MATHEMATICS · GRADES 10-12

Conditional probability

Difficulty level: Advanced

Mathematics: Grades 10-12

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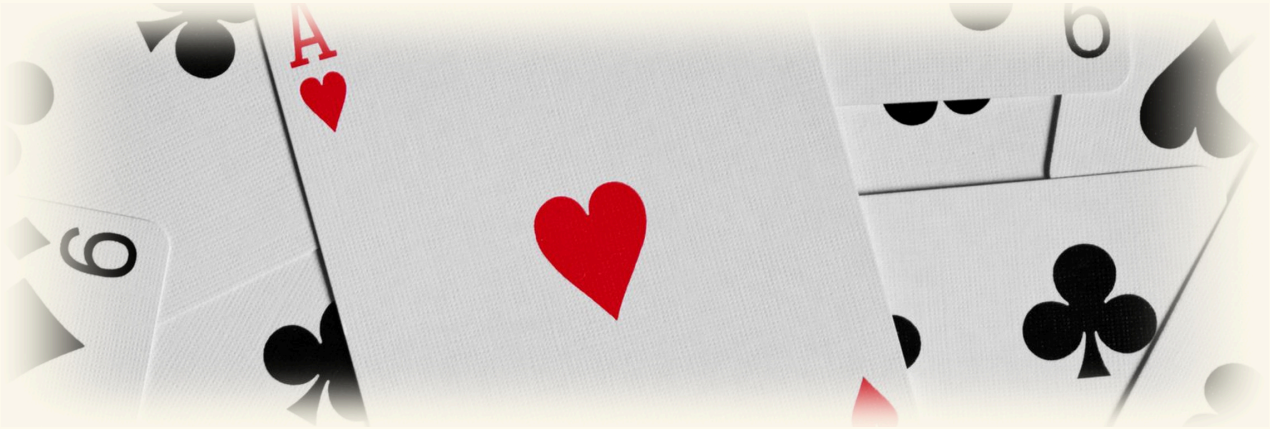
Overview of the concept

This is how you work out a chance once you already know something. The chance a card is an ace when you know it is red is different from the chance it is an ace with no information at all. New information changes the odds, and conditional probability is how you update them properly instead of guessing.



Rule

Conditional probability: P(A given B) equals $\frac{\text{P(A and B)}}{\text{P(B)}}$.

Knowing B has happened shrinks the sample space to only the outcomes where B happens. The chance of A is then counted inside that smaller space.

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Worked examples

EXAMPLE 1

Q Two dice are rolled. Given that the first die shows 6, what is the chance the total is 10?

SOLUTION

6 + ___ = 10

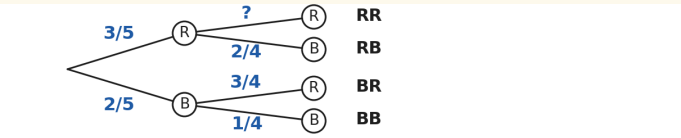
___ = 4

The second die has 6 equally likely faces.

Chance = $\frac{1}{6}$

EXAMPLE 2

Q A bag has 3 red and 2 blue balls. One red ball is drawn and kept. What is the chance the next ball is red?



SOLUTION

3 – 1 = 2 red

2 + 2 = 4 balls in total

Chance of red next = $\frac{2}{4}$

Chance = $\frac{1}{2}$

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Practice questions

1 Two coins are tossed. Given one is heads, what is the chance both are heads?

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2 A card is drawn from a deck. Given it is red, what is the chance it is a heart?

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3 State the conditional probability formula.

A $P(A \text{ given } B) = P(A) \times P(B)$

B $P(A \text{ given } B) = \frac{P(A \text{ and } B)}{P(A)}$

C $P(A \text{ given } B) = \frac{P(A \text{ and } B)}{P(B)}$

D $P(A \text{ given } B) = \frac{P(B)}{P(A \text{ and } B)}$

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4 A bag has 4 red and 6 blue balls. One blue is drawn and kept. What is the chance the next is blue?

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5 **Two dice are rolled. Given the total is 7, what is the chance the first die is 3?**

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6 **What does P(A given B) mean?**

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7 **Two coins are tossed. Given that the first coin is heads, what is the chance both are heads?**

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8 A die is rolled. Given the result is even, what is the chance it is 6?

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9 A bag has 5 red and 5 blue balls. One red is drawn and kept. What is the chance the next is red?

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10 Why does the sample space shrink in conditional probability?

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ANSWER KEY

1. $\frac{1}{3}$

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

3. $P(A \text{ given } B) = \frac{P(A \text{ and } B)}{P(B)}$

4. $\frac{5}{9}$

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

6. The chance of A happening, given that B has happened

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

8. $\frac{1}{3}$

9. $\frac{4}{9}$

10. Because outcomes that contradict what is known are no longer possible

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