Geometric Progression (GP)

In the lesson, we'll learn about geometric progression.

We'll cover the following

Geometric progression is a sequence of numbers such that each term after the first is obtained by multiplying the previous one by a fixed non-zero number, called the **common ratio**. For example:

$3, 6, 12, 24, ...$

Here the first term, a, is 3, $a = 3$, and the common ratio, r, is 2, $r = 2$.

In general,

$a, ar, ar^2, ar^3, ..., ar^{n-1}$

Where the nth term $= ar^{n-1}$

Sum

The sum of GP with n terms is

$a + ar + ar^2 + ... + ar^{n-1}$

$= \frac{(1-r)(a+ar+ar^2+...+ar^{n-1})}{1-r}$

$= \frac{(a+ar+ar^2+...+ar^{n-1})-(ar+ar^2+ar^3+...+ar^n)}{1-r}$

$= \frac{a-ar^n}{1-r}$

$= \frac{a(1-r^n)}{1-r}$

Infinite geometric progression

This is a special and very useful case of GP when the common ratio is $r < 1$.

It is easy to see that this is only where terms become smaller and smaller and hence the sum converge to a value when the number of terms $n \to \infty$

Sum

The sum is easy to calculate using the formula for the sum of GP terms.

We have

$sum = \frac{a(1-r^n)}{1-r}$

As $n \to \infty, r^n \to 0$

$sum = \frac{a}{1-r}$

In the next lesson, we'll start learning PnC (Permutations and Combinations), starting with permutation.