b. Approaching O'Hare for landing, a British Air flight from London has been in a holding pattern for 45 minutes due to bad weather. Landing is expected within 15 minutes. The flight crew could declare an emergency and land immediately, but an FAA investigation would be launched and other flights might be endangered. The null hypothesis is that there is enough fuel to stay aloft for 15 more minutes.

c. You are trying to finish a lengthy statistics report and print it for your evening class. Your color printer is very low on ink, and you just have time to get to Staples for a new cartridge. But it is snowing and you need every minute to finish the report. The null hypothesis is that you have enough ink.

9.3 A firm decides to test its employees for illegal drugs. (a) State the null and alternative hypotheses. (b) Define Type I and II errors. (c) What are the consequences of each type of error, and to whom?

9.4 A hotel installs smoke detectors with adjustable sensitivity in all public guest rooms. (a) State the null and alternative hypotheses. (b) Define Type I and II errors. (c) What are the consequences of each type of error, and to whom?

9.5 What is the consequence of a false negative in an inspection of your car's brakes? *Hint:* The null hypothesis is the status quo (things are OK).

9.6 What is the consequence of a false positive in a weekly inspection of a nuclear plant's cooling system? *Hint:* The null hypothesis is the status quo (things are OK).

9.2 STATISTICAL HYPOTHESIS TESTING

A **statistical hypothesis** is a statement about the value of a population parameter that we are interested in. For example, the parameter could be a mean, a proportion, or a variance. A **hypothesis test** is a decision between two competing, mutually exclusive, and collectively exhaustive hypotheses about the value of the parameter.

The hypothesized value of the parameter is the center of interest. For example, if the true value of μ is 5, then the sample mean should not differ greatly from 5. We rely on our knowledge of the *sampling distribution* and the *standard error of the estimate* to decide if the sample estimate is far enough away from 5 to contradict the assumption that $\mu = 5$. We can calculate the likelihood of an observed sample outcome. If the sample outcome is very unlikely, we would reject the claimed mean $\mu = 5$.

The null hypothesis states a benchmark value that we denote with the subscript "0" as in μ_0 or π_0. The hypothesized value μ_0 or π_0 does not come from a sample but is based on past performance, an industry standard, a target, or a product specification.

Where Do We Get μ_0 (or π_0)?

For a mean (or proportion), the value of μ_0 (or π_0) that we are testing is a *benchmark* based on past experience, an industry standard, a target, or a product specification. The value of μ_0 (or π_0) does *not* come from a sample.

For a mean, the null hypothesis H_0 states the value(s) of μ_0 that we will try to reject. There are three possible alternative hypotheses:

LO 9-4

Formulate a null and alternative hypothesis for μ or π.

Left-Tailed Test	*Two-Tailed Test*	*Right-Tailed Test*
H_0: $\mu \geq \mu_0$	H_0: $\mu = \mu_0$	H_0: $\mu \leq \mu_0$
H_1: $\mu < \mu_0$	H_1: $\mu \neq \mu_0$	H_1: $\mu > \mu_0$

The application will dictate which of the three alternatives is appropriate. The *direction of the test* is indicated by which way the inequality symbol points in H_1:

$<$ indicates a **left-tailed test**

$\neq$ indicates a **two-tailed test**

$>$ indicates a **right-tailed test**