . Find
  - (a)  $P(X > 10)$ , [2]
  - (b)  $P(X = 10)$ , [2]
- (ii) A random variable,  $Y$ , has the distribution  $B(2, \frac{1}{4})$ . Two independent values of  $Y$  are found. Find the probability that the sum of these two values is 1. [4]

**Q4 (Jun 2013, Q7)**

In a factory, an inspector checks a random sample of 30 mugs from a large batch and notes the number,  $X$ , which are defective. He then deals with the batch as follows.

- If  $X < 2$ , the batch is accepted.
- If  $X > 2$ , the batch is rejected.
- If  $X = 2$ , the inspector selects another random sample of only 15 mugs from the batch. If this second sample contains 1 or more defective mugs, the batch is rejected. Otherwise the batch is accepted.

It is given that 5% of mugs are defective.

- (i) (a) Find the probability that the batch is rejected after just the first sample is checked. [3]
- (b) Show that the probability that the batch is rejected is 0.327, correct to 3 significant figures. [5]
- (ii) Batches are checked one after another. Find the probability that the first batch to be rejected is either the 4th or the 5th batch that is checked. [3]

**Q5 (Jun 2014, Q4) [Modified]**

Each time Ben attempts to complete a crossword in his daily newspaper, the probability that he succeeds is  $\frac{2}{3}$ . The random variable  $X$  denotes the number of times that Ben succeeds in 9 attempts.

(i) Find

(a)  $P(X = 6)$ , [3]

(b)  $P(X < 6)$ , [1]

Ben notes three values,  $X_1$ ,  $X_2$  and  $X_3$ , of  $X$ .

(ii) State the total number of attempts to complete a crossword that are needed to obtain three values of  $X$ . Hence find  $P(X_1 + X_2 + X_3 = 18)$ . [4]

**Q6 (Jun 2015, Q5) [Modified]**

Each year Jack enters a ballot for a concert ticket. The probability that Jack will win a ticket in any particular year is 0.27.

(ii) Write down an expression for the probability that Jack wins a ticket on exactly 2 of his first 8 attempts, and evaluate this expression. [3]

(iii) Find the probability that Jack wins his 3rd ticket on his 9th attempt and his 4th ticket on his 12th attempt. [3]

**Q7 (Jun 2016, Q5) [Modified]**

(i) A random variable  $X$  has the distribution  $B(25, 0.6)$ . Find

(a)  $P(X \leq 14)$ , [1]

(b)  $P(X = 14)$ , [2]

(ii) A random variable  $Y$  has the distribution  $B(24, 0.3)$ . Write down an expression for  $P(Y = y)$  and evaluate this probability in the case where  $y = 8$ . [2]

(iii) A random variable  $Z$  has the distribution  $B(2, 0.2)$ . Find the probability that two randomly chosen values of  $Z$  are equal. [3]

**Q8 (Jun 2017, Q8)**

Every month Frankie posts 10 parcels, one to each of 10 friends. The friends live in different towns in a country where the postal service is unreliable. She has found that, for each parcel, the probability that it arrives is  $\frac{7}{8}$ .

(i) Name an appropriate distribution with which to model the number of parcels that arrive in a particular month, giving the value(s) of any parameters. State a necessary assumption for the model to be valid. [2]

(ii) Use this model to find the probability that in a particular month

(a) all 10 parcels arrive, [1]

(b) at least 9 parcels arrive. [2]

(iii) Frankie chooses 5 months at random. Find the probability that all 10 parcels arrive in at least 4 of these 5 months. [3]