

## 10.12: Odds and Odds Ratios

The result in the last section showed that the likelihood that the individual has cancer based on a positive PSA test result is still fairly low, even though it's more than twice as big as it was before we knew the test result. We would often like to quantify the relation between probabilities more directly, which we can do by converting them into *odds* which express the relative likelihood of something happening or not:

$$\text{odds of } A = \frac{P(A)}{P(\neg A)}$$

In our PSA example, the odds of having cancer (given the positive test) are:

$$\text{odds of cancer} = \frac{P(\text{cancer})}{P(\neg \text{cancer})} = \frac{0.14}{1 - 0.14} = 0.16$$

This tells us that the odds are fairly low of having cancer, even though the test was positive. For comparison, the odds of rolling a 6 in a single dice throw are:

$$\text{odds of 6} = \frac{1}{5} = 0.2$$

As an aside, this is a reason why many medical researchers have become increasingly wary of the use of widespread screening tests for relatively uncommon conditions; most positive results will turn out to be false positives.

We can also use odds to compare different probabilities, by computing what is called an *odds ratio* - which is exactly what it sounds like. For example, let's say that we want to know how much the positive test increases the individual's odds of having cancer. We can first compute the *prior odds* - that is, the odds before we knew that the person had tested positively. These are computed using the base rate:

$$\text{prior odds} = \frac{P(\text{cancer})}{P(\neg \text{cancer})} = \frac{0.058}{1 - 0.058} = 0.061$$

We can then compare these with the posterior odds, which are computed using the posterior probability:

$$\text{odds ratio} = \frac{\text{posterior odds}}{\text{prior odds}} = \frac{0.16}{0.061} = 2.62$$

This tells us that the odds of having cancer are increased by 2.62 times given the positive test result. An odds ratio is an example of what we will later call an *effect size*, which is a way of quantifying how relatively large any particular statistical effect is.

---

This page titled [10.12: Odds and Odds Ratios](#) is shared under a [CC BY-NC 4.0](#) license and was authored, remixed, and/or curated by [Russell A. Poldrack](#) via [source content](#) that was edited to the style and standards of the LibreTexts platform.