

Section 9-3:

Probability of Multiple Events "With" or "Without" Replacement

Objectives:

- Calculate probabilities of multiple events.
- Understand the meanings of "with" or "without" replacement.
- Find probabilities of multiple events "with replacement."
- Find probabilities of multiple events "without replacement."

Ex 1:

What is the probability of rolling a 5 and then a 2 on a standard die?

$$P(5 \text{ and } 2) = P(5, 2)$$

$$P(5, 2) = P(5) \cdot P(2) = \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$$

With Replacement:

Total # of options do NOT change

Without Replacement:

Total # of options change

Ex 2:

A jar of 12 marbles has 1 orange, 2 green, 4 red, and 5 blue. A marble is selected and then **REPLACED**. Then another marble is selected. What is the probability of selecting a green marble and then a blue marble?

$$P(G, B) = P(G) \cdot P(B) = \frac{2}{12} \cdot \frac{5}{12}$$

$= \frac{1}{6} \cdot \frac{5}{12}$

$= \frac{5}{72}$

Ex 3:

A jar of 12 marbles has 1 orange, 2 green, 4 red, and 5 blue. A marble is selected but **NOT REPLACED**. Then another marble is selected. What is the probability of selecting a green marble and then a blue marble?

$$P(G, B) = P(G) \cdot P(B) = \frac{2}{12} \cdot \frac{5}{11} = \frac{10}{132} = \frac{5}{66}$$

1. $P(\text{heads, heads}) = P(H) \cdot P(H) = \frac{1}{2} \cdot \frac{1}{2} = \left(\frac{1}{4}\right)$

2. $P(\text{tails, tails})$

3. $P(\text{tails, tails, tails}) = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \left(\frac{1}{8}\right)$



Two students randomly select a book from a shelf holding 3 novels, 2 biographies, and 1 history book. If the first student does **NOT** replace the book they choose, what is the probability that the students choose each of the following situations? (Give your answer as a simplified fraction and as a percent.)

5. Both choose novels. $\frac{3}{6} \cdot \frac{2}{5} = \frac{6}{30} = \left(\frac{1}{5}\right)$

6. Both choose biographies.

7. First student chooses a history book, second student chooses a novel.

$$\frac{1}{6} \cdot \frac{3}{5} = \frac{3}{30} = \left(\frac{1}{10}\right)$$



In the shelf of books above, two students choose a book. The first student chooses a book, and then returns that book to the shelf. Then the second student chooses a book. What is the probability that the students choose the following? (Give your answer as a simplified fraction and as a percent.)

9. Both choose novels. $\frac{3}{6} \cdot \frac{3}{6} = \frac{9}{36} = \frac{1}{4}$ 25%

10. Both choose biographies.

11. First student chooses a history book, second student chooses a novel.

$$\frac{1}{6} \cdot \frac{3}{6} = \frac{1}{6} \cdot \frac{1}{2} = \frac{1}{12} \quad 8.3\%$$

You are choosing gumballs from a jar. There are 7 green, 6 red, 4 white, 2 pink, and 1 blue. You choose the first gumball, look at the color, and then put it back. You then choose a second gumball. What is the probability that you choose the following? (Give your answer as a simplified fraction and as a percent.)

13. $P(\text{red, green}) = P(R) \cdot P(G) = \frac{6}{20} \cdot \frac{7}{20}$
 14. $P(\text{blue, blue}) = \frac{1}{20} \cdot \frac{1}{20} = \frac{1}{400}$

What if you keep the first gumball and then you choose a second gumball? What is the probability that you choose the following? (Give your answer as a simplified fraction and as a percent.)

17. $P(\text{red, green}) = P(R) \cdot P(G) = \frac{6}{19} \cdot \frac{7}{19}$
 18. $P(\text{white, white}) = \frac{4}{19} \cdot \frac{3}{19}$
 19. $P(\text{green, red}) = \frac{7}{19} \cdot \frac{6}{19}$

