such as biology, business, mathematics, and music. The variable *gender* can take on only two values: male or female. To test whether there is bias in the awarding of degrees, the administrators ask the following question:

Do the data suggest a relationship between the two variables?

If there is a relationship, then men and women are choosing majors at different rates, suggesting that a person's gender somehow influences his or her choice of major (either by choice or because of bias within different departments). If there is no relationship, it means there is no evidence that gender influences a person's choice of major.

This idea suggests the following choices for the two hypotheses. The null hypothesis, H_0, states that the two variables are *independent* (there is *no relationship* between them); in our current example, it states that there is no relationship between gender and major. The alternative hypothesis, H_a, states the opposite: There *is* a relationship between the variables, which in this case implies that gender influences a person's choice of major.

Null and Alternative Hypotheses with Two Variables

The **null hypothesis**, H_0, states that the variables are independent (there is *no relationship* between them).

The **alternative hypothesis**, H_a, states that there *is* a relationship between the two variables.

Displaying the Data in Two-Way Tables

With the hypotheses identified, the next step in the hypothesis test is to examine the data set to see if it supports rejecting or not rejecting the null hypothesis. Collecting the data for our current example means finding the numbers of men and women awarded degrees in various majors. Once the data have been collected, we need to find an efficient way to display them. Because we are dealing with two variables, we can display the data efficiently with a **two-way table** (also called a **contingency table**), so named because it displays two variables.

Table 10.2 shows what the two-way table might look like for data on the variables *major* and *gender*. Each cell shows a frequency (or count) for one combination of the two variables. For example, the cell in row *Women* and column *Biology* shows that 32 bachelor's degrees were awarded to women in biology. Similarly, the cell in row *Men* and column *Business* shows that 87 bachelor's degrees were awarded to men in business.

Table 10.2 Two-Way Table for the Variables *Major* and *Gender*

variable 1 *major* →

	Biology	Business	Mathematics	Psychology	...
Women	32	110	18	75	...
Men	21	87	15	70	...

↑ variable 2 *gender*

Note: One variable is displayed along the columns and the other along the rows. Here, there are only two rows because gender can be only either male or female. There are many columns for the majors, with just the first few shown here.

I cannot do it without counters.

—William Shakespeare, *The Winter's Tale*

Two-Way Tables

A **two-way table** shows the relationship between two variables by listing one variable in the rows and the other variable in the columns. The entries in the table's cells are called *frequencies* (or *counts*).