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Research Article

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Back to The Fundamental Principles of Arithmetic

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Abstract
This article wanna discuss the very beginning point of arithmetic that no one notices in the frame of the noncommutative principle, multiplication, division, and factorial under boundary conditions. Their explanation was carried out based on the Early Mongolian calculus. New evidence has been found: Some mistakes of arithmetic influence in all sciences.

Keywords: Division and Multiplications by Zero, Early Mongolian Calculus, Arithmetic in Factorial and Euler Formulas

1. Introduction

Major discoveries in physics contain more or fewer errors common feature of which found in almost all laws is the singularity expressed by Equation (1) [1].

$$y = \lim_{x \to 0} \frac{1}{x} \tag{1}$$

Physicists of all generations have avoided the zero and infinity boundary conditions in which singularity is dominated. This incompleteness is due to mathematics, not physics. As the value of x increases, the value of y decreases infinitely and vice versa. For the explaining, the singularity Newton's inverse square law has been used more than three hundred years and even now. It can be used in the average distance of celestial objects except that they are too close or too far away. Recent studies in quantum mechanics and cosmology have shown that the inverse square law is erroneous [1, 2].

I would like to show modern arithmetic in comparison with Early Mongolian calculus and to provide some explanations for the first point of mathematics that seems almost trivial, no one notices and ignores is the operations of division and multiplication in the boundary conditions as zero and infinity. With a bit more courage I would like to attempt to show arithmetic mistakes because Erwin Schrodinger said once that “the task is not so much to see what no one has yet seen; but to think what nobody has yet thought, about that which everybody sees” [3].

What if I told you that, despite what you may have learned in school, you can divide by zero if you just think of it in the right way? And what if the answer you get not only had real-world significance but could explain why other parts of math work the way they do? If you’re not afraid to question what you’ve been told, and you’re willing to be flexible with math, then read onward to discover… [4].

The research paper aims to clarify the fundamental principles of arithmetic: division, multiplication, factorial, and Euler formulas, finally, I review their practical evidence.

Some of you will probably think it simple from what I write here. Wait for hold on. So, let’s look at how arithmetic describes this situation.

2. Mongolian Mathematical Thinkings

The essence of mathematics is not to make simple things complicated, but to make complicated things simple. -S. Gudder.

2.1 Dividing operations

In ordinary arithmetic, the expression has no meaning, as there is no number which, when multiplied by 0, gives a (assuming a≠0) and so division by zero is undefined. Since any number multiplied by zero is zero, the expression 0/0 is also undefined; when it is the form of a limit, it is an indeterminate form [5]. There are mathematical structures in which a/0 is defined for some a such as in the Riemann sphere (a model of the extended complex plane) and the projectively extended real line; however, such structures do not satisfy every ordinary rule of arithmetic (the field axioms). In computing, a program error may result from an attempt to divide by zero [5, 6].

Table 1: Division in modern elementary arithmetic

Division	Size	Comment
1/0		Undefined
1/1	1	
1/2	0.5	
...	...	...
1/n	1/n	
1/∞	0	

In mathematics, 1/0 is meaningless. This is nonsense. 1/1 is 1. What it means is that if one thing is divided or sliced, it is still or not cut at all. In mathematics, the dividing operation shows only the sizes, but the number of slices is not important.

Table 2: Division according to Early Mongolian calculus [7, 8]

Division	Size	Number of slices
1/0	1	1
1/1	1⁄2	2
1⁄2	1⁄3	3
1⁄3	1⁄4	4
...	…	...
1/n	1 ⁄ (n+1)	n+1
1⁄∞		∞+1
$\lim_{x\to\infty} \frac{1}{x} = 0$	0	$\lim_{x\to\infty} \frac{1}{x} = \infty + 1$

1/0 means that it doesn't cut.1/1 means by 1 cutting the whole is divided into two pieces, but the size of a slice decreases by 2 times or 50%. 1/2 indicates that by 2 chops the whole is divided into 3 pieces and their sizes decrease by 0.33% and so on. When the numbers of divisors increase, the size of the dividend decrease (Figure 1).

Consider having ten cookies, and these cookies are to be distributed equally to five people at a table. Each person would receive 10/5=2 cookies. Similarly, if there are ten cookies, and only one person at the table, that person would receive 10/1=10 cookies. So, for dividing by zero, what is the number of cookies that each person receives when 10 cookies are evenly distributed amongst 0 people at a table? Certain words can be pinpointed in the question to highlight the problem. The problem with this question is the "when". There is no way to distribute 10 cookies to nobody. So, 10⁄0 at least in elementary arithmetic, is said to be either meaningless or undefined [4, 5].

Answer: There is no problem. As shown in Table 2, it is defined 10 ⁄ 0 =10. 10 cookies stay on the table and wait for persons to eat.

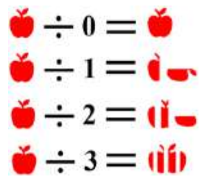

Figure 1: Division by Mongols

Following in the footsteps of Brahmagupta, the Indian mathematician Bhaskara (1114-1185 A.D.) seems to have worked extensively with the number zero. It is clear that Bhaskara knew that

In ancient Indian mathematics work, one also finds the formula

If one looks at this equation as

then the formula is correct [9-11].
We would like precise it.

$$\frac{a}{0} = \begin{cases} a \\ \infty \end{cases} \tag{2}$$

$$\frac{a}{0} \cdot 0 = a \cdot 0 = a \tag{3}$$

In 830, Mahāvīra unsuccessfully tried to correct Brahmagupta's mistake in his book in Ganita Sara Samgraha: "A number remains unchanged when divided by zero[12-15]".

In today's eyes, the solutions of Brahmagupta and Mahavira are correct or a/0 = a is unchanged.

2.1.2 Division in Ring

In the case of ring dividend and divisor are equal.

Table 3: Dividing the ring (circle)

Number of cutting	Slice	Comment
1/0	1	No cutting
1/1	1	
1/2	2	
1/3	3	
1/4	4	
...	…	
1/n	n	
1/∞	∞	

1⁄(0=1) means that it did not cut and remains unchangeable. We see the number of cutting equals slices. It proves that the circle and ring differ tremendously from other geometric forms.

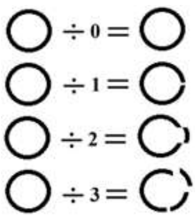

Figure 2: Dividend and divisor equal in a ring

2.1.3 Projectively Extended Real Line

The set ℝ ∪{∞} is the projectively extended real line, which is a one-point compactification of the real line. Here ∞ means an unsigned infinity, an infinite quantity that is neither positive nor negative. This quantity satisfies -∞=∞, which is necessary for this context. In this structure, a/0=∞ can be defined for nonzero a, and a/∞=0, when a is not ∞. It is the natural way to view the range of the tangent function and cotangent functions of trigonometry: tan(x) approaches the single point at infinity as x approaches either +π/2 or -π/2 from either direction. This definition leads to many interesting results. However, the resulting algebraic structure is not a field, and should not be expected to behave like one. For example, ∞+∞ is undefined in this extension of the real line [5,16-18].

2.2 Multiplication

2.2.1 The Multiplications in Elementary Arithmetic and Early Mongolian Calculus

Table 4: Multiplication in contemporary elementary arithmetic

Product	Size	Comment
1 x 0	0	
1 x 1	1	
1 x 2	2	
...	...	...
1 x *n*	n	
1 x ∞	∞	

Table 5: Multiplication of Early Mongolian calculus [8]

Product	Rise		Product	Rise
1 x 0	1		2 x 0	2
1 x 1	2		3 x 1	6
1 x 2	3		4 x 2	12
1 x 3	4		5 x 3	20
...	...		…	…

Its comment is shown in 2.2.2

Table 6: Multiplication of 0 by a number in the Early Mongolian calculus

Product	Rise		Product	Rise
0 x 0	0		0 x 4	0
0 x 1	0		…	…
0 x 2	0		0 x (n-1)	0
0 x 3	0		0 x x	0
...	...		…	…

The zero multiplied by any number is zero. Because it has no base number. It is the same that you have no money in the bank. You only imagine the money.

In this paper, we don’t explain the square of a number and square roots.

2.2.2 Banking Mathematics

There are some basic mistakes in arithmetic (Table 4), but amazingly, the banking and financial system can use the correct version (Table 5).

a. If the mathematician wants to increase your money 1 times, please don't give it. Because his calculation result is 1 x 1 = 1, only your money would be returned at least. But according to Mongolian calculus, the banker can account it is 1 x 1 = 2. Yes, your money will increase by 2 times.
b. The first number 1 is the base number (money deposited into a bank). Second number 1 shows the bank rate (if the bank rate is 1 it means 100%). Total money (T) equals the base money plus the dividend.
c. The banking account goes correctly by Early Mongolian calculus without knowing it.
d. Bank does not leave the base number in all operations.
e. We need to understand that 0 multiplied by any number is 0. Because it has no base (base money in the bank) for mathematical operations. It looks like he has no money and only imagines.
f. If a number multiplies by 0, it remains unchangeable. 1 x 0 = 1. He has money, which is in his pocket.
g. The negative numbers mean the deficits

3 Suggestions To Add To Some Expressions Of Classical Arithmetic

The division and multiplication of Early Mongolian calculus can be reflected in the following facts:

3.1 Less Size, More Slices

1 kg of frozen meat is prepared for dinner by 10 cuts, it becomes 11 pieces. You continue to cut it again, you will get 11x11x11 = 1331 small cubes of meat. The current mathematical method shows 10x10x10 = 1000 pieces. There are 331 more pieces, and the mathematical calculation is erroneous (Figure 3).

Figure 3: The size of sliced meat per 1 kg small, but its pieces become many [8].

The size of one piece becomes smaller (1/1331) and the number becomes a lot (1331). Therefore, don't worry you have 1 kg of meat.

$$\left(\frac{1}{1331}\right) \cdot 1331 = 1\, kg \quad (4)$$

Finely chop:

$$\left(\frac{1}{\infty}\right) \cdot \infty = 0 \cdot \infty = 1 \quad (5)$$

It is not suitable for mathematical notation here, so it can be written in the following format. However, expression (16) gives two answers.

$$\lim_{x\to\infty} \frac{1}{x} = \begin{cases} 0\ size \\ \infty\ number \end{cases} \quad (6)$$

In mathematics, $\infty + 1 \approx \infty$, because 1 is negligible. But 1 has a very deep meaning that nature does not throw away a single piece. That way nature is perfect. But people can throw, mathematics can throw.

3.2 Classroom Arithmetic

I would like to add my views to the traditional maths expressions in Section 2 and [8].

1) In the mathematical expression written in [5]:

$$0\,x\,1 = 0$$
$$0\,x\,2 = 0$$

The following is true:

$$0\,x\,1 = 0\,x\,2 \quad (7)$$

But it has a big problem, if

$$1\,x\,0 \neq 2\,x\,0 \text{ or } 1/(0 = 2/0).$$

In this case $1 \neq 2$.

This comment is false. As shown in Table 6, both sides of Equation (7) are equal. Because neither base number is present, both sides are equal to 0.

It is noncommutative:

$$0 * c \neq c * 0 \quad (8)$$

(Multiply zero by the number (c) to get 0. But if you multiply the number by zero, the number remains the same. Therefore 0≠c.)

$$a - \infty = \infty - a \quad a \in R \quad (9)$$

It is false,

$$-\infty \ll a \ll +\infty$$
$$a - \infty \approx -\infty;\ \infty - a \approx +\infty,$$
$$-\infty \neq +\infty$$
$$a / \infty = 0 \quad a \in R \quad (10)$$

The expression has 2 solutions

$$\frac{a}{\infty} = \begin{cases} 0\ \text{size} \\ \infty\ number \end{cases} \quad a \in R \quad (11)$$

In traditional arithmetic, numbers are omitted.

$$\frac{\infty}{a} = \infty \quad a \in R \quad (12)$$

The expression has 3 solutions:

$$\frac{\infty}{a} = \begin{cases} \infty\ size \\ a + 1\ (number) \\ a\ for\ a\ ring \end{cases} \quad (13)$$

$$\infty \cdot 0 \quad (14)$$

$\infty \cdot 0 = 1$, because $1/0 = \infty$. It is $1/\infty = 0$

$$0 \cdot \infty = 0;\ \infty \cdot 0 = \infty \quad (15)$$

3.3 Factorial: 0! ≠ 1 and 0! = 0

a) In mathematics, the factorial of n is denoted by n! and calculated by the integer numbers from 1 to n. The formula for n factorial is

$$n! = n \cdot (n-1)! \quad [19] \quad (16)$$

b) **Proof #1** as follows:

$$\begin{aligned} 5! &= 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 \cdot 0 \\ 4! &= 4 \cdot 3 \cdot 2 \cdot 1 \cdot 0 \\ 3! &= 3 \cdot 2 \cdot 1 \cdot 0 \\ 2! &= 2 \cdot 1 \cdot 0 \\ 1! &= 1 \cdot 0 \\ 0! &= 0 \end{aligned} \quad (17)$$

There is no problem that the number multiplied by 0 is equal to the number itself according to Table (5). So, 0!= 0

c) The latest term 0 in Equation (17) is called the empty product. In mathematics, an empty product, or nullary product or vacuous product, is the result of multiplying no factors. It is by convention equal to the multiplicative identity (assuming there is an identity for the multiplication operation in question),
just as the empty sum-the result of adding no numbers-is by con-

vention zero, or the additive identity [20-23].

The term empty product is most often used in the above sense when discussing arithmetic operations. However, the term is sometimes employed when discussing set-theoretic intersections, categorical products, and products in computer programming [24].

If 0 has factorial the Formula (16) would be written in the next form:

$$n! = n\cdot(n\text{-}1)! = n\cdot(n\text{-}1)\cdot\ldots\cdot1\cdot0\cdot(0\text{-}1)\cdot(0\text{-}2)\cdot\ldots \quad (18)$$

From Table (6)

$$0\cdot (0\text{-}1)\cdot(0\text{-}2)\cdot\ldots= 0 \quad (19)$$

The term "empty product" is not needed to be used. 0 is only a term of multiplications. For this reason, the definition of the factorial of n is denoted by n! and calculated by the integer numbers from n to 0. The formula for n factorial is

$$n! = n\cdot (n\text{-}1)! = n\cdot(n\text{-}1)\cdot\ldots\cdot1\cdot0 \quad (20)$$

Proof #2: If n=0, Equation (16) becomes

$$0! = 0\cdot(0\text{-}1)! = 0 \quad (21)$$

due to 0 multiplies by number is 0. So, 0 has no factorial.

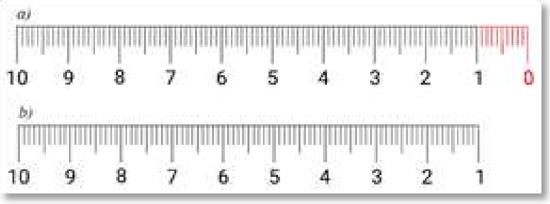

Figure 4: a) shows the order of 10! on a ruler, but b) is not 10!

Factorial seven is written 7!, meaning 1 × 2 × 3 × 4 × 5 × 6 × 7. Factorial zero is defined as equal to 1 [25].
This formulation of factorial is false, because of that:

i) 1 × 2 × 3 × 4 × 5 × 6 × 7 is not factorial form (see next item (ii))
ii) Factorial must include 0:
iii) 0×1 × 2 × 3 × 4 × 5 × 6 ×7=0 as shown in Table (6).
7!=7×6×5×4×3×2×1×0 due to expression (17).
iv) The factorial order is noncommutative:
0×1 × 2 × 3 × 4 × 5 × 6 ×7≠7×6×5×4×3×2×1×0
0≠7!
v) Factorial must have ordered from high to less as written in Equation (16)
vi) 0 is not an "empty product" further, but it is an elementary member of factorial.

As result, the new definition of the factorial of n is denoted by n! and calculated by the product of all positive integer numbers from n to 0.

Proof #3:

3.3 Division by 0 in Euler formula

Proof #4: The Euler's formula [26]:
Euler's formula is written in the next form:

$$e^{ix} = 1 + ix + \frac{(ix)^2}{2!} + \frac{(ix)^3}{3!} + \frac{(ix)^4}{4!} + \frac{(ix)^5}{5!} + \cdots$$

According to the Early Mongolian Calculus

$$e^{ix} = \frac{(ix)^0}{0} + \frac{(ix)^1}{1\cdot0} + \frac{(ix)^2}{2\cdot1\cdot0} + \frac{(ix)^3}{3\cdot2\cdot1\cdot0} + \frac{(ix)^4}{4\cdot3\cdot2\cdot1\cdot0} + \frac{(ix)^5}{5\cdot4\cdot3\cdot2\cdot1\cdot0} + \cdots \quad (22)$$

$$= \frac{1}{0} + \frac{(ix)^1}{1\cdot0} + \frac{(ix)^2}{2\cdot1\cdot0} + \frac{(ix)^3}{3\cdot2\cdot1\cdot0} + \frac{(ix)^4}{4\cdot3\cdot2\cdot1\cdot0} + i\frac{x^5}{5\cdot4\cdot3\cdot2\cdot1\cdot0} + \cdots$$

$$= 1 + i\frac{x}{1!} - \frac{x^2}{2!} - i\frac{x^3}{3!} + \frac{x^4}{4!} + i\frac{x^5}{5!}$$

Euler's formula is correct, but it shows the 1⁄0=1 and the factorial must to includes the 0.

4. Conclusion

1. According to early Mongolian calculus:

i. Division has 2 solutions: divisor and dividend. 1/0 means that there is no action of division. 1/1=1 means by 1 division the whole is divided into two pieces, but the size of a dividend decreases by 2 times or 50%. 1/2 indicates that by 2 chops the whole is divided into 3 pieces and their sizes decrease by 0.33% and so on. When the numbers of divisions increase, the sizes of dividends decrease.
1/0 = ∞, on the other hand, consists of an infinite number of fractions.

ii. Imagine there is one sack of endless milled grain, the arithmetician answers that there is nothing 1/∞=0). But there is one sack of grind flour ((1/∞)·∞=0·∞=1) by Mongolian calculus.

iii. Multiplication: 1x0=1; 1x1=2; 1x2=3 and so on. But 0x1=0; 0x2=0; 0x3=0 and so on.

iv. The next expression is noncommutative:
0*c≠c*0.

v. Bank mathematics is correct according to the Early Mongolian Calculus.

2. The new definition of the factorial of n is denoted by n! and calculated by the product of all positive integers from n to 0. The formula for n factorial is

$$n! = n\cdot (n\text{-}1)! = n\cdot (n\text{-}1)\cdot\ldots\cdot1\cdot0$$

3. 0! = 1 is false. 0! = 0 is correct.

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