

15.5.2

Assess Error in Hypothesis Testing

Jeremy is curious: what type of errors exist in hypothesis testing? He knows that the CEO will want to know all of the potential risks, so it's critical to get a handle on what errors could occur during this project phase.

In an ideal world, we would be able to definitively decide if our null hypothesis or alternative hypothesis was true by collecting all possible measurements or data points. But since this is often impossible, we must approximate truth using a subset of data.

In most cases, our approximations and hypothesis selection will be correct and represent the true real-world results. But due to the variability of data, at some point our hypothesis selection will be incorrect. Our incorrect hypothesis selection can fall into two categories:

- **Type I error** (also known as a **false positive** error)—an error in which we reject the null hypothesis when it is actually true. In other words, the observations and measurements used in our statistical test should have been attributed to random chance, but we attributed them to something else.
- **Type II error** (also known as a **false negative** error)—an error in which we fail to reject the null hypothesis when it is actually false. In other words, our analysis demonstrates that the observations were due to random chance, but they were not. The observations and measurements used in our statistical test failed to reflect an external force or influence to our problem.

While selecting the wrong hypothesis is never ideal, depending on our field of research or the importance of our proposed problem, one error type may be more problematic than the other.

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When it comes to limiting our type I and type II errors, there are two basic methods:

- A **type I error** can be limited by making your significance level smaller. A smaller significance level makes it harder to accidentally reject the null hypothesis when the data was truly random. This is also why our significance level (α or α) is sometimes referred to as our false positive rate.
- A **type II error** can be limited by increasing the power of the analysis. Although performing a power analysis is outside the scope of the course, power can be increased by adding additional measurements or observations to our analysis.

Now that we understand what a hypothesis test is, how to generate our hypothesis, and how to use the p-value to provide results and interpretations, we're ready to dive into our first statistical test.

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