

13-2 Study Guide and Intervention

Probability with Permutations and Combinations

Probability Using Permutations A permutation is an arrangement of objects where order is important. To find the number of permutations of a group of objects, use the **factorial**. A factorial is written using a number and !. The following are permutation formulas:

$$n! = n \cdot (n - 1) \cdot (n - 2) \cdot \dots \cdot 2 \cdot 1$$

$$5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 \cdot 0 = 120$$

n distinct objects taken r at a time	${}_n P_r = \frac{n!}{(n - r)!}$
n objects, where one object is repeated r_1 times, another is repeated r_2 times, and so on	$\frac{n!}{r_1! \cdot r_2! \cdot \dots \cdot r_k!}$
n objects arranged in a circle with no fixed reference point	$\frac{n!}{n}$ or $(n - 1)!$

Example The cheer squad is made up of 12 girls. A captain and a co-captain are selected at random. What is the probability that Chantel and Cadence are chosen as leaders?

Find the number of possible outcomes.

Find the number of favorable outcomes.

$${}_{12} P_2 = \frac{12!}{(12 - 2)!} = \frac{12!}{10!} = 12 \cdot 11 = 132$$

$$2! = 2$$

The probability of Chantel and Cadence being chosen is

$$\frac{\text{favorable outcomes}}{\text{total number of outcomes}} = \frac{2}{132} = \frac{1}{66}$$

Exercises

- BOOKS** You have a textbook for each of the following subjects: Spanish, English, Chemistry, Geometry, History, and Psychology. If you choose 4 of these at random to arrange on a shelf, what is the probability that the Geometry textbook will be first from the left and the Chemistry textbook will be second from the left?
 $\frac{1}{30}$
- CLUBS** The Service Club is choosing members at random to attend one of four conferences in LA, Atlanta, Chicago, and New York. There are 20 members in the club. What is the probability that Lana, Sherry, Miguel, and Jerome are chosen for these trips?
 $\frac{1}{4845}$
- TELEPHONE NUMBERS** What is the probability that a 7-digit telephone number generated using the digits 2, 3, 2, 5, 2, 7, and 3 is the number 222-3357?
 $\frac{1}{420}$
- DINING OUT** A group of 4 girls and 4 boys is randomly seated at a round table. What is the probability that the arrangement is boy-girl-boy-girl?
 $\frac{4}{35}$

Lesson 13-2

13-2 Study Guide and Intervention *(continued)***Probability with Permutations and Combinations**

Probability Using Combinations A **combination** is an arrangement of objects where order is NOT important. To find the number of combinations of n distinct objects taken r at a time, denoted by ${}_n C_r$, use the formula:

$${}_n C_r = \frac{n!}{(n-r)!r!}$$

Example

Taryn has 15 soccer trophies but she only has room to display 9 of them. If she chooses them at random, what is the probability that each of the trophies from the school invitational from the 1st through 9th grades will be chosen?

Step 1 Since the order does not matter, the number of possible outcomes is

$${}_{15} C_9 = \frac{15!}{(15-9)!(9!)} = 5005$$

Step 2 There is only one favorable outcome—the 9 specific trophies being chosen.

Step 3 The probability that these 9 trophies are chosen is

$$\frac{\text{number of favorable outcomes}}{\text{total number of outcomes}} = \frac{1}{5005}$$

Exercises

- 1. ICE CREAM** Kali has a choice of 20 flavors for her triple scoop cone. If she chooses the flavors at random, what is the probability that the 3 flavors she chooses will be vanilla, chocolate, and strawberry?

$$\frac{1}{1140}$$

- 2. PETS** Dani has a dog walking business serving 9 dogs. If she chooses 4 of the dogs at random to take an extra trip to the dog park, what is the probability that Fifi, Gordy, Spike and Fluffy are chosen?

$$\frac{1}{126}$$

- 3. CRITIQUE** A restaurant critic has 10 new restaurants to try. If he tries half of them this week, what is the probability that he will choose The Fish Shack, Carly's Place, Chez Henri, Casa de Jorge, and Grillarious?

$$\frac{1}{252}$$

- 4. CHARITY** Emily is giving away part of her international doll collection to charity. She has 20 dolls, each from a different country. If she selects 10 of them at random, what is the probability she chooses the ones from Ecuador, Paraguay, Chile, France, Spain, Sweden, Switzerland, Germany, Greece, and Italy?

$$\frac{1}{184,756}$$

- 5. ROLLER COASTERS** An amusement park has 12 roller coasters. Four are on the west side of the park, 4 are on the east side, and 4 are centrally located. The park's Maintenance Department randomly chooses 4 roller coasters for upgrades each month. What is the probability that all 4 roller coasters on the west side are chosen in March?

$$\frac{1}{495}$$