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Pavan Gampala's Pattern: A Novel Observation in Arithmetic Sequences

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Abstract:- In this paper, we present a newly observed pattern in the sums of consecutive natural numbers. The pattern demonstrates that the sum of the first *nn*n natural numbers, when added to the square of *nn*n, equals the sum of the next *nn*n natural numbers. This finding introduces a unique relationship within arithmetic sequences, offering a fresh perspective on the properties of natural number summation. The implications of this pattern may extend to various areas of number theory, combinatorics, and mathematical analysis.

I. INTRODUCTION

The study of arithmetic sequences has been fundamental to mathematics for centuries. Classical results, such as the formula for the sum of the first *nn*n natural numbers, have been well-established. Arithmetic sequences, defined as sequences of numbers with a constant difference between consecutive terms, play a crucial role in various mathematical applications. They are not only a foundation of elementary mathematics but also have implications in advanced areas such as algebra, calculus, and number theory *11*1.

However, new observations can still arise from re-examining these sequences. This paper introduces "Pavan's Pattern," a novel observation that connects the sum of the first *nn*n numbers plus the square of *nn*n with the sum of the subsequent *nn*n numbers. This pattern suggests a deeper underlying structure in arithmetic sequences that may have been previously overlooked. By exploring this pattern, we aim to contribute to the ongoing study of arithmetic sequences and their properties.

II. THE PATTERN

- *We Define "Pavan's Pattern" as follows:*

Given a natural number n, the sum of the first n numbers plus n^2 equals the sum of the next n numbers.

- *Formally, Let S1(n) be the Sum of the First n Natural Numbers:*

S1(n) = Σk=1 to n (k) = n(n + 1)/2

- *The Observation States:*

S1(n) + n^2 = S2(n)

- *Where S2(n) is the Sum of the Next n Numbers:*

S2(n) = Σk=n+1 to 2n (k)

III. PROOF OF THE PATTERN

- *We begin by Expressing S2(n) Explicitly:*

S2(n) = Σk=n+1 to 2n (k) = (n+1 + 2n)n / 2 = (3n+1)n / 2

- *Now, Consider the Expression for S1(n) + n^2:*

S1(n) + n^2 = n(n + 1)/2 + n^2

- *Simplifying Further:*

S1(n) + n^2 = (n(n + 1) + 2n^2) / 2 = n(3n + 1) / 2

- *Thus, we Find:*

S1(n) + n^2 = S2(n)

This confirms the pattern for all natural numbers n.

IV. EXAMPLES

Let's consider n = 2:

The sum of the first 2 numbers: S1(2) = 1 + 2 = 3

Adding 2^2: S1(2) + 4 = 7

The sum of the next 2 numbers: S2(2) = 3 + 4 = 7

Thus, S1(2) + 2^2 = S2(2), confirming the pattern.

V. GENERALIZATION AND IMPLICATIONS

"Pavan's Pattern" highlights a specific property of consecutive integer sums, suggesting potential avenues for further exploration in number theory. The discovery may inspire similar observations in other arithmetic sequences or inspire research into related combinatorial identities. Additionally, the pattern's connection to quadratic expressions hints at possible links to more advanced topics in algebra and number theory.

Furthermore, this observation could lead to a deeper understanding of the distribution of sums within sequences and their relationship to other mathematical concepts, such as polynomial functions and series expansions. Future

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research could explore the generalization of this pattern to other types of sequences, including geometric and harmonic sequences, to determine whether similar relationships exist.

VI. CONCLUSION

"Pavan's Pattern" offers a fresh insight into the relationships between consecutive sums of natural numbers. While rooted in fundamental arithmetic, this observation opens doors to new explorations in the field of number theory. The simplicity of the pattern, coupled with its general applicability, suggests that it could become a useful tool in both theoretical and applied mathematics. We encourage further study to fully explore the implications and potential applications of this pattern.

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