SUMMARY

In this chapter we have described one of the basic procedures by which probability theory is applied to data to produce conclusions. The following points are important.

1. Hypothesis testing is a decision-making process.
2. In a prototypical decision-making situation there are four possible outcomes: two possible states of reality combined with two possible decisions. Two of these outcomes are correct responses, and the other two outcomes are errors.
3. A decision is based both on the available *evidence* and on the decision maker's *criterion*.
4. In a statistical hypothesis-testing procedure, two possible states of reality are those in which an independent variable does or does not have an effect on some dependent variable with respect to the population as a whole. A type I error consists of concluding the existence of such an effect when none in fact exists. A type II error consists of not concluding the existence of such an effect when the effect does exist.
5. By convention, a criterion is constructed so that the probability of a type I error is less than 0.05.

PROBLEMS

1. List 10 instances of decision-making situations. For each situation, state the outcome analogous to a type I error and the outcome analogous to a type II error.

2. An experiment is done to test the hypothesis that a person's reaction time is slower when under the influence of alcohol than not when under the influence of alcohol. A subject sits at a table with a light in front of him. When the light goes on, the subject pushes a button as quickly as possible. The time he takes to do this is measured. Subjects perform this task twice: once after having drunk an alcoholic drink and once after having drunk a nonalcoholic drink.

   Of 36 subjects, 26 were slower in the alcohol condition and 10 were slower in the nonalcohol condition. Perform a sign test on these data using the following steps:
   a. What are the null and alternative hypotheses?
   b. Define a "success" as "person is slower with alcohol." What should the distribution of number of successes be if the null hypothesis is true?
   c. Should you reject the null hypothesis? Why or why not?

3. The Newark Daggers football team plays the Palo Alto Barons eight times in one season. The scores are as follows:

Game	Daggers	Barons
1	28	12
2	20	20
3	13	15
4	17	5
5	10	3
6	95	2
7	13	0
8	2	2

Can the Daggers coach use these data to support her claim that the Daggers are a better team than the Barons (use a 0.10 alpha level)?

4. Dr. Sanders is interested in whether people eat more food on rainy or on sunny days. So he gets individuals to participate in his study by coming to the laboratory on one rainy and one sunny day. A bowl of peanuts is put in front of them while they are waiting for the experiment to begin. Dr. Sanders counts the number of peanuts each person eats on both the rainy and the sunny days. Here are the data:

	Rainy Day	Sunny Day
S_1	12	9
S_2	24	11
S_3	21	17
S_4	19	18
S_5	4	0
S_6	7	6

Evaluate the hypothesis that more food is eaten on rainy days (use a 0.01 alpha level).

5. An experiment is done to test the hypothesis that rats prefer warm milk to a sugar solution. Each of 14 rats is given its choice of either of the two solutions. Twelve rats prefer the milk, one prefers the sugar, and one falls asleep without expressing a preference for either.

Can these data be used to conclude that rats prefer warm milk to the sugar solution?

6. A developmental psychologist finds 12 sets of identical twins brought up in different environments. In each case one twin was brought up in a high-socioeconomic-status (high-SES) environment, whereas the other was brought up in a low-SES environment. All 24 children are given an IQ test, and the following data are obtained.

Twin Pair	Low-SES Member	High-SES Member
1	100	98
2	95	115
3	80	101
4	98	125
5	120	120
6	98	102
7	80	92
8	103	110
9	104	105
10	68	75
11	111	112
12	110	90

Use a sign test to determine whether SEC influences IQ.

7. Alpha-Cola has outsold Beta-Cola in 8 of the past 11 years. Can Alpha use this datum to support its claim that people tend to prefer Alpha to Beta?

8. Stoors Beer claims it's the best, but Hood Beer claims to be just as good as Stoors. To check this out, eight University of Kelso students agree to take a blind test. That is, blindfolded, they each take a sip of each type of beer and indicate which tastes better.

   How many of the eight students would have to claim Stoors to be better in order to reject the null hypothesis that there is no difference between the two?

   a. Use the 0.10 level.
   b. Use the 0.05 level.

9. An occultist has two coins, a quarter and a dime. She claims that the quarter exerts a force field over the dime such that when the two coins are flipped, the dime will tend to turn up the same way (heads or tails) as the quarter. In 15 trials in which the quarter and dime were simultaneously flipped, the following pattern of results emerged:

		Quarter: Heads	Quarter: Tails
Dime	Heads	5	1
	Tails	2	7

Use a sign test to evaluate the occultist's hypothesis.

10. Suppose you were doing an experiment in which each of four subjects participated in each of two conditions. Your alternative hypothesis is that condition *A* will produce higher scores than condition *B*.

    Could you perform a sign test on the resulting data, using an alpha level of 0.05? Why or why not?