

# CAKE-BAKING EXPERIMENT

## 4. The Experiment Design

The objective of the experiment is to study the impact of baking time and temperature on the taste of a cake made from a mix specified in Section 2. The variables baking time and baking temperature are the factors. The responses are ratings of the taste of the cakes given by tasters.

The experimental design in this case consists of choosing various combinations of temperature and time settings, prepare cakes at each of these combinations, submit the cakes to a taste test that yields numerical scores, and analyze the scores for evidence that the mix performs well, or fails to perform well, over the combinations of settings.

In the previous section, we have specified three levels of baking time and three levels of baking temperature. The three levels of baking time are 55 minutes, 60 minutes, and 65 minutes. The three levels of baking temperature are 325 ° F, 350 ° F, and 375 ° F. Three cakes are baked at each of the nine combinations and the results can be recorded in the following table:

		Time (in minutes)		
		55	60	65
Temperature	325 F			
	350 F			
	375 F			

This implies that  $9 \times 3 = 27$  tasters and cakes are involved in the experiment. To avoid bias, the randomization process should be used in the experiment.

The process consists of the following steps:

1. Develop a protocol (that is, a detailed list of instructions) for preparing the cake mix and the oven so that the cakes are prepared under essentially identical conditions. The protocol (recipe) is given in Section 2.
2. Prepare 27 identical doughs according to the protocol specified in 1. Assign numerical labels 1, 2, ..., 27 to the doughs and mark each of them clearly.
3. Assign randomly the 27 doughs to the nine treatment groups, three doughs in each group. This can be done by creating a deck of 27 cards, three for each of the nine combinations, and laying the well-shuffled cards down in a row or by using the table of random digits.
4. Bake the cakes at combinations chosen in random order. This is done for two reasons. First, if there are effects that carry over systematically from one baking

to the next, moving systematically through the table of combinations introduces these carryover effects into the data. Second, the random selection of combinations creates a sound theoretical basis for the use of statistical inference methods in analyzing the data.

Use an oven and a timer that provide extremely precise and accurate settings. Substantial error in the experimental equipment compromises the precision of the experimental findings.

5. The baked cakes are assigned to tasters at random by arranging the tasters' names in random order and giving one cake to each taster in that order. Offering cakes to the taste testers in a random order allows you to avoid carryover effects from test to test.

Make sure that the people who taste the cakes do not know the experimental conditions under which the cakes were prepared. A person who knows the experimental conditions can transmit clues to the taste tester that can seriously affect the results. The blinding of the conductor as well as the tester is called double blinding.

Recruit taste testers who can truly discriminate differences between cakes. Some people are much better tasters than others.