Example 1

How to Get a Better Tan

Picture the Scenario

Statistics students were asked to design an experiment about a topic of choice, conduct the experiment, and then analyze the data. One student, Allison, decided to compare tanning methods without exposure to the sun to avoid skin cancer risk. She investigated two treatments—a bronze tanning lotion applied twice over a two-day period, or a tanning studio where the person is exposed to ultraviolet (UV) light. We'll refer to these treatments as "tanning lotion" and "tanning studio."

The tanning lotion is much less expensive, but Allison predicted that the tanning studio would give a better tan. To investigate this hypothesis, she recruited five untanned female friends to participate in an experiment. Another student in the class used a random number generator to pick three of the friends to use the tanning lotion. The other two friends used the tanning studio. After three days, Allison evaluated the tans produced. She was blinded to the treatment allocation, not knowing which participants used which tanning method. Allison ranked the friends in terms of the quality of their tans. The ranks went from 1 to 5, with 1 = most natural looking and 5 = least natural-looking.

Questions to Explore

- Once Allison ranked the five tanned participants, how could she summarize the evidence in favor of one treatment over the other?
- How can Allison find a P-value to determine if one treatment is significantly better than the other?

Thinking Ahead

You learned in Sections 10.2 and 10.3 how to compare means for two treatments using t tests. The tests assume a *normal* distribution for a quantitative response variable. The t tests are *robust*, usually working well even when population distributions are *not* normal. An exception is when the distribution is skewed, the sample sizes are small, and the alternative hypothesis is one-sided.

To use the t test, suppose Allison created a quantitative variable by assigning a score between 0 and 10 for each girl to describe the quality of tan. With such small sample sizes (only 2 and 3), she would not be able to assess whether quality of tan is approximately normal. Moreover, her prediction that the studio gives a better tan than the lotion was one-sided. In any case, Allison found it easier to rank the participants than to create a quantitative variable. For these reasons, then, it's not appropriate for her to use a t test to compare the tanning methods.

We'll now learn about an alternative way to compare treatments without having to assume a normal distribution for the response variable. **Nonparametric statistical methods** provide statistical inference without this assumption. They use solely the *ranking* of the subjects on the response variable.