

Resource Probability, Chance, Likelihood, and Odds

Probability

Sometimes, we use the word *risk* to talk about how likely it is that someone will get a disease. However, there are other words that can be used to describe this idea. In mathematics, we use **probability** to describe how likely it is that someone will get a disease. The formula for calculating a probability is shown:

$$\text{Probability of an event} = \frac{\text{Number of times the event occurs}}{\text{Number of times the event could occur}}$$

Mathematicians call the event “ E ”, and use “ P ” to represent probability of the event. Like this: $P(E)$

The parentheses are used differently in $P(E)$. They are not used as grouping symbols; instead, “ $P(E)$ ” is shorthand for the phrase: “the probability that E occurs.”

Example 1:

Here are the steps to calculate the probability of a woman being diagnosed with lung cancer in a year in the United States:

Number of women who get lung cancer: 110,110 women

Number of women in the United States: 116,289,249 women

$$\text{So, } P(\text{any woman getting lung cancer}) = \frac{110,110}{116,289,249} = 0.0009469$$

We read this statement as “the probability of any woman getting lung cancer is . . .”

Other words that are used to describe probability are **chance** and **likelihood**.

Odds

In the media, you often hear probability and odds used interchangeably. However, they are not the same thing! Odds are best stated as a ratio:

$$\text{Odds of an event} = \frac{\text{Number of times the event occurs}}{\text{Number of times the event does not occur}}$$

Example 1 continued:

So, the odds of a woman getting lung cancer are calculated as follows:

Number of women who got lung cancer: 110,110 women

Number of women who did not get lung cancer: 116,179,139 women

$$\text{Odds of a woman getting cancer} = \frac{110,110}{116,179,139} = \frac{0.0009487}{1}$$

Other ways to write this ratio are: 0.0009478 to 1 or **0.0009487:1**.

The odds of getting lung cancer are not very different from the probability of getting lung cancer. Let's look at a different example.

Example 2:

If we flip a coin, the probability of getting "heads" is:

$$P(\text{heads}) = \frac{\text{Number of heads}}{\text{Number of outcomes}} = \frac{1}{2}$$

The odds of getting "heads" are:

$$P(\text{heads}) = \frac{\text{Number of heads}}{\text{Number of "not heads"}} = \frac{1}{1}$$

We say "the odds of getting heads are 1 to 1."

Example 3:

Now suppose you have a jar with 5 marbles and 3 are green. You draw one marble from the jar.

The probability of drawing a green marble is $\frac{3}{5}$ or 60%.

The odds of drawing a green marble are 3 to 2.

Probabilities must be between 0 and 1. However, odds can be greater than 1, as in the example with the marbles. Probabilities can be expressed as a percentages, decimals, or ratios; odds are given as ratios.