Section 4.2 - Addition and Multiplication Rules

The **union** of the two events *A* and *B*, written $A \cup B$, is the event that *A* occurs or *B* occurs or both occur. Unions are often expressed in words by saying "*A* or *B*."

The **intersection** of the two events *A* and *B*, written $A \cap B$, is the event that both *A* and *B* occur. Intersections are often expressed in words by saying "*A* and *B*."

The sets *A* and *B* are said to be **disjoint** if $A \cap B$ is an impossible event, i.e. the intersection is the empty set.

The following very important probability rule relates unions and intersections of events: For any events *A* and *B*,

$$P(A \cup B) = P(A) + P(B) - P(A \cap B).$$

If A and B are disjoint, then $P(A \cap B) = 0$, and the rule becomes much simpler: For disjoint events *A* and *B*,

$$P(A \cup B) = P(A) + P(B).$$

Up to now, we have been thinking of events as being associated with single, 1-stage, experiments. It is often convenient to think of certain complicated experiments as a sequences of single-stage experiments.

For example...

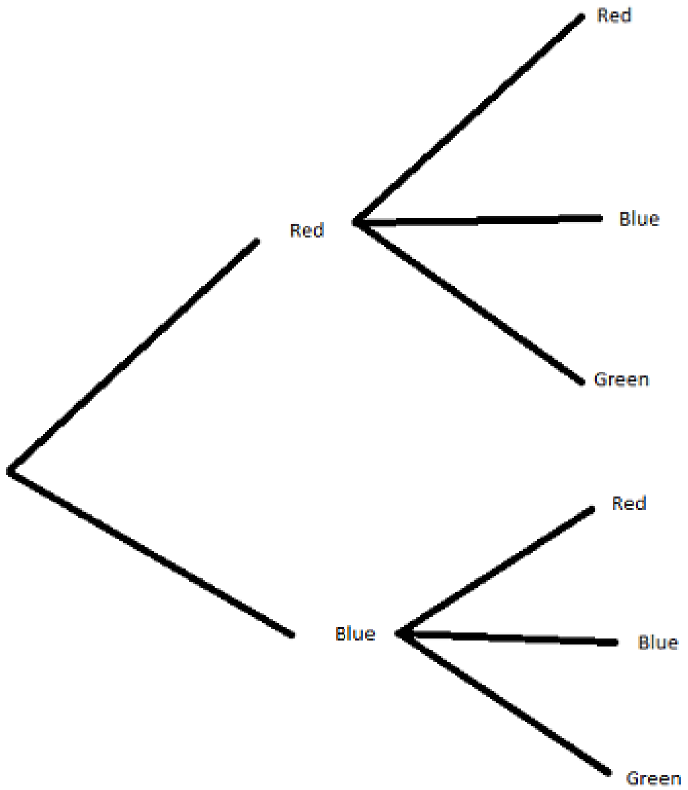
Jar 1 contains 4 red marbles and 7 blue marbles. Jar 2 contains 1 red marble, 3 blue marbles, and 4 green marbles. A single marble is selected at random from each jar.

This complicated probability experiment is best thought about in two stages:

Stage 1 - Select a marble from Jar 1

Stage 2 - Select a marble from Jar 2

Here is the tree diagram for the two-stage experiment. Determine the probability of each branch.



Multiplication Rule: For a tree diagram associated with a multi-stage experiment, the probability of a given path is the product of the probabilities along the branches.

Suppose a marble is selected from Jar 1 and placed into Jar 2. Then a marble is selected from Jar 2. How does the probability tree diagram change?