7.3: The Null Hypothesis

The hypothesis that an apparent effect is due to chance is called the null hypothesis, written H_0 ("H-naught"). In the Physicians' Reactions example, the null hypothesis is that in the population of physicians, the mean time expected to be spent with obese patients is equal to the mean time expected to be spent with average-weight patients. This null hypothesis can be written as:

$$\mathrm{H}_0 : \mu_{\text{obese}} - \mu_{\text{average}} = 0 \tag{7.3.1}$$

The null hypothesis in a correlational study of the relationship between high school grades and college grades would typically be that the population correlation is 0. This can be written as

$$\mathrm{H}_0 : \rho = 0 \tag{7.3.2}$$

where ρ is the population correlation, which we will cover in chapter 12.

Although the null hypothesis is usually that the value of a parameter is 0, there are occasions in which the null hypothesis is a value other than 0. For example, if we are working with mothers in the U.S. whose children are at risk of low birth weight, we can use 7.47 pounds, the average birthweight in the US, as our null value and test for differences against that.

For now, we will focus on testing a value of a single mean against what we expect from the population. Using birthweight as an example, our null hypothesis takes the form:

$$\mathrm{H}_0 : \mu = 7.47$$

The number on the right hand side is our null hypothesis value that is informed by our research question. Notice that we are testing the value for μ, the population parameter, NOT the sample statistic $\overline{\mathrm{X}}$. This is for two reasons: 1) once we collect data, we know what the value of $\overline{\mathrm{X}}$ is – it's not a mystery or a question, it is observed and used for the second reason, which is 2) we are interested in understanding the population, not just our sample.

Keep in mind that the null hypothesis is typically the opposite of the researcher's hypothesis. In the Physicians' Reactions study, the researchers hypothesized that physicians would expect to spend less time with obese patients. The null hypothesis that the two types of patients are treated identically is put forward with the hope that it can be discredited and therefore rejected. If the null hypothesis were true, a difference as large or larger than the sample difference of 6.7 minutes would be very unlikely to occur. Therefore, the researchers rejected the null hypothesis of no difference and concluded that in the population, physicians intend to spend less time with obese patients.

In general, the null hypothesis is the idea that nothing is going on: there is no effect of our treatment, no relation between our variables, and no difference in our sample mean from what we expected about the population mean. This is always our baseline starting assumption, and it is what we seek to reject. If we are trying to treat depression, we want to find a difference in average symptoms between our treatment and control groups. If we are trying to predict job performance, we want to find a relation between conscientiousness and evaluation scores. However, until we have evidence against it, we must use the null hypothesis as our starting point.