CSCanada
Studies in Mathematical Sciences
Vol. 8, No. 1, 2014, pp. 21-26
DOI:10.3968/4014

ISSN 1923-8444 [Print]
ISSN 1923-8452 [Online]
www.cscanada.net
www.cscanada.org

Proving the Twin Prime Conjecture

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Received: November 11, 2013/ Accepted: January 5, 2014/ Published online: February 26, 2014

Abstract: Presented and proved symmetry primes theorem, parallelism proving the twin primes conjecture, Goldbach conjecture. Give part of the calculation.

Key words: Integer; Primes; Composite number; Theorem

Liu, D., & Liu, J. F. (2014). Proving the Twin Prime Conjecture. *Studies in Mathematical Sciences, 8*(1), 21-26. Available from URL: http://www.cscanada.net/index.php/sms/article/view/4014 DOI: http://dx.doi.org/10.3968/4014

1. INTRODUCTION

Mathematicians found that primes of distance 2, there are infinitely many numbers known as twin primes conjecture [1-3], for example, (11, 13), (59, 61). In 1742, the German mathematician Goldbach found even greater than 4 are each equal to two prime numbers and. known as Goldbach conjecture, For example, 6 = 3+3, 8 = 3+5, Here proved:

$$L(x) \sim \frac{\pi^2(x)}{x}, \quad (x \to \infty) . \tag{1}$$

Here (1) known as *twin primes conjecture*. Wherein L (x) is the numbers of twin primes. And proved:

$$G(N) \sim \frac{\pi^2(N)}{N}, \quad (N \to \infty). \tag{2}$$

Here (2) known as *Goldbach conjecture*. Wherein G (x) is the numbers of two primes and.

2. DISTRIBUTION DENSITY OF SYMMETRY PRIMES

Set the Integer $x = 16$, we have:

k is 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14,

$k+2$ is 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,

Wherein $k+2$ is the primes have: 2, 3, 5, 7, 11, 13,

Set $k+2$ is the primes, the quantity as $\pi(x)$, we get [5-6]:

$$\frac{\pi(x)}{x}\ . \tag{3}$$

Here (3) as *distribution density of symmetry primes*.

Set the composite number h, here let 0 and 1 is the composite number, we have:

h is 0, 1, 4, 6, 8, 9, 10, 12, 14,

$h+2$ is 2, 3, 6, 8, 10, 11, 12, 14, 16,

Wherein $h+2$ is primes have: 2, 3, 11. Set the h quantity as F, $h+2$ is the primes, the quantity as $F(x)$, we get:

$$\frac{F(x)}{F}\ . \tag{4}$$

Here (4) also as *distribution density of symmetry primes*. Wherein $F = x - \pi(x) - 1$, for example, Let $x = 16$, $\pi(16) = 6$, and $F = 9$, $F(16) = 3$, by (3) and (4) get:

$\frac{\pi(16)}{16} = \frac{6}{16}$ and $\frac{F(16)}{9} = \frac{3}{9}$.

Calculate:

x,	$\pi(x)/x$,	$F(x)/F$,
10^1,	0.4,	0.4,
10^2,	0.25,	0.23,
10^3,	0.168,	0.162,
10^4,	0.1229,	0.1168,
10^5,	0.09592,	0.09256,
10^6,	0.078498,	0.076321,
10^7,	0.0664579,	0.0648711,
10^8,	0.05761455,	0.05646461,

3. THE TWIN PRIMES

Set primes p, we have:

p is 2, 3, 5, 7, 11, 13,

$p+2$ is 4, 5, 7, 9, 13, 15,

Wherein $p+2$ is the primes have: 5, 7, 13, the twin primes (3, 5), (5, 7), (11, 13). Set $p+2$ is the primes, the quantity as $L(x)$, we can get [1]:

$$\pi(x) = F(x) + L(x). \tag{5}$$

By (5) we can prove the twin primes conjecture.

4. SYMMETRY PRIMES THEOREM

The *T* theorem:

$$F(x) \sim \frac{F\pi(x)}{x}, \quad (x \to \infty). \tag{6}$$

Here (6) known as *symmetry primes theorem* [5].

Proof: by (4) we get:

$$F = x - \pi(x) - 1 = x\left(1 - \frac{\pi(x)+1}{x}\right). \tag{7}$$

By (7) can get:

$$\lim_{x\to\infty} \frac{x}{F} = 1.$$

If $F \sim x$, then $F(x) \sim \pi(x)$, by (3), (4) we can get:

$$\lim_{x\to\infty} \frac{x}{F} \Big/ \frac{\pi(x)}{F(x)} = 1. \tag{8}$$

By (8) can get:

$$\frac{F(x)}{F} \sim \frac{\pi(x)}{x}, \quad (x \to \infty). \tag{9}$$

By (9) The T theorem proved.

5. PROVE THE TWIN PRIMES CONJECTURE

By (5) we get:

$$L(x) = \pi(x) - F(x). \tag{10}$$

By (6), (10) can get:

$$L(x) \sim \pi(x) - \frac{F\pi(x)}{x}, \quad (x \to \infty). \tag{11}$$

By (11) we get:

$$L(x) \sim \frac{\pi^2(x)}{x}, \quad (x \to \infty).$$

The twin primes conjecture proved. The number of twin primes. By (10) we get [6-7]:

$$\pi(x) \sim \sum_{n=2}^{x} \frac{1}{\ln(n)} \text{ and } F(x) \sim \frac{x}{\ln x}.$$

Can get:

$$L(x) \sim \sum_{n=2}^{x} \frac{1}{\ln(n)} - \frac{x}{\ln x}, \quad (x \to \infty).$$

Generally speaking:

$$L(x) \sim c\sum_{n=2}^{x}\frac{1}{\ln(n)} - c\frac{x}{\ln x}, \quad c = 1.32\cdots\cdots$$

6. PROVE GOLDBACH CONJECTURE

Set even $N = 16$, $k < N$, we have:

k	is 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,
N-k	is 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1.

Set N-k is the numbers of primes as π (N), we get [4]:

$$\frac{\pi(N)}{N}. \tag{12}$$

Set composite number h, the numbers of composite number as F, we have:

h	is 4, 6, 8, 9, 10, 12, 14, 15,
N-h	is 12, 10, 8, 7, 6, 4, 2, 1.

Set N -h is the numbers of primes as F (N), we get [5]26,[6]:

$$\frac{F(N)}{F}. \tag{13}$$

Set the primes p, we have [4]:

p	is 2, 3, 5, 7, 11, 13,
N-p	is 14, 13, 11, 9, 5, 3,

Set N -p is the numbers of primes as G (N), we can get:

$$\pi(N) = F(N) + G(N). \tag{14}$$

By (12), (13) can prove:

$$F(N) \sim \frac{F\pi(N)}{N}, \quad (N \to \infty). \tag{15}$$

The proof and the twin primes conjecture are the same. by (14), (15) we can get [8]:

$$G(N) \sim \frac{\pi^2(N)}{N}, \quad (x \to \infty).$$

The Goldbach conjecture proved.

7. GOLDBACH'S CONJECTURE CALCULATION

Formulas are [3]:

$$G(N) \sim \frac{2c(N)\,N}{\ln^2(N)}. \tag{16}$$

Here (16) known as *Hardy formula*. Which *Laman Niu Yang factor*:

$$c(N)=\prod_{P\le N}\frac{p(P-2)}{(P-1)^2}\prod_{P|N}\frac{P-1}{P-2}.$$

8. WANG XINYU DOUBLE SIEVE TRANSFORM

Set $p>2$, have:

$$G(N)\sim\frac{N}{2}\prod_{P|N}\left(1-\frac{1}{P}\right)\prod_{P\perp N}\left(1-\frac{2}{P}\right),\quad p\le N^{1/2}. \tag{17}$$

Here (17) known as *double sieve transform formula*. qingdao china Wang Xinyu transform:

$$\frac{N}{2}\prod_{P|N}\frac{P-1}{P}\prod_{P\perp N}\frac{P-2}{P}=\frac{N}{2}\frac{\prod_{P|N}\frac{P-1}{P}}{\prod_{P|N}\frac{P-2}{P}}\prod_{P|N}\frac{P-2}{P}\prod_{P\perp N}\frac{P-2}{P}$$

$$=\frac{N}{2}\prod_{P|N}\frac{P-1}{P-2}\prod_{P\le\sqrt{N}}\frac{P-2}{P}$$

$$=\frac{N}{2}\prod_{P|N}\frac{P-1}{P-2}\prod_{P\le\sqrt{N}}\frac{P-2}{P}\frac{P^2}{(P-1)^2}\frac{(P-1)^2}{P^2}$$

$$=\frac{N}{2}\prod_{P|N}\frac{P-1}{P-2}\prod_{P\le\sqrt{N}}\frac{P(P-2)}{(P-1)^2}\prod_{P\le\sqrt{N}}\frac{(P-1)^2}{P^2}$$

Can get [2]:

$$\prod_{P\le\sqrt{N}}\frac{(P-1)^2}{P^2}\sim\frac{4\pi^2(N)}{N^2}.$$

Get:

$$G(N)\sim 2\prod_{P|N}\frac{P-1}{P-2}\prod_{P\le\sqrt{N}}\frac{P(P-2)}{(P-1)^2}\frac{N}{\ln^2 N}. \tag{18}$$

Here (18) also double sieve transform formula. And Hardy formulas are the same.

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