Math 140: General Multiplication Rule

Probabilities involving "AND" continued

Independent events revisited:

1. Consider drawing two cards (one at a time) from a deck of cards **with replacement**. Let K_{1st} be the event of "drawing a King the first time" and K_{2nd} be the event of "drawing a King the second time". Find:

   $P(K_{2nd}) =$

   $P(K_{2nd}|K_{1st}) =$

Event A and B are independent if and only if:

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2. Consider drawing two cards (one at a time) from a deck **without replacement**. Let K_{1st} be the event of "drawing a King the first time" and K_{2nd} be the event of "drawing a King the second time". Find:

   $P(K_{2nd}|K_{1st}) =$

General Multiplication Rule

The probability that two events A and B will occur in sequence is

$$P(A \text{ and } B) = P(A) \cdot P(B|A).$$

If events A and B are independent, then the rule can be simplified to

$$P(A \text{ and } B) = P(A) \cdot P(B).$$

Example 1. In a survey, 510 adults were asked if they drive a pickup truck and if they drive a Ford. The results showed that one in six adults surveyed drives a pickup truck, and three in ten adults surveyed drive a Ford. Of the adults surveyed that drive Fords, two in nine drive a pickup truck.

1. Find the probability that a randomly selected adult drives a pickup truck, **given** that the adult drives a Ford.

2. Are the events "driving a Ford" and "driving a pickup truck" independent or dependent? Explain.

3. Find the probability that a randomly selected adult drives a Ford pick up truck.

Using Tree Diagrams

The kind of picture that helps us look at conditional probabilities and multiplication rule for dependent events is called a **tree diagram**.

Example 2. According to a study 44% of college students engage in binge drinking, 37% drink moderately, and 19% abstain entirely. Another study finds that among binge drinkers, 17% have been involved in an alcohol-related automobile accident, while among non-bingers of the same age, only 9% have been involved in such accidents.

1. Build a tree diagram with corresponding probabilities on each possible outcome.

2. What's the probability that a randomly selected college student will be a binge drinker **and** has had an alcohol-related car accident?

3. What's the probability that a randomly selected college student will have an alcohol-related car accident **given** they are a moderate drinker?

4. What's the probability that a randomly selected college student will be a moderate drinker **and** has had no alcohol-related car accident?