

Basic Probability Formulas

Complementary events: The complement of event A is everything not in A. Complementary events are mutually exclusive events and together make up the sample space. The probability of the sample space is one.

Independent events: The occurrence of any one of the events does not affect the probabilities of the occurrences of the other events. Events A and B are independent if probability of A given B equals probability of A.

Dependent events (or non-independent events): Events that are not independent, i.e., $P(A \text{ given } B) \neq P(A)$.

Mutually exclusive events (or disjoint events): If event A occurs, then event B cannot occur, and conversely.

De Morgan's Rule (one form): Via a double complement, $A \text{ or } B = (A^c \text{ and } B^c)^c = \text{"not [(not A) and (not B)]"}$. For example, "I want A, B, or both to work" (Reliability) equates to "I do not want both A and B not to work" (Safety).

Event	Details	Formula (from English to mathematical operations)
A	Probability of A, $P(A)$	$P(A)$ is at or between zero and one: $0 \leq P(A) \leq 1$
not A, A^c	A^c is the complement of A	Probability of not A = $P(A^c) = 1 - P(A)$
A and B	A and B are independent events	$P(A \text{ and } B) = P(A)*P(B)$
	A and B are dependent events	$P(A \text{ and } B) = P(A)*P(B A) = P(B)*P(A B)$ as 2 forms
	A and B are mutually exclusive events	$P(A \text{ and } B) = 0$
A or B	A and B are independent events	$P(A \text{ or } B) = P(A) + P(B) - P(A)*P(B)$ conveniently expands to $= 1 - [1 - P(A)]*[1 - P(B)]$ or is obtained from De Morgan's Rule
	A and B are dependent events	$P(A \text{ or } B) = P(A) + P(B) - P(A)*P(B A)$ as 1 of 2 forms
	A and B are mutually exclusive events	$P(A \text{ or } B) = P(A) + P(B)$
A given B, $A B$	<u>Conditional</u> : outcome of A given B has occurred	$P(A \text{ given } B) = P(A B) = P(A)*P(B A) / P(B)$ [Bayes' Thm] To make this formula, solve the 2 forms in "A and B" for $P(A B)$