GENERAL

simple probability problems and solutions

Published: September 3, 2026 | Index ID: #-

Introduction

Probability is the mathematics of uncertainty, the tool that lets us quantify how likely an event is to occur. Whether you're a student preparing for a test, a data analyst predicting market trends, or just a curious mind wanting to understand the odds of flipping a coin, probability offers a clear framework for reasoning about chance. In this article, we'll focus on **simple probability problems and solutions**, breaking down common scenarios into step by step explanations that anyone can follow. By mastering these fundamentals, you'll build a strong foundation that will make tackling more complex problems feel effortless.

Understanding Probability Basics

What Is Probability?

In its simplest form, probability measures the likelihood of an event occurring relative to all possible outcomes. The probability of an event *E* is denoted as *P(E)*and is calculated by dividing the number of favorable outcomes by the total number of possible outcomes:

- Number of favorable outcomes
- Number of possible outcomes

Mathematically, **P(E) = (favorable outcomes) ÷ (total outcomes)**. The result is a value between 0 and 1, where 0 means the event will never happen and 1 means it is certain to happen.

Key Terms

- Experiment: Any process that produces outcomes.
- Sample Space (S): The set of all possible outcomes of an experiment.
- Event (E): A subset of the sample space.
- Complementary Event (Ec): The event that does not occur.
- Independent Events: Two events that do not influence each other's outcomes.
- Dependent Events: Two events where the outcome of one affects the other.

Simple Probability vs. Complex Probability

Simple probability problems involve straightforward calculations with clear, non overlapping events. Complex probability problems may involve multiple stages, conditional events, or advanced concepts like Bayes' theorem. Mastering simple problems is essential because they teach the core logic that applies to all probability questions.

Why Simple Probability Problems Matter

Understanding simple probability problems equips you with the analytical tools needed for everyday decision making. From choosing the best route on a rainy day to estimating the risk of a new investment, probability helps you weigh options and choose wisely. Moreover, these problems sharpen your logical thinking, improve your ability to read data, and foster a scientific mindset that values evidence over intuition.

Common Types of Simple Probability Problems

Coin Tosses

A coin toss is the quintessential example of a fair experiment with two equally likely outcomes: heads or tails. The probability of getting heads is 0.5, and the probability of tails is also 0.5.

Dice Rolls

Standard six sided dice have outcomes 1 through 6, each with an equal chance of 1/6. Dice problems often involve calculating the probability of rolling a particular number, a range of numbers, or a sum when multiple dice are rolled.

Card Draws

A standard deck of 52 playing cards contains four suits and thirteen ranks. Problems can ask for the probability of drawing a specific card, a particular suit, or a combination of ranks.

Birthday Paradox

While seemingly counterintuitive, the birthday paradox shows that in a group of just 23 people, there's a better than 50% chance that at least two share the same birthday. This classic problem illustrates the power of combinatorial thinking.

Combinations & Permutations

These concepts help you count the number of ways to choose or arrange items. A **combination** counts selections without regard to order, while a **permutation**counts selections where order matters. They are crucial for calculating probabilities in many simple scenarios.

Step by Step Solutions

Problem 1: Coin Toss – Probability of Getting Heads

Question: If you flip a fair coin once, what is the probability of landing on heads?

Solution:

1. Identify the sample space: {Heads, Tails}
2. Count favorable outcomes: 1 (Heads)
3. Count total outcomes: 2
4. Apply the formula: P(Heads) = 1 ÷ 2 = 0.5

Answer: 0.5 or 50%.

Problem 2: Dice Roll – Probability of Rolling a Sum of 7 with Two Dice

Question: What is the probability that two six sided dice sum to 7?

Solution:

1. Determine the total number of possible outcomes: 6 × 6 = 36.
2. List favorable pairs that sum to 7: (1,6), (2,5), (3,4), (4,3), (5,2), (6,1). There are 6.
3. Apply the formula: 6 ÷ 36 = 1 ÷ 6 "H 0.1667.

Answer: Approximately 16.67%.

Problem 3: Card Draw – Probability of Drawing an Ace

Question: If you draw one card from a standard deck, what is the probability it's an Ace?

Solution:

1. Sample space: 52 cards.
2. Favorable outcomes: 4 Aces.
3. Probability: 4 ÷ 52 = 1 ÷ 13 "H 0.0769.

Answer: About 7.69%.

Problem 4: Birthday Paradox – Probability of Shared Birthday in a Group of 30

Question: In a room of 30 people, what is the probability that at least two share a birthday?

Solution:

1. Assume 365 days in a year and ignore leap years.
2. Compute the probability that all birthdays are unique: (365/365) × (364/365) × … × (336/365).
3. Use a calculator or approximation: "H 0.293.
4. Subtract from 1 to get the probability of at least one match: 1 – 0.293 = 0.707.

Answer: Roughly 70.7% chance of a shared birthday.

Problem 5: Combinations – Choosing 3 Students from 10 for a Project

Question: How many ways can you select 3 students from a class of 10?

Solution:

1. Use the combination formula: C(n, k) = n! / [k!(n–k)!].
2. Plug in values: C(10, 3) = 10! / [3! × 7!] = 120.

Answer: 120 different groups.

Tips for Solving Probability Problems

- Visualize the Experiment: Sketch a tree diagram or use a table to map out all possible outcomes.
- Check for Overlap: Ensure events are mutually exclusive if you're summing probabilities.
- Use Complementary Events: Sometimes it's easier to calculate the probability of the opposite event and subtract from 1.
- Apply the Multiplication Rule for independent events: P(A and B) = P(A) × P(B).
- Use Conditional Probability when one event depends on another: P(A|B) = P(A and B) ÷ P(B).
- Double Check Units: Probabilities should always be between 0 and 1.

Practice Problems with Solutions

Solution: There are C(3,2) = 3 ways to choose which two flips are heads. Each sequence has probability (0.5)^3 = 0.125. Multiply: 3 × 0.125 = 0.375.

Problem:A bag contains 4 red, 5 blue, and 6 green marbles. If you draw one marble, what is the probability it is blue?

Solution: Total marbles = 4+5+6 = 15. P(blue) = 5 ÷ 15 = 1 ÷ 3 "H 0.333.

Problem: Two dice are rolled. What is the probability of rolling an even number on the first die and an odd number on the second die?

Solution: P(even on first) = 3/6 = 0.5. P(odd on second) = 3/6 = 0.5. Multiply: 0.5 × 0.5 = 0.25.

Problem: From a standard deck, draw two cards without replacement. What is the probability that both are kings?

Solution: First draw: 4/52 = 1/13. Second draw: 3/51. Multiply: (1/13) × (3/51) "H 0.0045.

Problem: A group of 5 people is randomly seated in a row. What is the probability that Alice sits next to Bob?

Solution: Treat Alice and Bob as a pair: 4! = 24 arrangements for the pair and the other 3 people. There are 2 ways for Alice and Bob to be arranged within the pair. Total favorable arrangements: 24 × 2 = 48. Total arrangements: 5! = 120. Probability: 48 ÷ 120 = 0.4.

Problem:A spinner is divided into 8 equal sectors labeled 1–8. What is the probability of landing on a number greater than 5?

Solution: Numbers >5: 6, 7, 8 !’ 3 outcomes. Probability: 3 ÷ 8 = 0.375.

Problem: A class has 12 boys and 8 girls. If a student is selected at random, what is the probability it is a girl?

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