

5. Prepare a probability table and a graph for a binomial distribution with

a) $n = 6$ and $p = 0.3$

b) $n = 8$ and $p = \frac{1}{9}$

6. What is the expected number of times a 6 appears when rolling a die 2000 times?

7. In a family of five children, what is the probability that there are exactly

a) two girls?

b) three boys?

$n = 10$
 $p = \frac{1}{10}$
 $E = 10 \times \frac{1}{10}$

Apply

8. Six people are asked to choose a number between 1 and 20. What is the probability that

a) two people choose the number 9?

b) at least two people choose the number 9?

9. Two dice are rolled repeatedly and their sum is recorded.

a) Show the probability distribution for the number of sums of 7 in five rolls.

b) Graph the distribution with a probability histogram.

c) Verify the formula $E(X) = np$.

10. In archery competitions, Paul hits the bull's-eye 45% of the time.

a) Show the probability distribution for the number of bull's-eyes in eight attempts.

b) What is the expected number of bull's-eyes in eight attempts?

c) What does $P(8)$ tell you?

11. a) You roll five dice at the same time. What is the probability that you roll two 3s?

b) Expand the binomial $(\frac{1}{6} + \frac{5}{6})^5$.

c) Which term in the expansion matches the answer in part a)?

d) How does the binomial probability distribution relate to the binomial

12. **Application** A machine makes light bulbs, and 6% do not meet the specifications. An inspector randomly chooses 10 light bulbs for testing.



a) What is the probability that three bulbs do not meet specifications?

b) What is the probability that seven bulbs do not meet specifications?

c) What is the probability that between three and seven bulbs do not meet specifications?

d) What method did you use in part c)? Describe an alternate method.

e) Should the inspector be concerned if two bulbs do not meet specifications? Explain your reasoning.

* 13. **Thinking** On a game show, five contestants are each given a box containing 10 car keys, one of which fits their assigned new car. Each contestant is allowed to choose one key and try to start their car. If no car starts, or only one car starts, nobody wins their car. If two or more cars start, then those contestants win their car. Do the results of the game favour the contestants or the game show? Justify mathematically.

14. Jamaal is successful on basketball free throws 80% of the time.

a) How likely is he to be successful on eight of 10 free-throw attempts?

b) How likely is he to be successful on at least eight of 10 free-throw attempts?

✓ Achievement Check

15. Jean forgot to study for an eight-question multiple choice quiz. Each question contains four possible answers. Jean will guess the answer to each question.
- What is the probability that she will get only two questions correct?
 - What is the probability that she will pass?
 - What is the expected number of correct answers on the quiz?
 - Predict the shape of the probability histogram for this distribution. Explain your reasoning.
 - Describe how the graph will change if Jean feels that she has a 40% chance of guessing correctly on each question.
 - Use technology to check your predictions to parts d) and e).

16. **Communication** A jar contains 12 red balls and eight green balls. Six balls are removed without replacement. What is the probability that four of the balls are red?
- Explain why the binomial distribution is not a suitable model for this problem.
 - Write a new question using the same set of balls so it can be modelled using a binomial distribution.
 - Solve the new problem.

17. Opinion polls based on small samples often yield misleading results. In a particular city, 65% of residents are opposed to a new light rail transit system.

- If a poll were taken, calculate the probabilities of a majority of people approving the transit system with a sample of
 - 7 people
 - 100 people
 - 1000 people
- Explain any differences in the results.

- * 18. **Thinking** A store offers a scratch and win discount for each customer who spends over \$100. Each card has six spots that give

a discount of \$10, three spots that give a discount of \$25, and one spot that gives a discount of \$50. What is the expected cost to the store if it has 200 customers one particular day?

19. Your teacher will provide you with the file **BinomialProbabilityDistribution.ftm** that was used in the Investigation at the beginning of this section.
- Edit the file to simulate the success and failure options for your choice of questions 8, 10, 11, 15, 16, or 18.
 - Try the simulation for 5 experiments, 10 experiments, 100 experiments, and so on, until the graph becomes close to matching the theoretical probabilities.
 - How many experiments did it take for the simulation to come close to the theoretical probabilities?

20. **Open Question** Use one of the following rates to develop your own problem involving the binomial distribution. Then, trade problems with a classmate.
- 19% of the Canadian population live in rural areas
 - 39% of the Canadian population live in Ontario

Extend

21. A standard die is painted so that opposite faces are green, red, and yellow, respectively. In 10 rolls of this die, how many could be red or green or yellow? This leads to what could be a trinomial distribution.

- Develop a formula to calculate the probability distribution in which there are three outcomes with individual probabilities of p , q , and r .
- Use your formula to determine the probability of rolling three reds, two greens, and five yellows in 10 rolls of the die described above.

22. Derive the formula for expectation of a