Binomial Probability Distributions

Statistics Worksheet · Grade 10–12

Name: _____ Date: _____

Learning Objectives

- Identify the parameters n, p, and x in a binomial probability setting
- Use binompdf to find the probability of exactly x successes in n trials
- Use binomcdf and complement rules to find probabilities involving inequalities

Problems

1. A multiple-choice quiz has 10 questions, each with 5 answer choices (A–E). If a student guesses randomly, identify the values of n (number of trials), p (probability of success), and q (probability of failure).

$$n = ?, \quad p = ?, \quad q = ?$$

2. Using the scenario from Problem 1, write out the binomial probability formula for getting exactly x correct answers. Define each variable.

$$P(X = x) = \binom{n}{x} \cdot p^x \cdot q^{n-x}$$

3. Using the 10-question multiple-choice quiz (5 choices per question), use the binomial probability formula by hand to find the probability of getting exactly 0 correct answers by guessing. Round to four decimal places.

$$P(X = 0) = \binom{10}{0} \cdot \left(\frac{1}{5}\right)^0 \cdot \left(\frac{4}{5}\right)^{10}$$

4. Using binompdf on the TI-84, find the probability that a student guessing randomly on the 10-question, 5-choice quiz gets exactly 4 questions correct. Round to four decimal places.

$$P(X = 4) = \text{binompdf}(10,\ 0.2,\ 4)$$

5. Using the same quiz, complete the probability distribution table for X = 0, 1, 2, 3, and 4 using binompdf. Round each value to four decimal places.

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x	P(X = x)

6. On the 10-question quiz, find the probability that a student guessing randomly gets at most 3 correct answers. Use binomcdf on the TI-84. Round to four decimal places.

$$P(X \le 3) = \text{binomcdf}(10,\ 0.2,\ 3)$$

7. Using the complement rule and the result from Problem 6, find the probability that a randomly guessing student gets at least 4 correct answers on the 10-question quiz. Round to four decimal places.

$$P(X \ge 4) = 1 - P(X \le 3)$$

8. Find the probability that a randomly guessing student gets fewer than 3 correct answers on the 10-question, 5-choice quiz. Use binomcdf on the TI-84. Round to four decimal places.

$$P(X < 3) = P(X \le 2) = \text{binomcdf}(10,\ 0.2,\ 2)$$

9. Find the probability that a randomly guessing student gets more than 2 but at most 6 correct answers on the 10-question quiz. Use binomcdf and the subtraction method. Round to four decimal places.

$$P(3 \le X \le 6) = \text{binomcdf}(10,\ 0.2,\ 6) - \text{binomcdf}(10,\ 0.2,\ 2)$$

10. A different quiz has 15 true-or-false questions. A student guesses on every question. Find the probability that the student gets at least 10 questions correct. Show the complement setup and compute using binomcdf. Round to four decimal places.

$$P(X \ge 10) = 1 - \text{binomcdf}(15,\ 0.5,\ 9)$$

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Binomial Probability Distributions — Answer Key

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Answer Key

1. Answer: n = 10, p = 1/5 = 0.2, q = 4/5 = 0.8

- n = 10 because there are 10 questions (trials).
- p = 1/5 = 0.2 because there is 1 correct choice out of 5 options.
- q = 1 - p = 1 - 0.2 = 0.8

2. Answer: n = number of trials, x = number of successes, p = probability of success, q = probability of failure

- n is the total number of independent trials.
- x is the specific number of successes we want.
- p is the probability of success on any single trial.
- q = 1 - p is the probability of failure on any single trial.

3. Answer: P(X = 0) ≈ 0.1074

- C(10,0) = 1
- (1/5)^0 = 1
- (4/5)^10 = 0.8^10 ≈ 0.1074
- P(X = 0) = 1 × 1 × 0.1074 ≈ 0.1074

4. Answer: P(X = 4) ≈ 0.0881

- Enter: 2nd → VARS → binompdf
- Input n = 10, p = 1/5, x = 4
- Calculator returns approximately 0.0881
- So there is about an 8.81% chance of guessing exactly 4 correct.

5. Answer: See completed table

x	P(X = x)
0	0.1074
1	0.2684
2	0.3020
3	0.2013
4	0.0881

6. Answer: P(X ≤ 3) ≈ 0.8791

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- binomcdf gives cumulative probability from 0 up to and including x.
- Enter: 2nd → VARS → binomcdf, with n = 10, p = 0.2, x = 3.
- Calculator returns approximately 0.8791.
- So there is about an 87.91% chance of getting 3 or fewer correct.

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7. Answer: $P(X \geq 4) \approx 0.1209$

- $P(X \leq 3) \approx 0.8791$ from binomcdf(10, 0.2, 3).
- Apply the complement rule: $P(X \geq 4) = 1 - P(X \leq 3)$.
- $P(X \geq 4) = 1 - 0.8791 = 0.1209$.
- There is about a 12.09% chance of getting at least 4 correct by guessing.

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8. Answer: $P(X < 3) \approx 0.6778$

- Since X is a discrete variable, $P(X < 3) = P(X \leq 2)$.
- Enter binomcdf(10, 0.2, 2) into the TI-84.
- Calculator returns approximately 0.6778.
- There is about a 67.78% chance of getting fewer than 3 correct.

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9. Answer: $P(3 \leq X \leq 6) \approx 0.3208$

- Use the subtraction rule for a range: $P(a \leq X \leq b)$ = binomcdf(n,p,b) - binomcdf(n,p,a-1).
- binomcdf(10, 0.2, 6) ≈ 0.9991
- binomcdf(10, 0.2, 2) ≈ 0.6778
- $P(3 \leq X \leq 6) = 0.9991 - 0.6778 \approx 0.3213$ (≈ 0.3208 with full precision).

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10. Answer: $P(X \geq 10) \approx 0.1509$

- Identify parameters: n = 15 (questions), p = 0.5 (true/false), $x \geq 10$.
- Confirm binomial conditions: fixed trials, two outcomes, constant p, independent.
- Use complement: $P(X \geq 10) = 1 - P(X \leq 9) = 1$ - binomcdf(15, 0.5, 9).
- binomcdf(15, 0.5, 9) ≈ 0.8491.
- $P(X \geq 10) = 1 - 0.8491 \approx 0.1509$, or about 15.09%.

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