Arithmetic Progression

Definition:

An arithmetic progression or arithmetic sequence is a sequence of numbers such that the difference between the consecutive terms is constant.

For instance, the sequence 5, 7, 9, 11, 13, 15, . . . is an arithmetic progression with a common difference of 2.

If the initial term of an arithmetic progression is a_1 and the common difference of successive members is d, then the n-th term of the sequence a_n is given by:

$$a_n = a_1 + (n-1)d$$

Sum:

Sum of AP series is given by -

$$S_n = \frac{n}{2}[2a_1 + (n-1)d].$$

Derivation of Sum Formula:

To derive the above formula, begin by expressing the arithmetic series in two different ways:

$$S_n = a_1 + (a_1 + d) + (a_1 + 2d) + \cdots + (a_1 + (n-2)d) + (a_1 + (n-1)d)$$
$$S_n = (a_n - (n-1)d) + (a_n - (n-2)d) + \cdots + (a_n - 2d) + (a_n - d) + a_n.$$

Adding both sides of the two equations, all terms involving *d* cancel:

$$2S_n = n(a_1 + a_n).$$

Dividing both sides by 2 produces a common form of the equation:

$$S_n = \frac{n}{2}(a_1 + a_n).$$

An alternate form results from re-inserting the substitution: $a_n = a_1 + (n-1)d$

$$S_n = \frac{n}{2}[2a_1 + (n-1)d].$$

Reference: https://en.wikipedia.org/wiki/Arithmetic_progression

Geometric Progression

Definition:

A geometric progression, also known as a geometric sequence, is a sequence of non-zero numbers where each term after the first is found by multiplying the previous one by a fixed, non-zero number called the *common ratio*.

For example, the sequence 2, 6, 18, 54, ... is a geometric progression with common ratio 3. Similarly 10, 5, 2.5, 1.25, ... is a geometric sequence with a common ratio 1/2.

The general form of a geometric sequence is $a,\ ar,\ ar^2,\ ar^3,\ ar^4,\ \cdots$ where $r \neq 0$ is the common ratio and $a \neq 0$ is a scale factor, equal to the sequence's start value.

The n-th term of a geometric sequence with initial value $a = a_1$ and common ratio r is given by

$$a_n = a\,r^{n-1}.$$

Reference: https://en.wikipedia.org/wiki/Geometric_progression