Lecture 2: Basics of Probability Theory

Professor Ilias Bilionis

Interpretation of probability

PREDICTIVE
SCIENCE LABORATORY

Knowledge-based interpretation

The probability of 

= how sure I am about the outcome of a coin toss experiments given all the information I have about the initial conditions of the tossing process

Arguing logical/scientific propositions

- A: a logical sentence
- B: another logical sentence
- I: all the information we know

No other restriction apart that A and B are not contradictions.

Notation shortcuts

not $A \equiv \neg A$

A **and** $B \equiv A, B \equiv AB$

A **or** $B \equiv A + B$

Talking about probabilities

$p(A \mid BI) =$ the probability of A being true given that we know that B and I are true

or (assuming I is implied)

$=$ the probability of A being true given that we know that B is true

or (assuming arguments about truth are implied)

$=$ the probability of A given B

Interpretation

$$p(A \mid B, I) \text{ in } [0,1]$$

quantifying the degree of plausibility that A is true given that B and I are true.

$p(A \mid B, I) = 1$ we are certain that A is **true** if B is true (and I)

$p(A \mid B, I) = 0$ we are certain that A is **false** if B is true (and I)

$0 < p(A \mid B, I) < 1$ we are uncertain about A if B is true (and I)

$p(A \mid B, I) = \frac{1}{2}$ we are completely ignorant about A if B is true (and I)