Chapter 14 - Embracing the Odds in Probability

Objective: I can calculate probabilities from equally likely outcomes and use complements.

Write each probability as a simplified fraction and show favorable and total outcomes.

1. A fair number cube is rolled. Find $P(\text{number greater than } 4)$.	**2.** One card is selected from a standard 52-card deck. Find $P(\text{heart})$.
3. One letter is selected from ALGEBRA. Find $P(\text{vowel})$.	**4.** If $P(\text{rain}) = 0.35$, find $P(\text{no rain})$.
5. List the sample space for two fair coin tosses and find $P(\text{exactly one head})$.	**6.** Two fair number cubes are rolled. Find the number of ordered outcomes and $P(\text{sum } 2)$.

Chapter 14 - Embracing the Odds in Probability

Objective: I can compare experimental and theoretical probability and predict long-run frequency.

State whether each result is experimental, theoretical, or an expectation.

7. A trial succeeds 48 times in 80 attempts. Find the experimental probability.	**8.** A fair device produces 1 through 8 equally often. Find $P($multiple of $3)$.
9. A coin gives 68 heads in 120 tosses. Compare the experimental probability with the theoretical value.	**10.** How many sixes are expected in 300 rolls of a fair number cube?
11. A sample contains 7 defective items among 250. Estimate the defect probability and percent.	**12.** Using Question 11's rate, estimate the expected number of defective items among $1{,}800$.

Chapter 14 - Embracing the Odds in Probability

Objective: I can calculate compound probabilities for independent and dependent events.

Indicate whether replacement makes the events independent or dependent.

13. A fair coin and fair number cube are used. Find $P(\text{head and even number})$.	**14.** Two cards are selected with replacement. Find $P(\text{both aces})$.
15. Two cards are selected without replacement. Find $P(\text{both aces})$.	**16.** A bag has 5 red and 3 blue items. Two are selected without replacement. Find $P(\text{both red})$.
17. Using the same bag, find $P(\text{red then blue})$ without replacement.	**18.** Three fair coins are tossed. Find $P(\text{at least one head})$ using a complement.

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Objective: I can use the Fundamental Counting Principle, permutations, and combinations.
State whether order matters before choosing a counting method.

19. How many outfits can be made from 4 shirts, 3 pants, and 2 pairs of shoes?	**20.** How many 5-digit PINs are possible if repetition is allowed and leading zero is permitted?
21. How many 4-letter codes can be made from 26 letters without repetition?	**22.** In how many orders can 6 distinct books be arranged?
23. How many 3-person committees can be selected from 10 people?	**24.** How many ordered first-, second-, and third-place results are possible among 8 finalists?

Chapter 14 - Embracing the Odds in Probability

Objective: I can calculate joint, marginal, conditional, and union probabilities from a two-way table.

Use

	B	W	C	T
$G9$	18	12	10	40
$G10$	15	5	20	40
T	33	17	30	80

for Questions 25-30.

25. Find P(bus).	**26.** Find P(Grade 10 and car).
27. Find P(car $\mid$ Grade 10).	**28.** Find P(Grade 10 $\mid$ car).
29. Are grade level and bus use independent? Justify numerically.	**30.** Find P(walk or Grade 9).

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Objective: I can apply union, intersection, complement, and independence rules.

Write the probability rule used before substituting values.

31. If $P(A) = 0.45$, $P(B) = 0.30$, and $P(A \cap B) = 0.12$, find $P(A \cup B)$.	**32.** Using Question 31, find $P(\text{neither } A \text{ nor } B)$.
33. Mutually exclusive events have probabilities 0.25 and 0.40. Find their union probability.	**34.** If $P(A \cup B) = 0.72$, $P(A) = 0.48$, and $P(B) = 0.39$, find $P(A \cap B)$.
35. Independent events have $P(A) = 0.60$ and $P(B) = 0.35$. Find their intersection and union probabilities.	**36.** Explain why mutually exclusive events with nonzero probabilities cannot be independent.

Chapter 14 - Embracing the Odds in Probability

Objective: I can calculate expected value, judge fairness, and estimate applied risk.

Treat money paid as negative and use complements when efficient.

37. A game pays $\$8$ with probability 0.25 and loses $\$2$ otherwise. Find the expected value.

38. A game costs $\$3$ and awards $\$12$ with probability $1/4$, otherwise 0. Find expected net value and judge fairness.

39. A raffle has 200 tickets, one $\$500$ prize, and $\$4$ ticket cost. Find expected net value per ticket.

40. For $\begin{array}{c|cccc} X & 0 & 1 & 2 & 3 \\ \hline P & .1 & .3 & .4 & .2 \end{array}$, find $E(X)$.

41. Is $0.20, 0.35, 0.25, 0.20$ a valid probability model? Justify.

42. Is $0.40, 0.35, 0.30$ a valid probability model? Justify.

43. Rain probability is 0.20 each of two independent days. Find $P(\text{no rain both days})$.

44. An item is defective with probability 0.03. For 4 independent items, find $P(\text{at least one defective})$.

Chapter 14 - Embracing the Odds in Probability

Objective: I can solve applied, conditional, error-analysis, and honors probability problems.

Show a complete probability model and simplify all exact results.

45. A birth month is equally likely among 12 months. Find $P(\text{June or July})$.	**46.** A condition affects 2%. A test detects 90% of cases and has 5% false positives. Find $P(\text{condition} \mid \text{positive})$.
47. A student says $P(A \cup B) = P(A) + P(B)$ always. If probabilities are $0.40, 0.50, 0.20$ for $A, B, A \cap B$, correct the error.	**48.** A bag has 6 green and 4 yellow items. Correct a student's $(6/10)^2$ calculation for two greens without replacement.
49. Honors challenge: In 4 independent trials with success probability 0.30, find $P(\text{exactly } 2 \text{ successes})$.	**50.** Honors challenge: Choose Box A or B equally. A has 3 red, 1 blue; B has 1 red, 3 blue. Given red, find $P(A)$.

Other topics for review:

- The complement rule is especially useful for "at least one" events.
- Replacement preserves original probabilities; no replacement changes them.
- Use permutations when order matters and combinations when it does not.
- Conditional probability restricts the sample space to the stated condition.
- Expected value describes a long-run average, not a guaranteed single outcome.