I flip a coin 100 times, and it shows heads every time. *Question:* What is the probability that it will show heads on the next flip?

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Probability \neq *Statistics*

Probability: mathematical theory that describes uncertainty

Statistics: set of techniques for extracting useful information from data

Frequency

The probability that the outcome of an experiment is A is P(A)

if the experiment is performed a large number of times and the fraction of times that the observed outcome is A is P(A).

The probability that the outcome of an experiment is A is P(A)

if the experiment is performed in each parallel universe and the fraction of universes in which the observed outcome is A is P(A).

Interpretations of probability

State of belief

The probability that the outcome of an experiment is A is P(A)

if that is the opinion of an observer *before* the experiment is performed.

Interpretations of probability

Abstract measure

The probability that the outcome of an experiment is A is P(A)

if P() satisfies a set of conditions.

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Interpretations of probability

Abstract measure

Axioms of probability

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Let U be a set of samples. Let E, E_1, E_2, \dots be subsets of S.

- $ullet 0 \leq P(E) \leq 1$
- $\bullet P(U) = 1$
- If $E_i \cap E_j$ is the null set, then $P(E_i \cup E_j) = P(E_i) + P(E_j)$