MATHEMATICS · GRADES 10-12

Addition and multiplication rules of probability

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you work out your real chances in a card game, a raffle, or a sports draw. You need one rule when you want one thing or another to happen (see Probability of Complementary Events), and a different rule when you need both to happen together. Knowing which rule fits the question stops you from guessing at odds that are actually easy to work out.

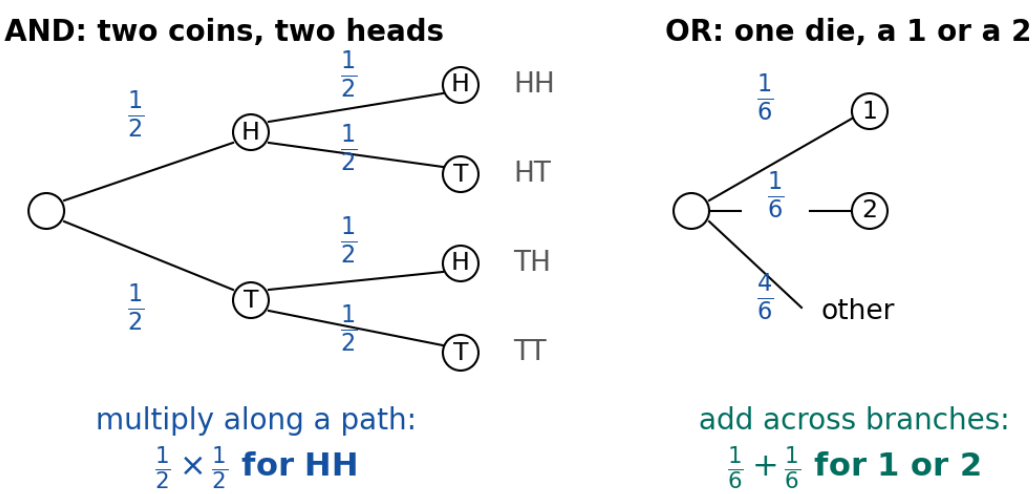


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Worked examples

EXAMPLE 1

Q One die is rolled. Use the addition rule for a 1 or a 2.



AND means multiply along one path. OR means add across branches.

SOLUTION

A die has six faces, so the chance of rolling a 1 is one face out of six: $\frac{1}{6}$. The chance of rolling a 2 is the same: $\frac{1}{6}$

These are mutually exclusive, which means one roll cannot show both a 1 and a 2 at the same time, so the two chances add: $\frac{1}{6} + \frac{1}{6}$

That gives $\frac{2}{6}$. Divide the top and bottom by 2 to simplify: $\frac{2}{6} = \frac{1}{3}$

So the answer is $\frac{1}{3}$

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EXAMPLE 2

Q Two coins are tossed. Use the multiplication rule for two heads.

SOLUTION

Each coin has two sides, so the chance of heads on one toss is one side out of two: $\frac{1}{2}$

The tosses are independent, which means one toss does not affect the other, so the chances multiply: $\frac{1}{2} \times \frac{1}{2}$

That gives $\frac{1}{4}$

So the answer is $\frac{1}{4}$

Practice questions

1 Two coins are tossed. What is the chance of two tails?

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2 A bag holds 3 red marbles and 2 blue marbles. What is the chance of picking a red marble or a blue marble?

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3 State the addition rule for mutually exclusive events.

A. P(A or B) = P(A) × P(B)

B. P(A or B) = P(A) + P(B)

C. P(A or B) = P(A) – P(B)

D. P(A or B) = P(A) ÷ P(B)

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4 State the multiplication rule for independent events.

- **A** P(A and B) = P(A) + P(B)
- **B** P(A and B) = P(A) – P(B)
- **C** P(A and B) = P(A) × P(B)
- **D** P(A and B) = P(A) ÷ P(B)

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5 Two dice are rolled. What is the chance the total is 7?

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6 One card is drawn from a deck. What is the chance of a queen or a jack?

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7 A coin is tossed and a die is rolled. What is the chance of heads and a 6?

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8 One die is rolled. What is the chance of an even number?

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9 Three coins are tossed. What is the chance of three heads?

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When do you add probabilities, and when do you multiply?

A. Multiply for or, when the events are mutually exclusive; add for and, when the events are independent

B. Add for and, when the events are independent; multiply for or, when the events are mutually exclusive

C. Add for or, when the events are independent; multiply for and, when the events are mutually exclusive

D. Add for or, when the events are mutually exclusive; multiply for and, when the events are independent

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ANSWER KEY

1. $\frac{1}{4}$

2. 1

3. P(A or B) = P(A) + P(B)

4. P(A and B) = P(A) × P(B)

5. $\frac{1}{6}$

6. $\frac{2}{13}$

7. $\frac{1}{12}$

8. $\frac{1}{2}$

9. $\frac{1}{8}$

10. Add for or, when the events are mutually exclusive; multiply for and, when the events are independent

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