Science Dynamics Masterclass

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Research Labs, Proverbs, a.s.

7 - Probability Fundamentals

Probability

$$P(E) = \frac{Number\ of\ Outcomes\ Satisfying\ E}{Total\ Number\ of\ Outcomes\ of\ the\ Experiment}$$

Probability

Probability

or degree of certainty - of the relative frequency of an event

Complement Rule of Probability

$$P(E_1) = 1 - P(E_2)$$

Complement Rule of Probability

Complement...

if there are no possible outcomes in common (OR male OR female etc...)

events are mutually exclusive or disjoint

Events Can Be

Events Can Be

- **independent and not mutually exclusive**
- **not independent and mutually exclusive**
- **not independent and not mutually exclusive**

Independence

Independence

they have no effect on each other and probability of each event does not depend on whether or not the other event has occurred

Mutual exclusiveness

Mutual exclusiveness

one even cannot be turned into the other state (male/female) etc.

Additive Rules of Probability

Additive Rules of Probability

$$P(E_1 or E_2) = P(E_1) + P(E_2)$$

First Additive rule of Probability

First Additive...

when two events are mutually exclusive we seek probability of E1 OR E2 by adding them together. This rule holds for more than two events it all are pairwise disjoint

$$P(E_1 or E_2) = P(E_1) + P(E_2) - P(E_1\ and\ E_2)$$

Second Additive Rule of Probability

Second Additi...

if both are mutually disjoint, we get the same result, but this one is more general -

Multiplicative Rule of Probability

$$P(E_1 and E_2) = P(E_1).P(E_2)$$

Multiplicative Rule of Probability

Multiplicative...

if experiment satisfies both E1 AND E2, events are INDEPENDENT

sampling with replacement

sampling with...

first event was replaced before second event occurred (measured a student from a data set and then again the same set was used to select again)

Examples

Examples

the first student expects, the second expects... p(E1)*PE(2)

Conditional Probability

$$P(E_1|E_2) = \frac{P(E_1 and E_2)}{P(E_2)}$$

Conditional Probability

Conditional Probability

e.g. - student is male|never smoked marijuana) doesn't equal to (a student never smoked marijuana|student is male) - those are equal only if PE1=PE2

"|" sign

"|" sign

denoting the probability of an event E1 given that an event E2 has occurred we write P(E1|E2)

The Law of Large Numbers

The Law of Large Numbers

The Law of...

the larger the number of trials, the better approximation of the relative frequency of E we get (p)