

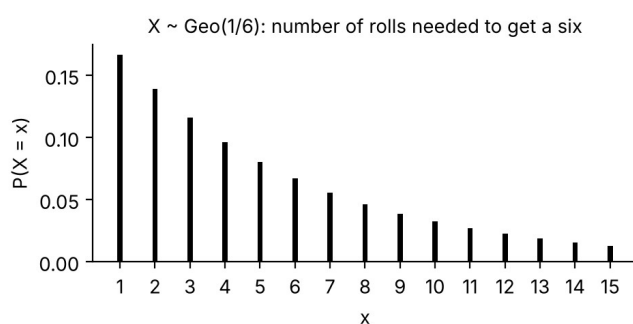
3A The Geometric Distribution

The geometric distribution models:

Conditions for a geometric model:

A fair dice is rolled until a six appears. X is the number of rolls needed.

x	1	2	3	4	...
$P(X = x)$	$1/6$				...



If $X \sim \text{Geo}(p)$, the probability function is:

$$P(X = x) = \quad x =$$

Cumulative geometric distribution (sum of a geometric series):

$$P(X \leq x) =$$

$$P(X > x) = \quad P(X \geq x) =$$

- Johan is playing a board game where he has to roll a six to start. Find the probability that Johan starts the board game on his fourth roll.

2. The probability that Genevieve passes her driving test on any one attempt is 0.6.
- a) Find the probability that:
- i) she passes on her fifth attempt
 - ii) she needs five or fewer attempts to pass
 - iii) she needs more than five attempts to pass.
- b) State two assumptions you have used in your calculations.

3B Mean and Variance of a Geometric Distribution

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

Mean of $X = E(X) = \mu =$

Variance of $X = \text{Var}(X) = \sigma^2 =$

Standard deviation:

1. Dorothy flips a biased coin until it lands on heads. She records the total number of flips, Y . Given that the mean of Y is 2.5, find:
 - a) the probability of the coin landing on heads on a single flip

b) the standard deviation of Y .

3C The Negative Binomial Distribution

The negative binomial distribution models:

Binomial vs negative binomial (what is fixed and what is the random variable?):

A fair dice is rolled until a total of three sixes have been rolled. X is the number of rolls needed.
What values can X take?

$P(X = 10)$ means:

$P(X = 10) =$

If $X \sim \text{Negative B}(r, p)$, the probability function is:

$P(X = x) =$ $x =$

In words, this is:

Notation:

1. Philomena is practising her piano scales. The probability that she completes a scale correctly on any one attempt is 0.4. She continues practising until she has completed four scales correctly.
 - a) Find the probability that she completes her fourth correct scale on her 12th attempt.
 - b) Find the probability that she completes her fourth correct scale on her 10th attempt, given that her first scale was correct.

3D Mean and Variance of the Negative Binomial Distribution

If $X \sim \text{Negative B}(r, p)$, then:

Mean of $X = E(X) = \mu =$

Variance of $X = \text{Var}(X) = \sigma^2 =$

Link to the geometric distribution ($r = 1$):

1. Iona and Juan play noughts and crosses. The probability that Iona wins is 0.7. The random variable X represents the number of games that they need to play for Iona to win seven times.
 - a) Find $E(X)$ and $\text{Var}(X)$.

They change games and start playing chess. The random variable Y represents the number of games that they need to play for Juan to win twice. Given that the mean of Y is 6, find:

- b) Juan's probability of winning any single game of chess

- c) the standard deviation of Y .