Multiplication Rule → multiple drawings

Used to find the probability of event A AND then event B occuring.

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

(B|A) ← given

Where $P(B|A)$ equals $P(B)$ if A and B are independent.

Independent Events : Events that have no effect on each others outcomes.

Ex. 1 What is the probability of landing a coin on heads and getting an odd number when rolling a six sided die?

$$P(\text{Heads and Odd}) = P(\text{Heads}) \cdot P(\text{odd})$$

$$\frac{1}{2} \cdot \frac{3}{6} = \frac{3}{12} = \frac{1}{4}$$

Ex. 2 A committee consists of four women and three men. The committee will randomly select two people to attend a conference in Hawaii. Find the probability that both are women

$$P(W \text{ and } W) = P(W) \cdot P(W|W)$$

$$\frac{4}{7} \cdot \frac{3}{6} = \frac{2}{7}$$

Ex. 3 What is the probability that a king will be drawn at random from a deck of cards, then after replacing it drawing a king again? $\frac{4}{52} \cdot \frac{4}{52} = \frac{1}{169} \approx 0.0059$

Ex. 4 What is the probability of drawing a king, holding onto the card, then drawing another king?

$\frac{4}{52} \cdot \frac{3}{51} = \frac{1}{221} \approx 0.0045$

Conditional Probability

The probability of an event B happening GIVEN that event A already occurred.

given

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

If A and B are independent then $P(B|A)=P(B)$ and $P(A|B)=P(A)$.

Ex. 1 A jar contains black and white marbles. Two marbles are chosen without replacement. The probability of selecting a black marble and then a white marble is 0.34, and the probability of selecting a black marble on the first draw is 0.47. What is the probability of selecting a white marble on the second draw, given that the first marble drawn was black?

$P(B \text{ and } W) = 0.34$

$P(B) = 0.47$

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

$P(W|B) = \frac{0.34}{0.47} = 0.723 = 72.3\%$

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

Ex. 2 The probability that it is Friday and that a student is absent is 0.03. Since there are 5 school days in a week, the probability that it is Friday is 0.2. The probability that student is absent is 0.02. What is the probability that a student is absent given that the day is Friday?

$P(F \text{ and } A) = 0.03$

$P(F) = 0.2$

$P(A) = 0.02$

$$P(A|F) = \frac{P(F \text{ and } A)}{P(F)}$$

$$= \frac{0.03}{0.2} = 0.15 = 15\%$$