Pointers Section 5.2

Addition Rule for Disjoint Events

Two events are **disjoint** if both cannot both occur at the same time. For example, if we are drawing a card from a deck of playing cards then the events "The card is a Heart" and "The card is a Diamond" are disjoint events because a card cannot be both a Heart and a Diamond.

We use the addition rule when we want to find the probability of "A or B" occurring.

$$P(A \text{ or } B) = P(A) + P(B)$$

General Addition Rule

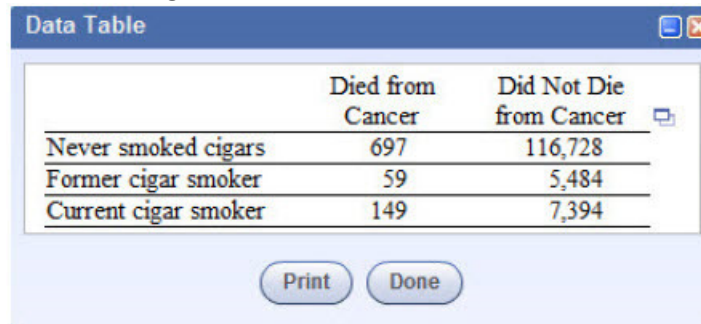We use the General Addition rule when events are not disjoint.

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

The basic idea is that we subtract out the probability that we counted twice when adding P(A) and P(B) together.

If we want to find the probability that a card is a King or a Spade, add up all of the Kings (4) and all of the Spades (13), then subtract all of the cards that are Kings AND Spades (1 – namely the King of Spades).
P(King or Spade) = P(King) + P(Spade) – P(King and Spade) = 4/52 + 13/52 – 1/52 = 16/52 or 4/13

A common problem involves working with a table like this.

Data Table		
	Died from Cancer	Did Not Die from Cancer
Never smoked cigars	697	116,728
Former cigar smoker	59	5,484
Current cigar smoker	149	7,394

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- To find the probability that a person died from cancer, add up all of the people who died from cancer (left column) and divide by the total of all values in the table.

- To find the probability that a person was a current cigar smoker, add up all of the people who were current cigar smokers (bottom row) and divide by the total number of people in the table.

- To find P(dies from cancer **AND** cigar smoker), look for where those two groups cross. That value will be your numerator. The denominator is the total number of people in the table.

- To find P(dies from cancer **OR** cigar smoker), add up all of the people who died from cancer and the people who were cigar smokers, then subtract the people that were in both groups at the same time.
  That value will be your numerator. The denominator is the total number of people in the table.
  (This is an application of the General Addition rule.)

Complement Rule
The complement of an event is made up of all the possible outcomes that are not included in the event.
- The complement of the set of females is the set of males.
- The complement of the group of people who are 30 or over is the group of people who are younger than 30.
- The complement of the group of Democrats is the group of non-Democrats.

Basically, you can think of the complement as the opposite or reverse of an event.
The complement of event A is written as A^C.

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

If you know that the probability of rain tomorrow is 0.3, then the probability of no rain is $1 - 0.3$ or 0.7. This is because "Rain" and "No Rain" are complements.