

# Factsheet: Binomial distribution

Michelle Arnetta and Tom Coleman

## Summary

A factsheet on the binomial distribution.

$\text{Bin}(n = 20, p = 0.40)$

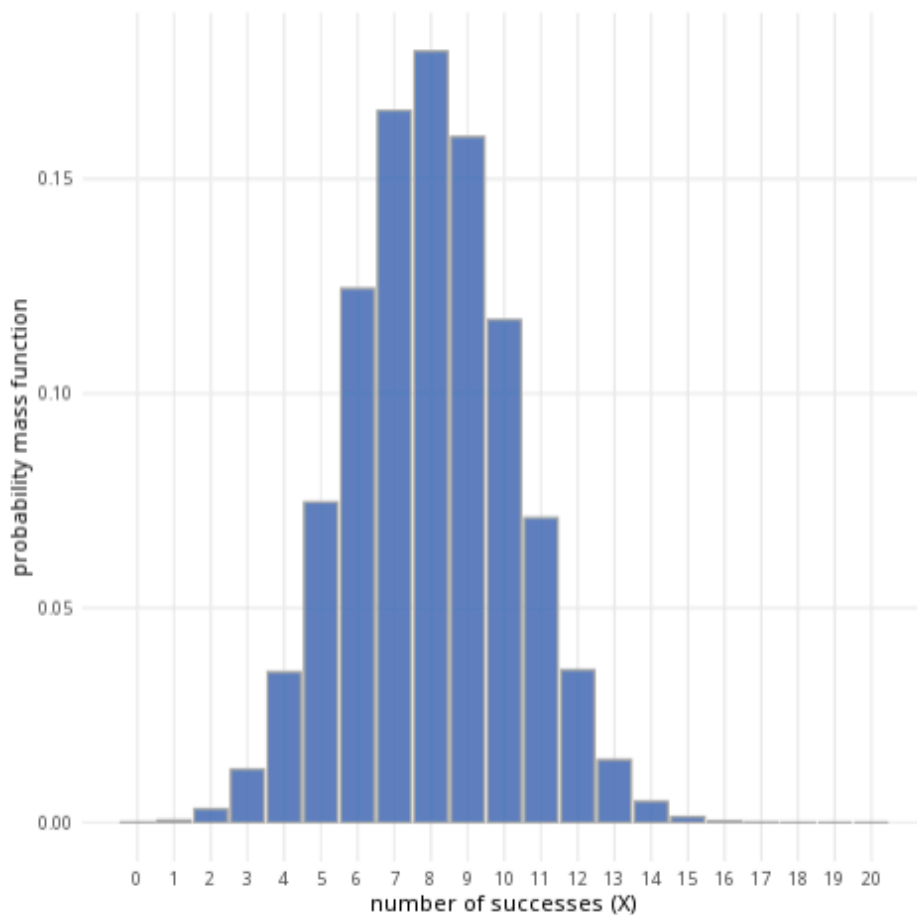


Figure 1: An example of the binomial distribution with  $n = 20$  and  $p = 0.4$ .

**Where to use:** The binomial distribution is used when there are a fixed number of trials ( $n$ ) and only two possible outcomes for each trial, representing  $n$  many Bernoulli trials. Here, the random variable  $X$  represents the number of successes.

**Notation:**  $X \sim \text{Binomial}(n, p)$  or  $X \sim B(n, p)$ .

**Parameters:** Two numbers  $n, p$  where: -  $n$  is an integer representing the number of trials, -  $p$  is a real number representing the probability of success of a trial (where  $0 \leq p \leq 1$ ).

Quantity	Value	Notes
<b>Mean</b>	$\mathbb{E}(X) = np$	
<b>Variance</b>	$\mathbb{V}(X) = np(1 - p)$	
<b>PMF</b>	$\mathbb{P}(X = x) = \frac{n!}{(n-x)!x!} p^x q^{(n-x)}$	
<b>CDF</b>	$\mathbb{P}(X \leq x) = I_q(n - \lfloor x \rfloor, 1 + \lfloor x \rfloor)$	$I_x(a, b)$ regularized incomplete beta function, $\lfloor x \rfloor$ the floor function

**Example:** You flip a coin 10 times, and the probability of getting ‘heads’ is 0.5. Taking ‘heads’ as a success, this can be expressed as  $X \sim B(10, 0.5)$ , meaning 10 trials are conducted, where the probability of success in each trial is 0.5.

## Further reading

This interactive element appears in [Guide: PMFs, PDFs, CDFs](#) and [Overview: Probability distributions](#). Please click the relevant links to go to the guides.

## Version history

v1.0: initial version created 04/25 by tdhc and Michelle Arnetta as part of a University of St Andrews VIP project.

- v1.1: moved to factsheet form and populated with material from [Overview: Probability distributions](#) by tdhc.

This work is licensed under [CC BY-NC-SA 4.0](#).