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PRIME NUMBER CONJECTURE

Chris Gilbert Waltzek

Northcentral University, USA

ABSTRACT: *This paper builds on Goldbach's weak conjecture, showing that all primes to infinity are composed of 3 smaller primes, suggesting that the modern definition of a prime number may be incomplete and requires revision. The results indicate that the axioms underpinning prime numbers should include one as a prime number and two as a non-prime number, adding a new dimension to the most fundamental of all integers.*

KEYWORDS: Prime Number, Goldbach's weak conjecture

PRIME NUMBER CONJECTURE

In a letter to the great mathematician Leonard Euler, Goldbach posited that all prime numbers ($\mathbb{P}'$) greater than five ($\mathbb{P}' > 5$) are the sum of 3 smaller primes, known as Goldbach's weak conjecture (Bruckman (2006); Bruckman (2008); Chang (2013) & Shu-Ping (2013). The conjecture was recently proven true therefore; all primes to infinity are composed of 3 smaller primes. The following theorem builds upon the conjecture to show that the modern definition of a prime number may require revision.

Theorem

Premise #1: Assume that *all* prime numbers are the sum of 3 smaller primes and not just those > 5 (as proposed by Goldbach to Euler) with only one exception, the number 1 (1 was assumed prime at the time of Euler and Goldbach).

Premise #2: Assume that the number *two is not, prime.* This claim is intuitive, not one *even* prime has been identified for any number up to 17 million digits in length, so why should it be assumed that the *even number 2* is prime?

Conversely, the empirical facts suggest that the current definition of a prime number requires revision. Given the two premises, a proof follows that resolves the problem in Goldbach's Weak Conjecture regarding primes of less than 6, en passant proving the primality of 1 and non-primality of 2. Contrary to the work of Goldbach, the numbers 5 and 3 are shown to be composed of 3 smaller prime numbers and the number 2 does not fit the revised definition of a prime number.

Proof

$3 + 1 + 1 = 5$

$1 + 1 + 1 = 3$

$1 + 1 + ? \neq 2$

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Quod Erat Demonstrandum (Q.E.D.).

Therefore, the modern definition of a prime number is de facto, incomplete. The number 1 is prime and the number two is not prime. A new prime number definition follows:

Deduction

1. A prime number is an *odd* and natural number,
2. composed of *the sum of three smaller prime numbers*,
3. with *only two factors*: 1 and itself.

The only exception is 1, which is presumed to be a special case prime, almost transcendental (π = 3.14, e = 2.71, & Φ = 1.618), the mother / father of all prime numbers and the only common factor of *all prime numbers*. A logical proof follows (see Equation 1.1):

$$\therefore \{x \mid x \in \mathbb{P}', 1 \subset x \land 2 \not\subset x\} \Rightarrow \top \ \blacksquare \qquad 1.1.$$

Hóper édei deîxai (OEΔ)

Although the results seem trivial on the surface, the findings suggest that the axioms underpinning prime numbers may require adjustment ($2 \neq \mathbb{P}'$), adding a new dimension to the most fundamental of all integers, prime numbers.

DISCUSSION

This paper builds on Goldbach's weak conjecture, showing that all primes to infinity are composed of 3 smaller primes, suggesting that the modern definition of a prime number may be incomplete and requires revision. The results indicate that the axioms underpinning prime numbers should include one as a prime number and two as a non-prime number and adding a new dimension to the most fundamental of all integers, prime numbers.

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