

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 | B |
| C | D |
- 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 | B |
| C | D |
- 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]