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Research Article

Pathak's Theory of Number Interaction (PTNI)

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Abstract

Pathak's Theory of Number Interaction (PTNI) introduces a new idea for understanding how numbers interact. It defines an" interactive strength" between two numbers based on their difference, providing a novel framework for thinking about number relationships with simple mathematical rules applicable to various kinds of numbers.

More Information

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1. Introduction

We tend to think of numbers in terms of easy operations like adding, subtracting, multiplying, and dividing. But what if we thought of numbers not just in terms of these operations, but in terms of how they interact with each other, like physical bodies pushing or pulling? Pathak's Theory of Number Interaction (PTNI) is a new way of thinking about these interactions.

In PTNI, we define an interactive strength as a function of the difference between two numbers. The bigger the difference, the weaker the interaction. By altering how we define this difference, we can simulate various types of number interactions. Just like forces in physics depend on the distance between objects.

Additionally, the notation for the strength is N, also referred to as Numo-tract.

2. The number interaction theory

To define how two numbers interact, we start with a simple idea: the strength between two numbers depends on their difference. In the same way that physical forces are often described as inversely proportional to distance raised to a power, we begin with the idea:

$$N\alpha \frac{1}{|a-b|^n} \quad (1)$$

To convert this proportionality into an equation, we introduce a constant of proportionality, denoted by k, giving us:

$$N(a,b)=\frac{k}{|a-b|^n} \quad (2)$$

Here:

- a and b are the two numbers we are comparing.
- k is a constant that scales the interactive strength.
- n is an exponent that tells us how quickly the interaction gets smaller as the difference increases.
- $|a - b|$ is the absolute difference between the numbers, always positive.

This formula tells us that the interactive strength gets weaker when the numbers are farther apart. The exponent n tells us how quickly the strength decays as the difference increases [1].

3. Special cases

There are some interesting cases where the interaction behaves in unique ways.

3.1. When one number is very small

If one number becomes very small, say $a \to 0$, and b is much larger than a, the difference $|a - b|$ approaches $|b|$, and the strength behaves as follows:

$$N(0,b)=\frac{k}{|0-b|^n}=\frac{k}{|b|^n} \quad (3)$$

Thus, as a approaches zero, the strength between 0 and b behaves similarly to the strength between b and any small number. The magnitude of the interaction depends on b raised to the power n.

3.2. When one number is very large

If one number is much larger than the other, the difference becomes very large. This means the interactive strength becomes very small. For example, if a = 1 and b is very large:

$$N(1,b) = \frac{k}{|1-b|^n} \tag{4}$$

Since the difference is so large, the strength is almost zero.

3.3. When the numbers are the same

If $a = b$, then the difference is zero:

$$N(a,a) = \frac{k}{|a-a|^n} = \frac{k}{0^n} \tag{5}$$

This results in division by zero, so the interaction is undefined. This aligns with the idea that identical numbers do not "interact" in this framework.

3.4. When one number is infinitely large

When one number becomes infinitely large, say $b \to \infty$, the difference $|a - b|$ grows without bound:

$$N(a,\infty) = \frac{k}{|a-\infty|^n} = 0 \tag{6}$$

The interaction vanishes as the difference becomes infinite, mirroring how physical forces diminish with distance.

4. Examples

4.1. Example 1: Numbers 10 and 5

If a = 10, b = 5, and n = 2:

$$N(10,5) = \frac{1}{|10-5|^2} = \frac{1}{5^2} = \frac{1}{25} = 0.04 \tag{7}$$

4.2. Example 2: Numbers 100 and 50

If a = 100, b = 50, and n = 3:

$$N(100,50) = \frac{1}{|100-50|^3} = \frac{1}{50^3} = \frac{1}{125000} = 8\times10^{-6} \tag{8}$$

4.3. Example 3: Numbers 3 and 1

If a = 3, b = 1, and n = 1:

$$N(3,1) = \frac{1}{|3-1|} = \frac{1}{2} = 0.5 \tag{9}$$

5. Applications of PTNI

PTNI can be used in many areas of mathematics and science.

5.1. Group theory and algebra

In group theory, PTNI can help us understand how elements in a group interact. The strength can tell us how similar or different two elements are, which is useful for understanding the structure of algebraic systems [2,3].

5.2. Prime numbers

In number theory, PTNI can be used to study how prime numbers are spaced apart. The strength between two prime numbers becomes smaller as the numbers get larger, which can give us new insights into how primes are distributed.

5.3. Cryptography

In cryptography, PTNI can help us think about how hard it is to break encryption. The interaction between numbers could represent the difficulty of solving a cryptographic problem, with larger numbers making the problem harder.

6. Further extensions

PTNI can also be extended to more complicated situations:

6.1. Fractional and complex powers

We can use fractional or even complex values for n. For example, if $n = \frac{1}{2}$, the interaction will decay more slowly. Complex values of n can introduce more interesting behaviors, like oscillations.

6.2. Number interaction theory in vector form

In higher-dimensional spaces, we can extend PTNI to work with vectors. Let $\vec{a}$ and $\vec{b}$ be two vectors in a vector space. The interactive strength between these vectors is given by:

$$\vec{N}(\vec{a},\vec{b}) = \frac{k}{|\vec{a}-\vec{b}|^n}\hat{r} \tag{10}$$

where $|\vec{a}-\vec{b}|$ is the Euclidean distance between the two vectors and $\hat{r}$ is the unit vector pointing from $\vec{a}$ to $\vec{b}$.

Vector Example

Consider an example in 2D space where $\vec{a} = (x_1, y_1)$ and $\vec{b} = (x_2, y_2)$:

$$\vec{N}(\vec{a},\vec{b}) = \frac{k}{\left[(x_2-x_1)^2+(y_2-y_1)^2\right]^{n/2}}\hat{r} \tag{11}$$

Where

$$\hat{r} = \frac{\vec{b}-\vec{a}}{\vec{b}-\vec{a}} \tag{12}$$

7. Symmetry in PTNI

Symmetry in PTNI refers to the idea that the strength between two numbers or vectors should remain unchanged if their positions are swapped.

7.1. Symmetry in scalar form

In the scalar case, the interaction is defined as:

$$N(a,b) = \frac{k}{|a-b|^n} \tag{13}$$

This function is symmetric because $|a - b| = |b - a|$, so $N(a,b) = N(b, a)$.

7.2. Symmetry in vector form

In the vector case:

$$\vec{N}(\vec{a},\vec{b}) = \frac{k}{|\vec{a}-\vec{b}|^n}\hat{r} \tag{14}$$

Here, $\hat{r}$ points from $\vec{a}$ to $\vec{b}$, so swapping $\vec{a}$ and $\vec{b}$ reverses the direction:

$$\vec{N}(\vec{a},\vec{b}) = -\vec{N}(\vec{b},\vec{a}) \tag{15}$$

Thus, the strength vector is **antisymmetric**.

7.3. General symmetry condition

- In scalar form, the strength is symmetric.
- In vector form, the strength is antisymmetric (direction changes, magnitude remains).

Conclusion

Pathak's Theory of Number Interaction (PTNI) gives us a new way to think about numbers and how they interact. By using the difference between two numbers and raising it to a power, we can define an interaction that shows how strong or weak the relationship between two numbers is. PTNI can be applied in many areas of mathematics and science, helping us understand everything from simple numbers to complex systems.

Originality note

Pathak's Theory of Number Interaction (PTNI) is an original mathematical framework introduced by the author. The references below are intended for general mathematical context and do not specifically address PTNI. This work is shared to inspire curiosity and further exploration.

References

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