Factsheet: Binomial distribution

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Summary

A factsheet on the binomial distribution.

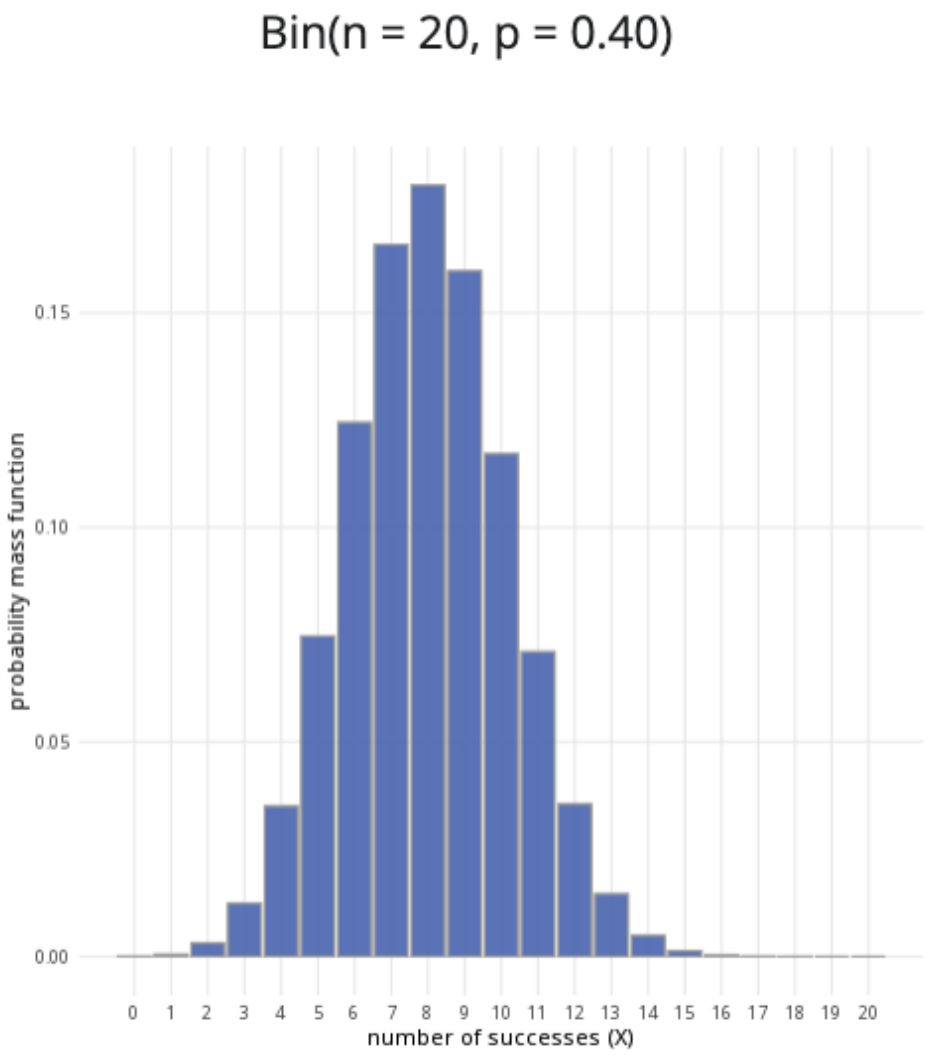

Figure 1: An example of the binomial distribution with $n = 20$ and $p = 0.4$.

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
Mean	$\mathbb{E}(X) = np$	
Variance	$\mathbb{V}(X) = np(1-p)$	
PMF	$\mathbb{P}(X = x) = \frac{n!}{(n-x)!x!} p^x q^{(n-x)}$	
CDF	$\mathbb{P}(X \leq x) = I_q(n - \lfloor x \rfloor, 1 + \lfloor x \rfloor)$	$I_x(a, b)$ 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.