

When looking at situations involving counting the number of possible outcomes it is often not practical to count things individually. Instead techniques have been developed to help us count efficiently and accurately.

Firstly however let's look at the Multiplication Counting Principle which states:

If there are m ways of doing one thing and n ways of doing another, then there are $m \cdot n$ ways of doing the first thing followed by the second.

This rule can best be understood by looking at an example.

Example 1 : An ice-cream shop offers 3 types of cones and 5 different flavors of ice-cream. How many possible ice-cream cone combinations are there if you are allowed only one type of ice-cream?

For each of the 3 cones there are 5 possible flavors of ice cream so altogether there are $3 \cdot 5 = 15$ possible ice-cream cone combinations.

Example 2: You need a password for your new email account. The company requires your password to be 5 characters long with the first 2 characters being a single digit from 0 to 9. The last three characters being a lower case letter. If numbers can be repeated but letters can't be repeated find the number of different passwords possible: $10 \cdot 10 \cdot 26 \cdot 25 \cdot 24 = 1,560,000$

Example 3: There are 6 people in a race. The following medals are awarded: 1st place: Gold 2nd place: Silver 3rd place: Bronze. How many ways can these medals be awarded?

Since no person can be awarded more than one medal there are the following ways to award the medals: $6 \cdot 5 \cdot 4 = 120$

Find the number of outcomes possible for each situation. Show how you arrived at your answers.

1. The local pizzeria offers a choice of 2 pizzas - supreme or vegetarian, 3 sides - chips, salad or coleslaw, and 4 drinks - juice, coke, ginger ale or water. For dinner I decide to have 1 pizza, 1 side, and 1 drink. How many possible meals do I have to choose from?
2. How many different car licence plates can be made if each is to display 3 capital letters followed by 3 digits? Both letters and digits can repeat.
3. Your friend wants to perform a magic trick and asks you to draw 2 cards from a standard deck of 52. The first card you draw must be placed face down and the second placed face up on the table. How many ways are there of drawing the 2 cards?
4. You want to change your password to your bank account. The bank requires the password to be 7 characters long and must contain 3 numbers, 3 letters, and one of the following special characters: %, #, \$, &, or !. If letters can repeat but numbers can't repeat, find the number of different passwords possible.
5. Seven people entered a contest in which prizes are awarded to each person where the first prize is \$100, second prize is \$90, and each prize after that reduces by \$10. How many ways can these seven prizes be awarded?