

Exercise walk-through

4.12

The Geometric Distribution

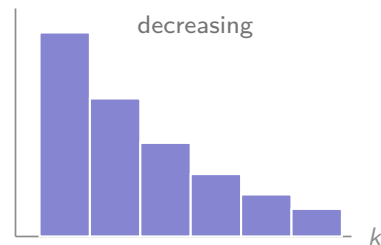
AP Statistics

The geometric distribution

The **geometric setting** keeps going *until* the first success (no fixed n).

$$P(X = k) = (1 - p)^{k-1} p \quad \mu_X = \frac{1}{p}$$

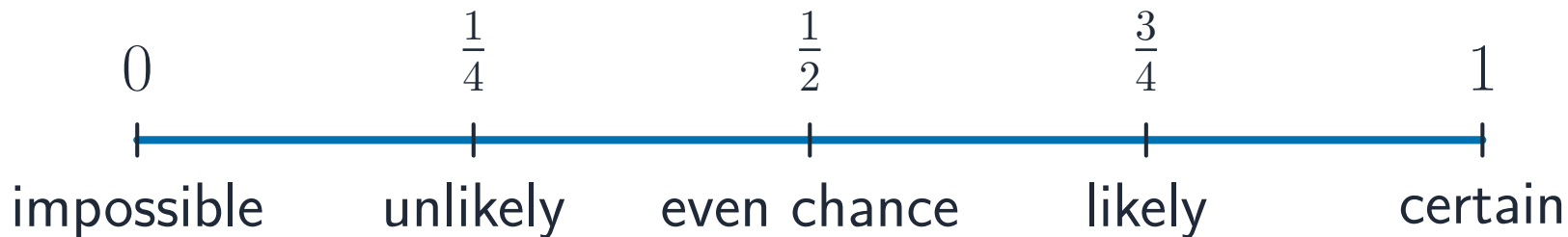
X counts **trials until** the first success; a binomial counts successes in a **fixed** number of trials.



Roll until a six:

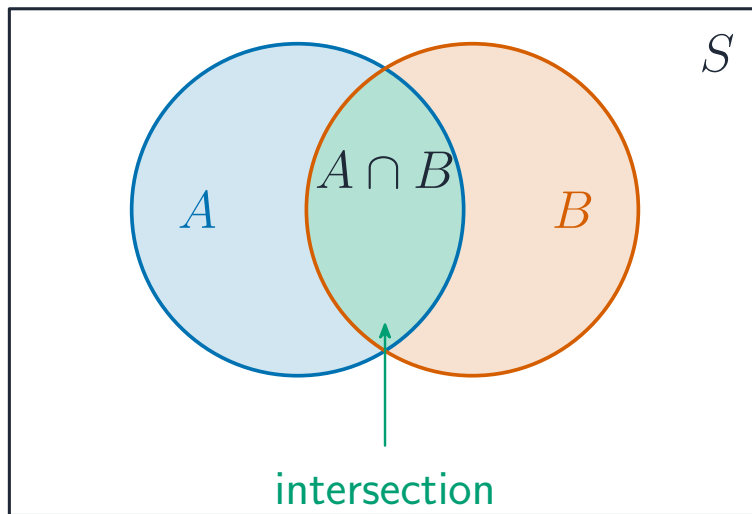
$$\mu = 6.$$

Introduction to Probability



Probability runs from 0 (impossible) to 1 (certain)

Mutually Exclusive Events



A Venn diagram: the overlap is the intersection of two events

Independent Events and Unions of Events

		die 2					
+		1	2	3	4	5	6
die 1	1	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
	6	7	8	9	10	11	12

the six highlighted cells all give a total of 7

A sample space diagram lists every equally likely outcome

Exam tips

- A probability lies in $[0, 1]$; use the **complement** $(1 - P)$ and add mutually exclusive events.
- For independent events multiply; for “and/or” use the general addition and conditional rules.
- **Expected value** $= \sum(\text{value} \times \text{probability})$.
- Recognise **binomial** (fixed n , two outcomes, constant p) and **geometric** settings.
- Draw a tree or table for multi-stage problems and multiply along branches.

Exercises 2.1-2.3

2.1 State what a geometric random variable counts.

[1]

2.2 For $p = 0.25$, find the mean number of trials to the first success.

[2]

2.3 Write $P(\text{first success on trial 1})$ in terms of p .

[1]

Exercises 2.1-2.3

2.1 State what a geometric random variable counts. [1]

2.1

- the number of trials until the first success
-

2.2 For $p = 0.25$, find the mean number of trials to the first success. [2]

2.2

- $\mu_X = \frac{1}{0.25} = 4$
-

2.3 Write $P(\text{first success on trial 1})$ in terms of p . [1]

2.3

- $P(X = 1) = p$

Exercises 3.1-3.2

3.1 A geometric random variable counts the

[1]

☐

A number of successes in n trials

B number of trials until the first success

C total number of trials

D number of failures only

3.2 The mean of a geometric distribution is

[1]

☐

A p

B $\frac{1}{p}$

C np

D $\sqrt{p}$

Exercises 3.1-3.2

3.1 A geometric random variable counts the

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- A number of successes in n trials
- B number of trials until the first success
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3.1 B

- number of trials until the first success.

3.2 The mean of a geometric distribution is

[1]

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- A p
- B $\frac{1}{p}$
- C np
- D $\sqrt{p}$

3.2 B

- $\frac{1}{p}$.

Exercise 3.3 (a)

3.3 A game gives $P(\text{win}) = 0.1$ on each try.

(a) Find the expected number of tries until the first win.

[2]

Exercise 3.3 (a)

3.3 A game gives $P(\text{win}) = 0.1$ on each try.

(a) Find the expected number of tries until the first win.

[2]

(a)

- $\frac{1}{0.1} = 10$

Exercise 3.3 (b)

3.3 A game gives $P(\text{win}) = 0.1$ on each try.

(b) Name the distribution.

[1]

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3.3 A game gives $P(\text{win}) = 0.1$ on each try.

(b) Name the distribution.

[1]

(b)

- geometric