# 4.10 Introduction to the Binomial Distribution

Name: ____________ Class: ________ Date: __________ **Total: 11 marks**

**KEY WORDS** binomial 二项 • random 随机 • probability 概率 • independent 独立 • random variable 随机变量

## Objective

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

**You must be able to:**

- recognise a **binomial** 二项 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]

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

## 3 Exam-style questions

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

- **A** trials
- **B** successes in $n$ trials
- **C** failures only
- **D** outcomes

**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

**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]

## Solutions

**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.