Theoretical Methods to Determine Probabilities

Learning Objective: Relate the probability of an event to the likelihood of this event occurring.

Determining Probability

There are two fundamental ways in which we can determine probability:

- Theoretical (also known as Classical)
- Empirical (also known as Observational)

Classical methods are used for games of chance, such as flipping coins, rolling dice, spinning spinners, roulette wheels, or lotteries.

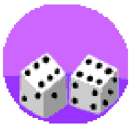
They are "classical" because their values are determined by the game itself.

Example: Flipping a Fair Coin

A coin has two sides; we usually call them "heads" and "tails." For a "fair" coin (one that is not unevenly weighted, and does not have identical images on both sides) the chances that a "flip" will result in either side facing up are equally likely. Thus, P(heads) = P(tails) = 1/2 or 0.5. Letting **H** represent "heads," we can abbreviate the probability: **P(H) = 0.5.**

Classical probabilities can also be used for more realistic and useful situations. A practical use of a coin flip would be for you and your roommate to decide randomly who will go pick up the pizza you ordered for dinner. A common expression is "Let's flip for it." This is because a coin can be used to make a random choice with two options. Many sporting events begin with a coin flip to determine which side of the field or court each team will play on, or which team will have control of the ball first.

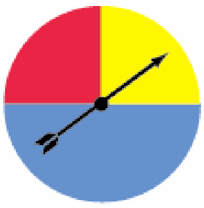
Example: Rolling Fair Dice



Each traditional (cube-shaped) die has six sides, marked in dots with the numbers 1 through 6. On a "fair" die, these numbers are equally likely to end up face-up when the die is rolled. Thus, P(1) = P(2) = P(3) = P(4) = P(5) = P(6) = 1/6 or about 0.167.

Here, again, is a practical use of classical probability. Suppose six people go out to dinner. You want to randomly decide who will pick up the check and pay for everyone. Again, the P(each person) = 1/6.

Example: Spinners



This particular spinner has three colors, but each color is not equally likely to be the result of a spin, since the portions are not the same size.

Since the blue is half of the spinner, P(blue) = 1/2. The red and yellow make up the other half of the spinner and are the same size. Thus, P(red) = P(yellow) = 1/4.

Suppose there are 2 freshmen, 1 sophomore, and one junior in a study group. You want to select one person. The P(F) = 2/4 = 1/2; P(S) = 1/4; and P(J) = 1/4, just like the spinner.

Example: Selecting Students

Suppose we had three students and wished to select one of them randomly. To do this you might have each person write his/her name on a (same-sized) piece of paper, then put the three papers in a hat, and select one paper from the hat without looking.

Since we are selecting randomly, each is equally likely to be chosen. Thus, each has a probability of 1/3 of being chosen.

A slightly more complicated, but more interesting, probability question would be to propose selecting 2 of the students pictured above, and ask, "What is the probability that the two students selected will be different genders?"
