PROBLEM-SOLVING AND DATA ANALYSIS / 01 UNDERSTAND

Probability

An illustrated lesson ▪ Theory, reasoning and worked examples

Define the experiment and event

Probability measures how likely an event is under a specified random process. The sample space contains all possible outcomes; the event is the subset of interest. For equally likely outcomes, probability is favourable outcomes divided by total outcomes. Counting works only when the outcomes being counted have equal likelihood.

Probabilities stay between zero and one

An impossible event has probability 0, and a certain event has probability 1. Every other probability lies between them. A result above 1 usually indicates a denominator or counting error. Fractions, decimals and percentages can represent the same probability, but the requested format determines how to report it.

The complement is what does not happen

The probability of not A is 1 - P(A). If a bag contains only red and blue counters, the probabilities of red and blue sum to 1. Complement reasoning can avoid listing many outcomes, especially for an event such as at least one success: first consider no successes.

CONDITIONING CHANGES THE DENOMINATOR

Group	Cycle	Do not cycle	Total
Year 1	12	8	20
Year 2	8	12	20

P(cycles | Year 1) = 12/20. Across both years: 20/40.

Illustrative teaching diagram. Values and examples are explained in the lesson.

THE ESSENTIAL IDEA

For equally likely outcomes, probability = favourable outcomes / all possible outcomes.

PROBLEM-SOLVING AND DATA ANALYSIS / 02 BUILD THE METHOD

From idea to method

Read a two-way table carefully

For the probability that a randomly selected student cycles, use the cycling total divided by all students. For the probability of cycling given that the student is in Year 1, restrict the denominator to Year 1 students. The condition changes the sample space before the fraction is calculated.

Account for overlap

For A or B, add P(A) and P(B), then subtract P(A and B), because the overlap was counted twice. If the events cannot occur together, the overlap is zero. The word or in this rule includes the possibility that both events occur.

Independence is a condition, not an assumption

For independent events, P(A and B) = P(A)P(B). Without replacement, the first selection changes the available population, so probabilities often change on the second draw. With replacement and a fresh random draw, the original proportions are restored.

WORKED EXAMPLE / A CONDITIONAL PROBABILITY

In Year 1, 12 of 20 students cycle. In Year 2, 8 of 20 cycle. Find P(cycles | Year 1).

01 Set up the reasoning

The condition Year 1 limits the sample space to 20 students.

02 Apply the relationship

Of those students, 12 cycle, so the probability is 12/20 = 3/5.

03 Interpret and check

Across both years, cycling probability is 20/40 = 1/2. That is a different question with a different denominator.

Keep these distinctions handy

Complement	P(not A) = 1 - P(A).
Union	P(A or B) = P(A) + P(B) - P(A and B).
Conditional sample	Count within the given group before forming the ratio.

PROBLEM-SOLVING AND DATA ANALYSIS / 03 CONNECT & REMEMBER

See the deeper pattern

Without-replacement reasoning

A bag has 3 red and 2 blue counters. The probability of two reds without replacement is (3/5)(2/4) = 3/10. After the first red, there are only 2 red counters among 4 remaining. Squaring 3/5 would describe a different experiment in which the first counter was replaced.

ONE MORE WORKED APPLICATION

A bag contains 2 red counters and 3 blue counters. One counter is chosen uniformly at random. What is the probability of red?

1. Total counters = 5.

2. Red outcomes / total = 2/5 = 2/5.

Answer: 2/5

Mistakes to recognize

- Check whether all counted outcomes are equally likely.
- A conditional denominator contains only the restricted group.
- Do not treat mutually exclusive events as independent automatically.

A quick understanding check

Why does a conditional probability have a different denominator?

Explanation: The given condition narrows the set of possible outcomes.

MORE PRACTICE IN YOUR DASHBOARD

Open prepvora.com/app/ and use the SAT question bank. Work on Problem-Solving and Data Analysis, then look for probability questions. Solve independently before reviewing the explanation. Use this guide for the theory; use the dashboard for a longer practice session.

Open your dashboard → | Explore the resource library →

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