

Probability Reference

Probability basics

Probability measures how likely an event is. An experiment produces outcomes; the sample space lists every possible outcome, and an event is a chosen set of outcomes. Every probability is from 0 to 1. Impossible events have probability 0, certain events have probability 1, and $P(\text{not } A) = 1 - P(A)$.

For a fair die, the sample space is {1, 2, 3, 4, 5, 6}.



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Equally likely outcomes

When all outcomes are equally likely, $P(A) = \text{favorable outcomes} / \text{total outcomes}$. Check this assumption before counting.

For an even result on a fair die: $3/6 = 1/2$.

$$3 / 6 = 1/2$$

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Independent events

Events are independent when one result does not change the probability of the next. Multiply probabilities along a specified sequence.

Three heads in three fair tosses: $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$.

$$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$$

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Dependent events

Without replacement, the first draw changes the available outcomes. Use the new conditional count on the second draw. Replacement restores the original sample space.

From a bag with 4 blue and 2 red counters, $P(\text{red then blue without replacement}) = \frac{2}{6} \times \frac{4}{5} = \frac{4}{15}$.

$$P(A) \times P(B | A)$$

$$\frac{1}{3} \times \frac{4}{5} = \frac{4}{15}$$

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Probability trees

A tree shows every branch in order. Multiply along each path; mutually exclusive complete path probabilities add to 1.

Two draws without replacement from 4 blue and 2 red: RR=1/15, RB=4/15, BR=4/15, BB=2/5; the four paths total 1.

