

### Lesson 3 Mathematics Is More Than Just Numbers

## Mathematics Is Everywhere

Mathematics is beneficial in everyday life. We use math concepts and skills to understand patterns, define relationships, and predict the future. You would be amazed to see the emergence of math in unexpected situations. Here are a few examples.

### The Mathematics of Airplane Boarding

What is the most efficient way to board a plane?

The standard procedure starts by boarding first class, then business class, and then economy class. In the case of economy class passengers, they are divided into blocks according to their seat rows to board.

This often results in a crowded, chaotic situation for passengers. Mathematicians compared various boarding methods and found that boarding a plane starting from the front row took the longest while starting from the back row took the second longest.

From a mathematical point of view, the most efficient way appears to be seating passengers by the window, starting from the back. Then, passengers in the aisle seats board next, from back to front.

This way, passengers can store their bags in the overhead bins almost simultaneously without disturbing each other. Further, since the boarding starts from the back, there is no need for passengers to pass each other. Moreover, filling window seats first gets rid of the trouble of aisle seat passengers having to stand up and move into the aisle while others take their seats. In short, the most efficient way is to start with window seat passengers and move from back to front.

## The Mathematics of Passwords

In movies, hackers are often shown sitting in front of a computer, trying to figure out other people's passwords. Is your password safe? That depends on how securely it was created.

According to one survey, 26% of adults use passwords that are easy to memorize, such as birthdays or names, and surprisingly, the most common passwords used were "123456," "password," "12345," "12345678," and "qwerty."

The passwords used for mobile phones and banks are often four digits, and these are not very secure. Each digit can be selected from 10 numbers from 0 to 9, so there are  $10^4$  possible codes. A computer can try all 10,000 combinations in the blink of an eye. Let's assume that, for security purposes, you create a password with six or more letters. Choosing a word with six or more letters as a password may be more secure. Six letters from the 26-letter alphabet make a possible  $26^6$  combinations, or more than 300 million total possibilities.

It's much better than a four-digit combination, though it's still possible for a computer to check them all in only a few seconds. Passwords become difficult to hack when they are long and combine various characters. There can be  $90^{20}$  combinations for a 20-digit password using around 90 letters, numbers, and special characters on a standard computer keyboard. However, there is a problem here as well. How will the user memorize this long password? Passwords should not be too easy but also not too complicated to memorize. Using a passphrase with a story will make it easy to memorize, even if the phrase is long. For example, if you use a passphrase like "mathfirstenglishlater," which means that you will study math first and English later, it will be easy to memorize but difficult to hack. You can make your password even more secure by adding capital letters and special characters. For example, "mathfirst,Englishlater" is a very secure password.

## The Mathematics of Baseball

Baseball is a game of statistics. It's essential to know how many hits a batter can get and how many bases they can reach. Traditionally, batting average, which measures how often a player gets a hit, has been considered the most important criterion.

However, in baseball, there is another way to reach first base besides a hit, and that's a walk.

Nevertheless, walks aren't included in batting average, so players who don't get many hits but are good at getting walks could be rated too low. If players get on base in any way, they create scoring opportunities. Therefore, recent analyses have shown that on-base percentage is much more important for winning than batting averages.

A general manager of a professional baseball team in the United States, whose team could not afford to pay the biggest star players, created his own criteria for selecting players. His system valued how many bases a player averages per at-bat. It differed from the traditional batting average by taking into account not only the number of hits but also the types of hits (singles, doubles, triples, and home runs).

It gave 1 point for singles, 2 points for doubles, 3 points for triples, and 4 points for home runs.

Moreover, the system considered a player's ability to draw walks as it contributes to getting on base and overall team success.

Using such standards, the team recruited valuable players other teams declined to pay. These players had low batting averages but excelled at drawing walks and had high on-base percentages. Despite having the third-lowest total player salary in the entire Major Leagues, the team reached the playoffs two years in a row, all thanks to this analytical approach.

In conclusion, math is a subject that we use every day, from simple calculations to more complex problem-solving. It is a powerful tool that we need to navigate the world around us and to live efficiently and conveniently. Therefore, understanding basic math concepts is essential for making informed decisions.