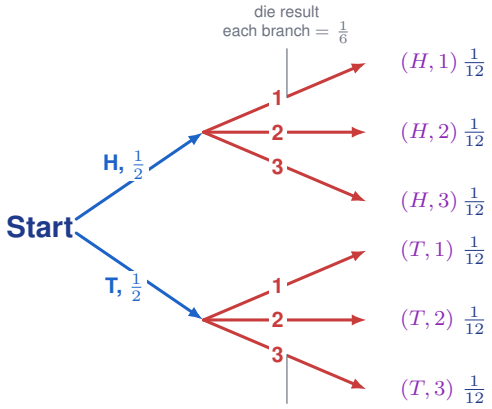
CCSS • 7.SP.8

Compound Events (Independent)

Name: _____	Date: _____	Score: _____ / 18

A **compound event** combines two or more events, and when those events are **independent**—meaning one outcome does not affect the other—the math is surprisingly simple! Just multiply the individual probabilities together to find the probability of both happening. Flipping a coin and rolling a die at the same time? Independent! Recognizing independence is the key that unlocks these problems.



$P(H \text{ and } 2) = \frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$
independent events multiply

Key Concepts & Quick Review

Independent events: knowing A happened tells you nothing about B.
$P(A \text{ AND } B) = P(A) \times P(B)$ (multiply the individual probabilities).

With replacement = independent. After drawing a card and replacing it, the deck resets — the next draw is independent of the first.

Examples

① A fair coin is flipped twice. Find: (a) $P(\text{HH})$ (b) $P(\text{H then T})$ (c) $P(\text{at least one H})$.

Think It Through: Each flip is independent, so the second flip is not affected by the first. For parts (a) and (b), multiply the probability of each step: $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$. For part (c), the complement is easier. Instead of listing HH, HT, and TH, find the probability of no heads, which is TT. Since $P(\text{TT}) = \frac{1}{4}$, the probability of at least one head is $1 - \frac{1}{4} = \frac{3}{4}$.

Answer: *(a)* $\frac{1}{4}$; *(b)* $\frac{1}{4}$; *(c)* $\frac{3}{4}$

② A bag has 3 red and 7 blue marbles. A marble is drawn, **replaced**, then drawn again. Find $P(\text{both red})$ and $P(\text{red then blue})$.

Think It Through: Because the marble is replaced, the bag resets after the first draw. That makes

the two draws independent, so the probabilities stay $\frac{3}{10}$ for red and $\frac{7}{10}$ for blue on each draw. Multiply along the path for each ordered event: $P(\text{RR}) = \frac{3}{10} \times \frac{3}{10} = \frac{9}{100}$ and $P(\text{RB}) = \frac{3}{10} \times \frac{7}{10} = \frac{21}{100}$.

Answer: $P(RR) = \frac{9}{100}$; $P(RB) = \frac{21}{100}$

Practice Problems

Assume each trial is independent. Write each probability as a simplified fraction.

1. A fair coin is flipped twice. Find $P(\text{heads, then heads})$. _____
2. Two fair six-sided dice are rolled. Find $P(\text{both dice show } 6)$. _____
3. Two fair six-sided dice are rolled in order. Find $P(\text{first } 5, \text{ then } 3)$. _____
4. A fair coin is flipped and a fair die is rolled. Find $P(\text{heads and } 4)$. _____
5. A bag has 3 red and 5 blue marbles. Draw with replacement twice. Find $P(\text{red, then red})$. _____
6. A bag has 3 red and 5 blue marbles. Draw with replacement twice. Find $P(\text{red, then blue})$. _____
7. From a standard deck, draw with replacement twice. Find $P(\text{red card both times})$. _____
8. From a standard deck, draw with replacement twice. Find $P(\text{ace, then king})$. _____
9. A fair coin is flipped 3 times. Find $P(\text{all heads})$. _____
10. A fair coin is flipped 4 times. Find $P(\text{all tails})$. _____
11. A fair coin is flipped 3 times. Find $P(\text{heads, heads, tails in that order})$. _____
12. Two fair dice are rolled in order. Find $P(\text{first die even, second die } 1)$. _____
13. Two fair dice are rolled. Find $P(\text{both numbers are prime})$. _____
14. A spinner has equal sections numbered 1 through 8. Spin twice. Find $P(\text{greater than } 3 \text{ both times})$. _____
15. Three fair dice are rolled. Find $P(\text{all three dice show } 1)$. _____

Study Tips

- **Independent = multiply.** Always confirm independence first: are the trials separate experiments with replacement/reset?
- "At least one" problems are easiest via the complement: $P(\text{at least one}) = 1 - P(\text{none})$.
- The multiplication rule extends to three or more events: $P(A \cap B \cap C) = P(A) \times P(B) \times P(C)$ if all are independent.

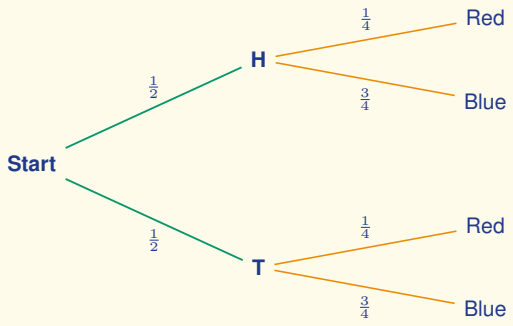
Word Problems

16. A factory machine produces bolts. The probability that any single bolt is defective is $\frac{1}{20}$, and defects occur independently. (a) What is the probability that two bolts in a row are both defective? (b) What is the probability that neither of two bolts is defective? (c) What is the probability that at least one of three bolts is defective?

_____

17. A game show contestant must answer three multiple-choice questions correctly to win a car. Each question has 4 options with one correct answer. The contestant guesses randomly on all three. (a) What is the probability of getting all three correct? (b) What is the probability of getting exactly the first two correct? (c) A contestant who studied has a $\frac{3}{4}$ chance on each question. What is their probability of winning? _____

18. The probability tree below models flipping a fair coin (Heads or Tails) and then drawing one ball from a bag with 4 balls: 1 red and 3 blue. The branch probabilities are labeled. Use the tree to find (a) $P(\text{Heads and Red})$, (b) $P(\text{Tails and Blue})$, and (c) $P(\text{Red ball drawn})$ overall.



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Answer Keys

1) $\frac{1}{4}$
2) $\frac{1}{36}$
3) $\frac{1}{36}$
4) $\frac{1}{12}$
5) $\frac{9}{64}$
6) $\frac{15}{64}$
7) $\frac{1}{4}$
8) $\frac{1}{169}$
9) $\frac{1}{8}$
10) $\frac{1}{16}$
11) $\frac{1}{8}$
12) $\frac{1}{12}$
13) $\frac{1}{4}$
14) $\frac{25}{64}$
15) $\frac{1}{216}$
16) (a) $\frac{1}{400}$; (b) $\frac{361}{400}$; (c) $\frac{1141}{8000} \approx 14.3\%$
17) (a) $\frac{1}{64}$; (b) $\frac{3}{64}$; (c) $\frac{27}{64} \approx 42.2\%$
18) (a) $\frac{1}{8}$; (b) $\frac{3}{8}$; (c) $\frac{1}{4}$

Step-by-Step Explanations

Strategy: For Mean Absolute Deviation (MAD), find the mean, measure each distance from that mean, then average those distances. A tidy deviation table keeps every distance from the mean visible.

Practice 1: 2, 4, 6, 8, 10 **Answer:** $\frac{12}{5}$
In the first example, find the mean, measure each distance from the mean, then average those distances.

Practice 15: 40, 44, 48, 52, 56 **Answer:** $\frac{24}{5}$
Toward the end, find the mean, measure each distance from the mean, then average those distances.

Word-problem notes:

16. Answer: Mean $= 12.0\,mm$; deviations: $0.2, 0.2, 0, 0.4, 0.4, 0.1, 0.1, 0$; MAD $= 1.4/8 = 0.175\,mm < 0.3$ — passes.
Add the bolt lengths and divide by 8 to get the mean, which is exactly $12.0\,mm$. Then find each absolute deviation from 12.0: $0.2, 0.2, 0, 0.4, 0.4, 0.1, 0.1, 0$. Their total is 1.4, so the MAD is $1.4 \div 8 = 0.175\,mm$. Since the allowed average deviation is at most $0.3\,mm$ and $0.175 < 0.3$, the batch passes quality control.

17. Answer: A: mean $= 5$, MAD $= 1.0$; B: mean $= 6$, MAD $= 4.0$; Archer A far more consistent — choose A.
Archer A's mean distance is $5\,cm$, and the shots stay close to that mean, giving a MAD of 1.0. Archer B's mean is $6\,cm$, but the shots vary widely from very close to very far, so the MAD is much larger at 4.0. A smaller MAD means more consistency, so Archer A is the better choice if you want the next shot to land near the bullseye.

18. Answer: Data: $70, 70, 71, 72, 72, 74, 75$; mean $= \frac{504}{7} = 72$; deviations: $2, 2, 1, 0, 0, 2, 3$ (sum $= 10$); MAD $= \frac{10}{7} \approx 1.43$.
Read the data from the dot plot: $70, 70, 71, 72, 72, 74, 75$. Their sum is 504, so the mean is $\frac{504}{7} = 72$. Compute the absolute deviations from 72: $|70 - 72| = 2$, $|70 - 72| = 2$, $|71 - 72| = 1$, $|72 - 72| = 0$, $|72 - 72| = 0$, $|74 - 72| = 2$, $|75 - 72| = 3$. The deviations sum to 10, so MAD $= \frac{10}{7} \approx 1.43$.

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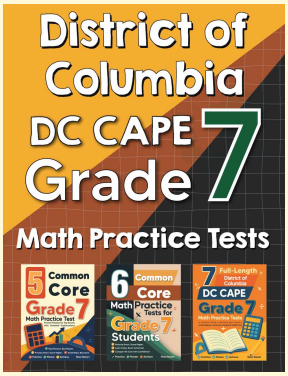

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