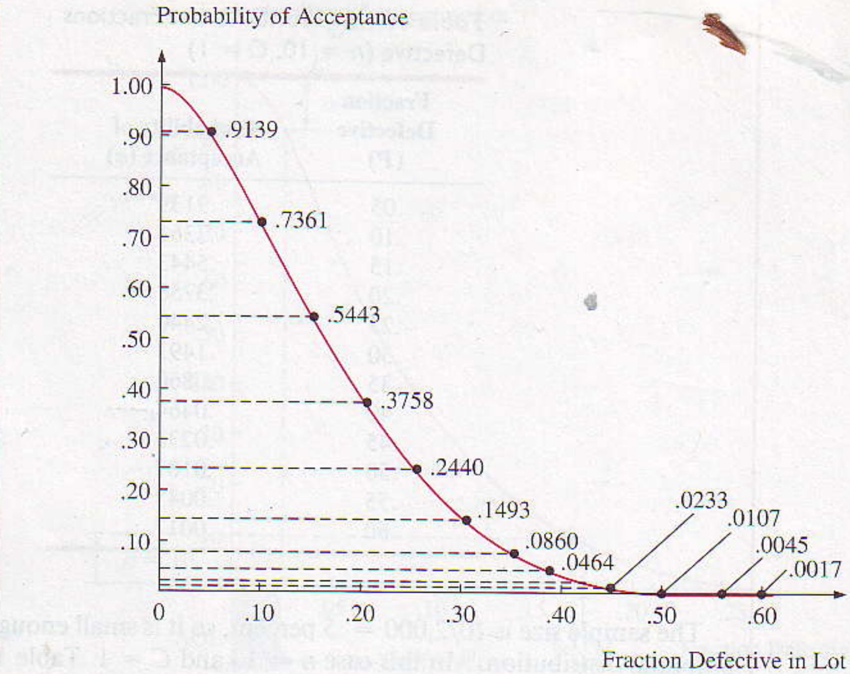

Figure 11A.3
OC Curve for $n = 10, c = 1$

Source: W. J. Stevenson, *Production/Operations Management*, 3rd ed., 1990, p. 835, reprinted by permission of Richard D. Irwin.

Questions and Problems

1. For each of the following, test the indicated hypothesis.
   a. $n = 16, \bar{x} = 1{,}550, s^2 = 12, H_0: \mu = 1{,}500, H_1: \mu > 1{,}500, \alpha = .01$
   b. $n = 9, \bar{x} = 10.1, s^2 = .81, H_0: \mu = 12, H_1: \mu \neq 12, \alpha = .05$
   c. $n = 49, \bar{x} = 17, s = 1, H_0: \mu \geq 18, H_1: \mu < 18, \alpha = .05$
2. The estimated variance based on 4 measurements of a spring tension was .25 gram. The mean was 37 grams. Test the hypothesis that the true value is 35 grams. Use $\alpha = .10$ and $H_1: \mu > 35$.
3. A population has a variance σ^2 of 100. A sample of 25 from this population had a mean equal to 17. Can we reject $H_0: \mu = 21$ in favor of $H_1: \mu \neq 21$? Let $\alpha = .05$.
4. Suppose a sample of 15 rulers from a given supplier have an average length of 12.04 inches and the sample standard deviation is .015 inch. If α is .02, can we conclude that the average length of the rulers produced by this supplier is 12 inches, or should we accept $H_1: \mu \neq 12.00$?
5. The drained weights, in ounces, for a sample of 15 cans of fruit are given below. At a 5 percent level of significance, use MINITAB to test the hypothesis that on average a 12-ounce drained-weight standard is being maintained. Use $H_1: \mu \neq 12.0$ as the alternative hypothesis.

12.0	12.1	12.3	12.1	12.2
11.8	12.1	11.9	11.8	12.1
12.4	11.9	12.3	12.4	11.9

6. An advertisement for a brand-name camera stated that the cameras are inspected and that "60 percent are rejected for the slightest imperfections." To test this assertion, you observe the inspection of a random selection of 30 cameras and find that 15 are rejected. Construct a test, using $\alpha = .05$.

7. A 1984 study indicated that the average yearly housing cost for a family of 4 was \$12,983. A random sample of 200 families in a U.S. city resulted in a mean of \$14,039 with a standard deviation of \$2,129. Is this city's sample mean significantly higher than the population mean? Use $\alpha = .05$.

8. The data entry operation in a large computer department claims that it gives its customers a turnaround time of 6.0 hours or less. To test this claim, one of the customers took a sample of 36 jobs and found that the sample mean turnaround time was $\bar{x} = 6.5$ hours with a sample standard deviation of $s = 1.5$ hours. Use H_0: $\mu = 6.0$, H_1: $\mu > 6.0$, and $\alpha = .10$ to test the data entry operation's claim.

9. The following data represent the time, in seconds, that it took the sand in a sample of timers to run out. At the 10 percent significance level, can we conclude that the mean for timers of this type is not equal to the nominal 3 minutes?
   a. Use H_1: $\mu \neq 180$ as the alternative hypothesis.
   b. Use MINITAB to test (1) H_1: $\mu \neq 180$ and (2) H_1: $\mu > 180$.

190	199	198	176	180	174
181	183	208	188	198	165

10. Independent random samples from normal populations with the same variance gave the results shown in the following table. Can we conclude that the difference between the means, $\mu_1 - \mu_2$, is less than 5? That is, test H_0: $\mu_1 - \mu_2 \geq 5$ with $\alpha = .05$.

Sample	n	Mean	Standard Deviation
1	15	22	9
2	9	25	7

11. What is hypothesis testing? Why are we interested in hypothesis testing? In hypothesis testing, is it possible to prove a hypothesis true?

12. What are the types of errors that can be made in hypothesis testing? Which type of error is generally regarded as more serious?

13. For each of the following pairs of hypotheses, explain what the null hypothesis should be.
   a. Not guilty versus guilty in a court case.
   b. Cage is safe versus cage is unsafe when testing the safety of lion cages.
   c. New drug is safe to use versus new drug is unsafe when determining whether the FDA should allow a new arthritis medicine to be sold.
   d. New treatment is safe versus new treatment is unsafe when determining whether the FDA should allow a new treatment for AIDS to be used.

14. Compare the concepts of interval estimation discussed in Chapter 10 with the concept of hypothesis testing discussed in this chapter. How are they related?

15. Compare a one-tailed test with a two-tailed test. Give some examples wherein a one-tailed test is preferable to a two-tailed test. Give some examples wherein a two-tailed test is preferable to a one-tailed test.

16. Briefly explain what is meant by the power of a test. Why is the power of the test important.?

17. What is a simple hypothesis? What is a composite hypothesis? Give some examples of a simple hypothesis. Give some examples of a composite hypothesis.

18. In 1981 the election for governor of the state of New Jersey in which Tom Kean defeated Jim Florio was so close that Florio demanded a recounting of the votes. If you were Florio and you were conducting an hypothesis test of who won the election, what would your null hypothesis be? How would your answer change if you were Kean?

19. In conducting an hypothesis test, how do we determine the rejection region?

20. Briefly explain why the central limit theorem is important in hypothesis testing.

21. Evaluate the following statement: "If we reject the null hypothesis that $\mu = \mu_0$ in a two-tailed test, we will also reject it in a one-tailed test (using the same α)."

22. Find the critical values for the following standard normal distributions:
   a. Two-tailed test for $\alpha = .05$
   b. One-tailed test for $\alpha = .05$
   c. Two-tailed test for $\alpha = .01$
   d. One-tailed test for $\alpha = .01$
   e. Two-tailed test for $\alpha = .10$
   f. One-tailed test for $\alpha = .10$

23. You are given the information $\bar{x} = 10$, $\sigma = 2$, and $n = 35$. Conduct the following hypothesis test at the .05 level of significance.

$$H_0: \mu = 0 \quad \text{versus} \quad H_1: \mu > 0$$

24. Use the information given in question 23 to test

$$H_0: \mu = 0 \quad \text{versus} \quad H_1: \mu \neq 0$$

at the .05 level of significance.

25. You are given the information $\bar{x} = 150$, $\sigma = 30$, and $n = 20$. Conduct the following hypothesis test at the .01 level of significance.

$$H_0: \mu = 100 \quad \text{versus} \quad H_1: \mu > 100$$

26. Use the information given in question 25 to test

$$H_0: \mu = 100 \quad \text{versus} \quad H_1: \mu \neq 100$$

at the .01 level of significance.

27. You are given the information $\bar{x} = 1{,}050$, $s_x = 250$, and $n = 20$. Conduct the following hypothesis test at the .10 level of significance.

$$H_0: \mu = 1100 \quad \text{versus} \quad H_1: \mu < 1100$$

28. Use the information given in question 27 to test

$$H_0: \mu = 1100 \quad \text{versus} \quad H_1: \mu \neq 1100$$

at the .10 level of significance.

29. A sample of 100 students in a high school have a sample mean score of 550 on the math portion of the SAT. Assuming that the sample standard deviation is 75, test, at the .05 level of significance, the hypothesis that the high school's mean SAT score is 500 against the alternative hypothesis that the school's mean SAT score does not equal 500.

30. Redo question 29, testing $H_0: \mu = 500$ against $H_1: \mu > 500$.

31. A sample of 20 students in a high school has a sample mean score of 520 on the English portion of the SAT. If the sample standard deviation is 65, test, at the .01 level of significance, the hypothesis that the school's mean SAT score is equal to 500 against the alternative hypothesis that the school's mean SAT score does not equal 500.

32. Redo question 31, substituting the alternative hypothesis $H_1: \mu > 500$.

33. Suppose a random sample of 25 people at a local weight-loss center is taken, and the mean weight loss is found to be 12 pounds. From past history, the standard deviation is known to be 3 pounds. Test the hypothesis that the mean weight loss for all the members of the weight-loss center is 10 pounds against the alternative that it is more than 10 pounds. Do the test at the .05 level of significance.

34. Redo question 33, but assume that the standard deviation is not known and that 3 pounds represents the sample standard deviation. Do the test at the 5 percent level of significance.

35. A quality control engineer is interested in testing the mean life of a new brand of light bulbs. A sample of 100 light bulbs is taken, and the sample mean life of these light bulbs is found to be 1,075 hours. Suppose the standard deviation is known and is 100 hours. Use a .05 level of significance to test the hypothesis that the mean life of the new bulbs is greater than 1,000 hours.

36. Suppose that the quality control engineer in question 35 does not know what the standard deviation is and therefore uses the sample standard deviation. Does your answer to question 35 change? Why or why not?

37. Suppose that the quality control engineer in question 35 does not know what the standard deviation is and that this time, he selects a random sample of only 25 light bulbs. Does your answer to question 35 change? Explain.

38. An auditor is interested in the mean value of a company's accounts receivable. He randomly samples 200 accounts receivable and finds that the mean accounts receivable is \$231. From past experience he knows that the standard deviation is \$25. Use a .01 level of significance to test whether the population mean accounts receivable is different from \$200.

39. Use the information given in question 38 to test the hypothesis that the population mean accounts receivable is greater than \$200 at the .05 level of significance.

40. An investment advisor is interested in determining whether a retirement community represents a potential clientele base. Of the 2,000 residents, he randomly samples 100 individuals and finds their

mean wealth to be $525,000 with a sample standard deviation of $52,000. Use a .10 level of significance to test the hypothesis that the mean wealth is greater than $500,000.

41. An automobile manufacturer claims that a new car gets an average of 35 miles per gallon. Assume that the distribution is known to be normal with a standard deviation of 3.2 miles per gallon. A random sample of 10 cars gives an average of 35.1 miles per gallon. Test, at the .01 level of significance, the alternative hypothesis that the population mean is at least 35 miles per gallon.

42. Use the information given in question 41, except this time assume that the standard deviation is not known and that 3.2 miles per gallon represents the sample standard deviation. Again test, at the .01 level of significance, the alternative hypothesis that the population mean is at least 35 miles per gallon.

43. An aspirin manufacturer claims that its aspirin stops headaches in less than 30 minutes. A random sample of 100 people who use the pain killer finds that the average time it takes to stop a headache is 28.6 minutes with a sample standard deviation of 4.2 minutes. Test, at the 5 percent level of significance, the manufacturer's claim that this product stops headaches in less than 30 minutes.

44. Bob's SAT Preparation Service claims that the course it offers enables students to score an average of 600 or better on the math portion of the SAT. Suppose a random sample of 25 people taking the course has a mean score of 650 with a sample standard deviation of 50. Would it be more appropriate to use a one-tailed or a two-tailed test? Test the company's claim at the 10 percent level of significance.

45. An advertising company claims that 80 percent of stores that use their advertisements show increased sales. A random sample of 100 stores that used the company's advertisements reveals that 80 showed increased sales. Test, at the 5 percent level of significance, whether at least 75 percent of stores using the advertisements had increased sales.

46. Flip a coin 40 times and count the number of heads. Test, at the 5 percent level of significance, whether the proportion of heads is .5.

47. A manufacturer claims that 95 percent of its parts are free of defects. A random sample of 100 parts finds that 92 are free of defects. Test the manufacturer's claim at the 1 percent level of significance.

48. An investment advisor claims that 70 percent of the stocks she recommends will increase in price. Suppose testing a random sample of 125 stocks she recommends reveals that 75 have increased in price. Test her claim at the 10 percent level of significance.

49. Ed's Bar Exam Review claims that 90 percent of the people who take its review course pass the bar exam on the first try. A random sample of 500 people who took the course reveals that 425 passed the bar exam on the first try. Test, at the 5 percent level of significance, the null hypothesis that at least 90 percent of those who take the review course pass the bar exam on the first try.

50. Use the information given in question 49 to test, at the 1 percent level of significance, the null hypothesis that less than 80 percent of those who take the course pass the bar exam on the first try.

51. In a taste test using 400 randomly selected people, 220 preferred a new brand of coffee to the leading brand. Test, at the 1 percent significance level, the alternative hypothesis that at least 52 percent prefer the new brand.

52. A popular commercial states that 4 out of 5 dentists who chew gum prefer sugarless gum. Suppose a random sample of 100 gum-chewing dentists is taken and 75 are found to prefer sugarless gum. Test, at the 10 percent level of significance, the null hypothesis that the commercial's claim is true.

53. A diet center claims that people subscribing to its program lose an average of 4 pounds in the first week of the diet. Suppose 25 people in the diet center's program are chosen at random and are found to have lost 4.3 pounds in the first week with a sample standard deviation of 1.1 pounds. Test, at the 5 percent level of significance, the hypothesis that the mean weight loss is 4 pounds.

54. Use the information given in question 53 and test, at the 5 percent level of significance, the alternative hypothesis that the mean weight loss is at least 4 pounds.