On the Properties of Multiplicative Digit Mapping in Geometric Calculations

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Abstract

This paper proposes a mathematical convention termed the Consecutive Digit Multiplication Rule (CDMR). Under this rule, the standard positional base-10 interpretation of a number is replaced by a multiplicative function of its constituent digits. The paper defines this rule formally and demonstrates its application in determining the area of a circle where the radius is expressed as a digit string.

I. Introduction

In standard arithmetic, a sequence of digits d1 d2 ... dn is interpreted using positional base-10 notation:

$$d1\ d2 \ldots dn = d1 \times 10^{(n-1)} + d2 \times 10^{(n-2)} + \ldots + dn \times 10^0$$

This paper explores an alternative system in which the relationship between consecutive digits is defined to be purely multiplicative. Under this system, a digit string represents the product of its individual digits.

II. Theorem 1: The Consecutive Digit Multiplication Rule (CDMR)

Statement:
For any integer represented by a sequence of decimal digits d1 d2 ... dn, the effective value V of the sequence under CDMR is defined as:

$$V = d1 \times d2 \times \ldots \times dn$$

Proof (by Definition):

Let
LHS = d1 d2 ... dn

By the definition of CDMR, juxtaposition of digits implies multiplication. Therefore,

$$RHS = d1 \times d2 \times \ldots \times dn$$

Hence,

LHS = RHS

Therefore proved.

III. Theorem 2: Application to Circle Area

Statement:
Let the radius r of a circle be defined by a digit string under CDMR. Then the area A of the circle is given by:

$A = \pi r^2$
$A = \pi (d1 \times d2 \times ... \times dn)^2$

Proof:

LHS = πr^2

Substituting r using CDMR:

$r = d1 \times d2 \times ... \times dn$

Therefore,

RHS = $\pi (d1 \times d2 \times ... \times dn)^2$

Thus,

LHS = RHS

Therefore proved.

Examples

Example A:
Let r = 12
Under CDMR:

$r = 1 \times 2 = 2$

$A = \pi \times 2^2 = 4\pi$

Example B:
Let r = 3844
Under CDMR:

$r = 3 \times 8 \times 4 \times 4 = 384$

$A = \pi \times 384^2$

IV. The Zero-Digit Constraint (Handling Edge Cases)

Under CDMR, if any digit in the sequence equals 0, then:

$V = 0$

Observation:
If $r = 10$, then:

$r = 1 \times 0 = 0$
$A = \pi \times 0^2 = 0$

Thus, the digit 0 acts as a nullifier, consistent with the zero-product property of multiplication.

V. Conclusion

The Consecutive Digit Multiplication Rule (CDMR) provides a systematic method for mapping digit strings to multiplicative values and applying them within geometric formulas. Further exploration may include inverse mappings and properties under this alternative numeral interpretation.