

IV. X. Probability Distinctions Between Probability Classifications

PROBABILITY CLASSIFICATIONS

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The typical course in probability and statistics devotes a section or chapter each to mutually exclusive events, independent events, and conditional probability. Distinctions between these may be lost. This outline may help.

From the "Queen of Hearts" Formula, $P(A \text{ or } B) = P(A) + P(B) - \mathbf{P(A \text{ and } B)}$
or $P(A \cup B) = P(A) + P(B) - \mathbf{P(A \cap B)}$,
we can make correct distinctions for classifying probability situations.

Mutually exclusive events cannot happen at the same time. Example: let

A: The event of being in Idaho at noon next Friday.

B: The event of being in Cuba at noon next Friday.

What is the probability of either event coming true?

Effect on main formula: $\mathbf{P(A \text{ and } B) = 0}$; $\mathbf{P(A \cap B) = 0}$

So $P(A \cup B) = P(A) + P(B) - 0 = P(A) + P(B)$

Independent events happen at the same time *by chance*. Example: let

A: The event of a rabbit eating 2 gm. of clover.

B: The event of a 2 gm. meteor striking Mars.

What is the probability of either event coming true?

Effect on main formula: $\mathbf{P(A \text{ and } B) = P(A) \cdot P(B)}$; $\mathbf{P(A \cap B) = P(A) \cdot P(B)}$

$P(A \cup B) = P(A) + P(B) - P(A) \cdot P(B)$

Dependent events happen together due to some cause-effect relationship.

"The happier the campus, the more students want to attend."

(How much more? Somebody needs to investigate...)

Example: let A: The event that more students attend your University.

B: The event that your University is a happy place.

Effect on main formula: $\mathbf{P(A \text{ and } B) > 0}$; $\mathbf{P(A \text{ and } B) \neq P(A) \cdot P(B)}$

The main formula $P(A \cup B) = P A + P B - P A \cap B$ is still good. The value of $P A \cap B$ has to be obtained by some experience. It is neither zero, like mutually exclusive events, nor is it $P(A) \cdot P(B)$, like independent events.

Conditional probability is the probability that an event will occur given that another related event has already occurred.

Example: Find probability that a chosen poker-deck card is a king K, given that aces and all other cards with values two through ten have been eliminated.

Most conditional probability questions can be solved by restricting the sample space. This shrinks the denominator.

If needed, here's a formula:

$$P(K \text{ given restriction}) = \frac{P \text{ K \& restriction}}{P \text{ restriction}}$$