

Starter

1) Complete the probability distribution function.

x	4	5	6
$P(X = x)$	0.2		0.45

2) For the table above calculate $E(X)$ and $\text{Var}(X)$

Aug 21-15:35

Binomial Distribution

Today we are learning...

What the binomial distribution is and how we use it.

I will know if I have been successful if...

I know what the Binomial Distribution is.

I understand the conditions that must be met to use it.

I can calculate probabilities using it.



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The Binomial Distribution

The binomial distribution is a special discrete probability distribution.

If $X \sim \text{Bin}(n, p)$ then:

$$P(X = x) = \begin{cases} \binom{n}{x} p^x q^{n-x} & \text{for } x = 0, 1, 2, \dots, n \\ 0 & \text{otherwise} \end{cases}$$

where $0 < p < 1$ and $q = 1 - p$

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Binomial Distribution

The Binomial Distribution can be used to calculate probabilities of certain experiments. The following conditions must be met when using the binomial distribution.

- 1) There are a fixed number of trials, n .
- 2) There only two outcomes, "success" and "failure".
- 3) The trials are **independent**.
- 4) There is a constant probability of success p .
- 5) The random variable, X , is the total number of successes in n trials.

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Common Examples

Common examples of experiments where the binomial distribution can be used to calculate probabilities are:

- a) Flipping a coin 5 times and counting the number of heads we get.
- b) Rolling a dice 8 times and counting the number of times we get an even number.
- c) Picking a counter out of bag of 4 red and 3 green and getting a green 3 times when you conduct the experiment 6 times.


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Let's look at the formula in more detail...

If $X \sim \text{Bin}(n, p)$

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

Takes into account all the different orders in which something can happen.



where $0 < p < 1$ and $q = 1 - p$

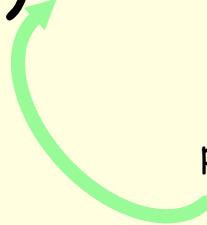
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Let's look at the formula in more detail...

If $X \sim \text{Bin}(n, p)$

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

Calculate the
probability of x
successes.



where $0 < p < 1$ and $q = 1 - p$

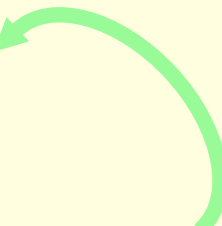
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Let's look at the formula in more detail...

If $X \sim \text{Bin}(n, p)$

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

Calculate the
probability of $n - x$
failures.



where $0 < p < 1$ and $q = 1 - p$


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Expectation and Variance

It can be shown that for a binomial distribution with, n trials and a probability of success, p or in other words $X \sim \text{Bin}(n, p)$ that...

$$E(X) = np$$

$$\text{Var}(X) = npq$$

 This is given in the data booklet.

For Example:

If $X \sim \text{Bin}(20, 0.3)$

Then $E(X) =$

$\text{Var}(X) =$

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Calculating Probabilities

We have 3 ways to actually calculate the probabilities.

- 1) Using the formula.
- 2) Using the tables in the data booklet.
- 3) Using your calculator.

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Example

Suppose $X \sim \text{Bin}(7, 0.4)$

Calculate

$$P(X = 4) = 0.1935$$

$$P(X = 6) = 0.0172$$

$$P(X \leq 5) = 0.9812$$

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Continue to Practice using the Binomial Distribution

Ex 2.3A

Ex 2.3B

Aug 22-15:04

Plenary - 2017 Exam Question

A researcher is studying woodland rodents as hosts for parasite transmission. The study involves capturing, examining, marking and releasing rodents on a number of sites in the Loch Lomond basin in the West of Scotland. The theoretical chance of a recapture (capturing a rodent that has previously been marked and released), determined from previous studies, is 20%.

- (a) At one site the researcher captures 20 individuals. What is the probability that exactly 3 are recaptures?

(2017)

Aug 28-09:48

Plenary - 2017 Exam Question

Question		Generic scheme	Illustrative scheme	Max mark
10	(a)	<ul style="list-style-type: none"> •¹ correct distribution •² calculate probability 	<ul style="list-style-type: none"> •¹ $X \sim B(20, 0.2)$ •² $P(X = 3) = 0.2053$ 	2

(2017)

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