

2. A survey shows that 60% of the households in a large metropolitan area have microwave ovens. If ten households are selected at random, what is the probability that five or fewer of these households have microwave ovens?

Solutions to Self-Check Exercises 8.4 can be found on page 474.

8.4 Concept Questions

- Suppose that you are given a Bernoulli experiment.
 - How many outcomes are there in each trial?
 - Can the number of trials in the experiment vary, or is it fixed?
 - Are the trials in the experiment dependent?
 - If the probability of success in any trial is p , what is the probability of exactly x successes in n independent trials?
- Give the formula for the mean, variance, and standard deviation of X , where X is a binomial random variable associated with a binomial experiment consisting of n trials with probability of success p and probability of failure q .

3.4

8.4 Exercises

In Exercises 1–6, determine whether the experiment is a binomial experiment. Justify your answer.

- Rolling a fair die three times and observing the number of times a 6 is thrown
- Rolling a fair die and observing the number of times the die is thrown until a 6 appears uppermost
- Rolling a fair die three times and observing the number that appears uppermost
- A card is selected from a deck of 52 cards, and its color is observed. A second card is then drawn (without replacement), and its color is observed.
- Recording the number of accidents that occur at a given intersection on four clear days and one rainy day
- Recording the number of hits a baseball player, whose batting average is .325, gets after being up to bat five times

In Exercises 7–10, find $C(n, x)p^xq^{n-x}$ for the given values of n , x , and p .

7. $n = 4, x = 2, p = \frac{1}{3}$ 8. $n = 6, x = 4, p = \frac{1}{4}$
 9. $n = 5, x = 3, p = .2$ 10. $n = 6, x = 5, p = .4$

In Exercises 11–16, use the formula $C(n, x)p^xq^{n-x}$ to determine the probability of the given event.

- The probability of exactly no successes in five trials of a binomial experiment in which $p = \frac{1}{3}$
- The probability of exactly three successes in six trials of a binomial experiment in which $p = \frac{1}{2}$
- The probability of at least three successes in six trials of a binomial experiment in which $p = \frac{1}{2}$
- The probability of no successful outcomes in six trials of a binomial experiment in which $p = \frac{1}{3}$
- The probability of no failures in five trials of a binomial experiment in which $p = \frac{1}{3}$
- The probability of at least one failure in five trials of a binomial experiment in which $p = \frac{1}{3}$
- A fair die is rolled four times. Calculate the probability of obtaining exactly two 6s.
- Let X be the number of successes in five independent trials in a binomial experiment in which the probability of success is $p = \frac{2}{3}$. Find:
 - $P(X = 4)$
 - $P(2 \leq X \leq 4)$
- A binomial experiment consists of five independent trials. The probability of success in each trial is .4.
 - Find the probabilities of obtaining exactly 0, 1, 2, 3, 4, and 5 successes in this experiment.
 - Construct the binomial distribution, and draw the histogram associated with this experiment.
 - Compute the mean and the standard deviation of the random variable associated with this experiment.
- Let the random variable X denote the number of girls in a five-child family. If the probability of a female birth is .5:
 - Find the probabilities of 0, 1, 2, 3, 4, and 5 girls in a five-child family.
 - Construct the binomial distribution, and draw the histogram associated with this experiment.
 - Compute the mean and the standard deviation of the random variable X .
- The probability that a fuse produced by a certain manufacturing process will be defective is $\frac{1}{50}$. Is it correct to infer from this statement that there is at most 1 defective fuse in each lot of 50 produced by this process? Justify your answer.
- SPORTS** If the probability that a certain tennis player will serve an ace is $\frac{1}{4}$, what is the probability that he will serve exactly two aces out of five serves? (Assume that the five serves are independent.)
- SPORTS** If the probability that a certain tennis player will serve an ace is .15, what is the probability that she will

serve at least two aces out of five serves? (Assume that the five serves are independent.)

24. **SALES PREDICTIONS** From experience, the manager of Kramer's Book Mart knows that 40% of the people who are browsing in the store will make a purchase. What is the probability that, among ten people who are browsing in the store, at least three will make a purchase?

25. **CUSTOMER SERVICES** Mayco, a mail-order department store, has six telephone lines available for customers who wish to place their orders. If the probability is $\frac{1}{4}$ that any one of the six telephone lines is engaged during business hours, find the probability that all six lines will be in use when a customer calls to place an order.

26. **RESTAURANT VIOLATIONS OF THE HEALTH CODE** Suppose 30% of the restaurants in a certain part of a town are in violation of the health code. If a health inspector randomly selects five of the restaurants for inspection, what is the probability that:
- None of the restaurants are in violation of the health code?
 - One of the restaurants is in violation of the health code?
 - At least two of the restaurants are in violation of the health code?

27. **ADVERTISEMENTS** An advertisement for Brand A chicken noodle soup claims that 60% of all consumers prefer Brand A over Brand B, the chief competitor's product. To test this claim, David Horowitz, host of *The Consumer Advocate*, selected ten people at random. After tasting both soups, each person was asked to state his or her preference. Assuming that the company's claim is correct, find the probability that:
- Six or more people stated a preference for Brand A.
 - Fewer than six people stated a preference for Brand A.

28. **VOTERS** In a certain congressional district, it is known that 40% of the registered voters classify themselves as conservatives. If ten registered voters are selected at random from this district, what is the probability that four of them will be conservatives?

29. **VIOLATIONS OF THE BUILDING CODE** Suppose that one third of the new buildings in a town are in violation of the building code. If a building inspector inspects five of the buildings chosen at random, find the probability that:
- The first three buildings will pass the inspection and the remaining two will fail the inspection.
 - Exactly three of the buildings will pass inspection.

30. **EXAMS** A biology quiz consists of eight multiple-choice questions. Five must be answered correctly to receive a passing grade. If each question has five possible answers, of which only one is correct, what is the probability that a student who guesses at random on each question will pass the examination?

31. **BLOOD TYPES** It is estimated that one third of the general population has blood type A+. If a sample of nine people is selected at random, what is the probability that:
- Exactly three of them have blood type A+?
 - At most three of them have blood type A+?

32. **EXAMS** A psychology quiz consists of ten true-or-false questions. If a student knows the correct answer to six of

the questions but determines the answers to the remaining questions by flipping a coin, what is the probability that she will obtain a score of at least 90%?

33. **QUALITY CONTROL** The probability that a DVD player produced by VCA Television is defective is estimated to be .02. If a sample of ten players is selected at random, what is the probability that the sample contains:
- No defectives?
 - At most two defectives?

34. **QUALITY CONTROL** As part of its quality-control program, the video-game DVDs produced by Starr Communications are subjected to a final inspection before shipment. A sample of six DVDs is selected at random from each lot of DVDs produced, and the lot is rejected if the sample contains one or more defective DVDs. If 1.5% of the DVDs produced by Starr is defective, find the probability that a shipment will be accepted.

35. **ROBOT RELIABILITY** An automobile-manufacturing company uses ten industrial robots as welders on its assembly line. On a given working day, the probability that a robot will be inoperative is .05. What is the probability that on a given working day:
- Exactly two robots are inoperative?
 - More than two robots are inoperative?

36. **ENGINE FAILURES** The probability that an airplane engine will fail in a transcontinental flight is .001. Assuming that engine failures are independent of each other, what is the probability that on a certain transcontinental flight, a four-engine plane will experience:
- Exactly one engine failure?
 - Exactly two engine failures?
 - More than two engine failures? (*Note:* In this event, the airplane will crash.)

37. **QUALITY CONTROL** The McCormack Company manufactures solar panels. As a part of its quality control, the company checks the day's production by examining samples of 10. The following table shows the number of defective panels contained in a distribution of 40 samples.

Number of Defective Panels in a Sample of 20	0	1	2	3	4	5 or more
Number of Samples	33	3	2	1	1	0

Find the mean number of defective panels per sample, and assuming that the distribution is binomial, estimate the percentage of defective solar panels in the day's production.

38. **QUALITY CONTROL** The panels for the Pulsar 32-inch widescreen LCD HDTVs in a production run were checked by examining samples of 6. The following table shows the number of defective panels contained in a distribution of 30 samples.

Number of Defective Panels in a Sample of 20	0	1	2	3	4 or more
Number of Samples	26	2	1	1	0

Find the mean number of defective panels per sample, and assuming that the distribution is binomial, estimate the percentage of defective panels in the production run.