MATH 186: CH. 7 - PROBABILITY

Key Probability Definitions and Notation

A **simple event** is a unique possible outcome of a random circumstance.

The **sample space** for a random circumstance is the collection of all simple events.

A **compound event** is an event that includes two or more simple events.

An **event** is any collection of one or more simple events in the sample space; events can be simple events or compound events.

Events are often written using capital letters A, B, C, and so on, and their probabilities are written as $P(A)$, $P(B)$, $P(C)$, and so on.

One event is the **complement** of another event if the two events do not contain any of the same simple events *and* together they cover the entire sample space. For an event A, the complement is denoted A^c.

Two events are **mutually exclusive** if they do not contain any of the same simple events (outcomes); that is, the two events cannot occur simultaneously. We also say two such events are **disjoint**.

Two events are **independent** of each other if knowing that one will occur (or has occurred) does not change the probability that the other occurs.

Two events are **dependent** if knowing that one will occur (or has occurred) changes the probability that the other occurs.

The **conditional probability of the event B, given that the event A has occurred or will occur**, is the long-run relative frequency with which event B occurs when circumstances are such that A has occurred or will occur. We denote this as $P(B|A)$.

Probabilities are always between 0 and 1 and the sum of the probabilities over all possible simple events is 1.

Probability Rules

Simple Probability:

$$P(A) = \frac{|A|}{|S|}$$

where $|A|$ is the number of ways event A can occur and $|S|$ is the total number of events in the sample space.

Complementary Events:

$$P(A^c) = 1 - P(A)$$

Addition and Multiplication Rules:

When Events Are:	$P(A \text{ or } B)$ is:	$P(A \text{ and } B)$ is:	$P(A\|B)$ is:
Mutually Exclusive	$P(A) + P(B)$	0	0
Independent	$P(A) + P(B) - P(A)P(B)$	$P(A)P(B)$	$P(A)$
Any	$P(A) + P(B) - P(A \text{ and } B)$	$P(A)P(B\|A)$	$\frac{P(A \text{ and } B)}{P(B)}$

Bayes' Rule:

$$P(A|B) = \frac{P(A \text{ and } B)}{P(B|A)P(A) + P(B|A^c)P(A^c)}$$