**THE DERIVATION OF FORMULAS FROM NUMBER SEQUENCES**

By Jun 8(2), Edited by Oscar 8(7)

Number sequences and their derived formulas may sound simple, but they can produce some of the most complex problems in number theory. In fact, the oldest mathematical problem that is still unsolved is based on the topic of number sequences. It concerns whether or not odd perfect numbers exist, i.e. odd positive integers equal to the sum of their factors excluding the number itself.

The derivation of formulas from number sequences has little application in real life, but they can be used, if mastered well enough, as a convenient way to solve many types of problems.

**Definitions**

The two main types of sequences are arithmetic and geometric sequences. In basic arithmetic sequences, each term differs by a constant value, the common difference. Formulas for arithmetic sequences are typically related to addition (subtraction is the addition of a negative number).

On the other hand, in geometric sequences, the th term of the sequence is multipled by a common multiple to get the th term, . Thus, formulas derived from a geometric sequence are usually related to multiplication (division is the multiplication of a reciprocal).

**Simple Problems**

Applying these formulas to complex sequences can be difficult without practice, but there are a few tips and tricks to speed up the process (as we all know, try-check-and-revise would be an inefficient method). The first tip is to determine whether it is a multiplication or addition formula. If you can figure out which type of sequence is shown, the formula would be easier to find. After some practice, these problems would become a matter of speed.

Example 1: 3, 4, 5, 6. It is apparent that the sequence is arithmetic, and the formula for a term is n+2.

Example 2: 0, 0, 0, 0. The sequence is both arithmetic and geometric (in fact it is constant), so the formula is a constant .

Example 3: 2, 4, 5, 7, 7, 10, 9, 12. The formula might be unclear at first, but if we subtract from each term , we get {1, 2, 2, 3, 2, 4, 2, 4}. After some observation, it can be concluded that , where is the number of factors of .

**Complex Problems**

Sometimes the sequence involves both addition and multiplication. For example, {12, 19, 26, 33, 40} is a sequence with a common difference of 7, but the first term differs from 7 by 5, so the formula is .

Example 4: 1, -2, -5, -8. Using the method above, we can write the formula .

Example 5: 5, 11, 17, 23. The common difference subtracted from the first term is , so the formula is .

**数列通项的推导**

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数列及其衍生公式可能听起来简单，但它们可以产生数论中一些最复杂的问题。实际上，最古老的未解数学问题之一就是围绕数列展开的：它涉及是否存在“完美奇数”，即一个等于不包括它本身的因子之和的奇数。

虽然从数列推导公式在现实生活中应用不多，但如果掌握得足够好，它们可以作为

解决多种类型问题的便捷方法。

**定义**

两种主要的序列类型是等差数列和等比数列。在基本的等差数列中，每两项之间都有一个常数值的差，称为公差。等差数列的公式通常与加法有关（注：减法可以视为加上一个负数）。

另一方面，在几何序列中，序列的第项乘以一个公倍数，得到第（n+1）项。因此，从几何序列中推出的公式通常与乘法有关（注：除法是倒数的乘法）。

**简单问题**

将这些公式应用于复杂的序列可能会很困难，但有一些技巧可以加快这一过程。众所周知，尝试-检查-修正的方法效率较低。第一个技巧是确定序列是基于加法还是乘法。一旦确定了序列的类型，找到公式就会容易得多。经过一段时间的练习，这些问题会变得更快解决。

示例1: 3，4，5，6。很明显，该序列是等差数列，项的公式是。

示例2: 0，0，0，0。该序列是等差和等比的（事实上它是常数），因此通项公式就是一个常数：。

例3: 2，4，5，7，7，10，9，12。这个公式一开始可能很不清楚，但如果我们从每个项中减去，我们得到{1，2，2，3，2，4，2，4}。经过一些观察，可以得出结论，，其中是的因子个数。

复杂问题

有时，数列涉及加法和乘法。例如，{12，19，26，33，40}是一个共差为7的序列，但第一项与7相差5，因此公式为。

例4:1，-2，-5，-8。使用上述方法，我们可以写出公式。

例5:5，11，17，23。从第一项中减去的共同差值为-1，因此公式为。