Chapter 4.3 Addition Rule

Events A and B are **Mutually Exclusive** (disjoint) if they cannot occur at the same time.

<table>
<thead>
<tr>
<th>Ex.</th>
<th>A = choosing a red card</th>
<th>B = choosing a king</th>
<th>A and B are not Mutually Exclusive since a card can be a red king.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A = choosing an ace</td>
<td>B = choosing a king</td>
<td>A and B are Mutually Exclusive since a card cannot be an ace and a king</td>
</tr>
</tbody>
</table>

**Addition Rule**

\[
P(A \text{ or } B) = P(A) + P(B) - (A \text{ and } B)
\]

\[P(A \text{ and } B) = 0 \text{ if and only if } A \text{ and } B \text{ are mutually exclusive.}
\]

Ex. Draw one card from a standard deck, find the following:

a. The probability the card is a 7.

\[
P(7) = \frac{4}{52} = \frac{1}{13}
\]

b. The probability the card is a 7 or a heart.

\[
P(7 \text{ or heart}) = P(7) + P(\text{heart}) - P(7 \text{ and heart})
\]

\[
= \frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13}
\]

c. The probability the card is a 7 or a jack.

\[
P(7 \text{ or jack}) = P(7) + P(\text{jack}) - P(7 \text{ and jack})
\]

\[
= \frac{4}{52} + \frac{4}{52} - 0
\]

\[
= \frac{8}{52}
\]

\[
= \frac{2}{13}
\]

The **complement** of event A, denoted $\overline{A}$, is all outcomes in which A does not occur.

\[
P(\overline{A}) = 1 - P(A)
\]

Ex. Toss a pair of dice, find the probability the sum is not 12.

There are 36 outcomes from tossing a coin and only 1 (66) has a sum of 12.

\[P(\text{sum is not 12}) = 1 - P(\text{sum is 12}) = 1 - \frac{1}{12} = \frac{35}{36}
\]