

# 4.10 Introduction to the Binomial Distribution

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 11 marks

## Objective

Build the skills to answer exam questions on **the binomial distribution**.

**You must be able to:**

- recognise a **binomial** 二項 setting:  $n$  independent trials, each a success or failure, with fixed  $p$
- calculate  $P(X = x) = \binom{n}{x} p^x (1 - p)^{n-x}$

## 1 Worked examples

Study these first. Each one shows the method for a question type used later.

### ■ The binomial setting

A binomial random variable  $X$  counts the number of **successes** in  $n$  trials that are:

- **fixed** in number ( $n$ ),
- **two-outcome** (success/failure),
- **independent**, with
- a **constant** probability of success  $p$ .

### ■ The binomial formula

$$P(X = x) = \binom{n}{x} p^x (1 - p)^{n-x}.$$

For  $n = 3$ ,  $p = 0.5$ ,  $x = 2$ :  $\binom{3}{2} (0.5)^2 (0.5)^1 = 3 \times 0.125 = 0.375$ .

## 2 Practice

**2.1** State the four conditions of a binomial setting.

[2]

**2.2** Write the binomial probability formula. [1]

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**2.3** For  $n = 4$ ,  $p = 0.5$ , find  $P(X = 4)$ . [2]

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### 3 Exam-style questions

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**3.1** A binomial random variable counts the number of [1]

- **A** trials
  - **B** successes in  $n$  trials
  - **C** failures only
  - **D** outcomes
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**3.2** In a binomial setting, the probability of success  $p$  is [1]

- **A** changing each trial
  - **B** constant across trials
  - **C** zero
  - **D** exactly 1
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**3.3** A fair coin is flipped 3 times;  $X$  = number of heads.

(a) State  $n$  and  $p$ . [1]

(b) Find  $P(X = 0)$ . [2]

(c) Name the distribution. [1]

### 4 Go further

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- work through the **4.10 Introduction to the Binomial Distribution** lesson on the **Learn** page;
  - read the **Probability, Random Variables, and Probability Distributions** section of the AP Statistics handout on the **Know** page.

## Solutions

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**2.1** fixed number of trials; two outcomes; independent trials; constant  $p$ .

**2.2**  $P(X = x) = \binom{n}{x} p^x (1 - p)^{n-x}$ .

**2.3**  $P(X = 4) = \binom{4}{4} (0.5)^4 = (0.5)^4 = 0.0625$ .

**3.1 B.**

**3.2 B.**

**3.3** (a)  $n = 3$ ,  $p = 0.5$ . (b)  $P(X = 0) = (0.5)^3 = 0.125$ . (c) binomial.