

Probability versus Odds

In a non-statistical context over casual discussions and even in published articles, the terms “probability” and “odds” are often used interchangeably. But, it may be noted that although probability and odds are two basic statistic terms to describe the likeliness that an event will occur, they are not mathematically equivalent because we are looking at likeliness in different contexts. Let’s see their mathematical difference.

The probability is the fraction of desired outcomes in the context of every possible outcome, expressed as a number between 0 and 1 or in percentage. It is a measure of the likelihood of occurrence.

The odds however, are defined as the probability that the event will occur divided by the probability that the event will not occur. In other words, they represent a ratio of desired outcomes versus the rest. Mathematically, this is expressed as follows:

$$\text{Odds of event} = \frac{P}{1-P}$$

For instance, when we say “odds in favor”, we mean the odds describing if an event will occur.

To illustrate the difference between probability and odds, assume we have five blocks, one of which is shaded:



If we randomly selected a block, the odds would be 1 to 4 that it would be shaded because there are one shaded block and four white blocks. We may also write the odds as 1:4 ratio instead of 1 to 4.

In probability terms, the probability that a *randomly* selected block would be shaded is 1/5 or 20% since there is one shaded block out of five possible outcomes. Note that the keyword in the discussion of probability is “random”.

If someone says, “The odds are 1 *in* 5”, he or she is incorrectly using the term “odds”; “1 in 5” and “1 out of 5” are in fact probability statements.

Can we convert from one method to the other? The answer is “yes”.

If the odds are stated as A to B, the corresponding probability will be:

$$P = \frac{A}{A+B}$$

For this example, $A = 1$ and $B = 4$, and so $P = 1/(1+4) = 1/5$.

On the other hand, if we want to convert a probability to odds, we would use the following relationship:

$$P \text{ to } (1 - P)$$

For this example, $P = 1/5$, and so the odds would be written as

$$1/5 \text{ to } (1 - 1/5) \text{ or,}$$

$$1/5 \text{ to } 4/5.$$

By dividing both sides by the smaller value, i.e. $1/5$, we state that it is 1 to 4 odds.

It may be noted that odds usually are stated as integer numbers, often with one of the numbers being 1.