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On the singular series in the Jiang prime *k*-tuple theorem

Abstract

Using Jiang function we prove Jiang prime -tuple theorem. We find true singular series. Using the examples we prove the Hardy-Littlewood prime -tuple conjecture with wrong singular series. Jiang prime -tuple theorem will replace the Hardy-Littlewood prime -tuple conjecture.

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Theorems

Jiang prime k-tuple theorem with true singular series.[1,2]

We define the prime k-tuple equation

$$p,\ p+n_i, \tag{1}$$

where $2\,|\,n_i, i=1,\cdots k-1$.

we have Jiang function[1,2]

$$J_2(a)) = \prod_P (P-1-\chi(P)), \tag{2}$$

where $co=\prod_P P$, $\chi(P)$ is the number of solutions of congruence

$$\prod_{i=1}^{k-1}(q+n_i)\equiv 0 \ (\bmod P),\ q=1,\cdots,p-1 \tag{3}$$

which is true.

If $\chi(P)<P-1$ then $J_2(\omega)\neq 0$. There exist infinitely many primes P such that each of $P+n_i$ is prime. If $\chi(P)=P-1$ then $J_2(\omega)=0$. There exist finitely many primes P such that each of $P+n_i$ is prime. $J_2(\omega)$ is a subset of Euler function $\varnothing(co)$.[2]

If $J_2(\omega)\neq 0$, then we have the best asymptotic formula of the number of prime P.[1,2]

$$\pi_k(N,2) = |\{P\le N : P+n_i = prime\}| - \frac{J_2(co)co^{k-1}N}{\varnothing^k(co)\log^k N} = C(k)\frac{N}{\log^k N} \tag{4}$$

$$\varnothing(co)=\prod_P (P-1)$$

$$C(k)=\prod_P\left(1-\frac{1+\chi(P)}{P}\right)\left(1-\frac{1}{P}\right)^{-k} \tag{5}$$

is Jiang true singular series.

Example 1

Let $k=2, P, P+2$, twin primes theorem.

From (3) we have

$$\chi(2)=0, \chi(P)=1\ if\ P>2 \tag{6}$$

Substituting (6) into (2) we have

$$J_2(a)) = \prod_{P\ge 3}(P-2)\neq 0 \tag{7}$$

There exist infinitely many primes P such that $P+2$ is prime. Substituting (7) into (4) we have the best asymptotic formula

$$\pi_k(N,2) = |\{P\le N : P+2 = prime\}| - 2\prod_{P\ge 3}\left(1-\frac{1}{(P-1)^2}\right)\frac{N}{\log^2 N} \tag{8}$$

Example 2

Let $k=3, P, P+2, P+4$.

From (3) we have

$$\chi(2)=0,\ \chi(3)=2 \tag{9}$$

From (2) we have

$$J_2(\omega)=0 \tag{10}$$

It has only a solution $P=3, P+2=5, P+4=7$. One of $P, P+2, P+4$ is always divisible by 3. Example 2 is not admissible.

Example 3

Let $k=4, P, P+n$, where $n=2,6,8$.

From (3) we have

$$\chi(2)=0, \chi(3)=1, \chi(P)=3\ if\ P>3. \tag{11}$$

Substituting (11) into (2) we have

$$J_2(\omega)=\prod_{P\ge 5}(P-4)\neq 0, \tag{12}$$

There exist infinitely many primes P such that each of $P+n$ is prime. Example 3 is admissible.

Substituting (12) into (4) we have the best asymptotic formula

$$\pi_4(N,2) = |\{P\le N : P+n = prime\}| - \frac{27}{3}\prod_{P\ge 5}\frac{P^3(P-4)N}{(P-1)^4\log^4 N} \tag{13}$$

Example 4

Let $k=5, P, P+n$, where $n=2,6,8,12$.

From (3) we have

$$\chi(2)=0, \chi(3)=1, \chi(5)=3, \chi(P)=4\ if\ P>5 \tag{14}$$

Substituting (14) into (2) we have

$$J_2(\omega)=\prod_{P\geq 7}(P-5)\neq 0 \tag{15}$$

There exist infinitely many primes P such that each of $P+n$ is prime. Example 4 is admissible. Substituting (15) into (4) we have the best asymptotic formula

$$\pi_5(N,2)=|\{P\leq N:P+n=prime\}|-\frac{15^4}{2^{11}}\prod_{P\geq 7}\frac{(P-5)P^4N}{(P-1)^5\log^5 N} \tag{16}$$

Example 5

Let $k=6,P,P+n$, where $n=2,6,8,12,14$.

From (3) and (2) we have

$$\chi(2)=0,\ \chi(3)=1,\ \chi(5)=4,\ J_2(5)=0 \tag{17}$$

It has only a solution $P=5,P+2=7,P+6=11,P+8=13,P+12=17,P+14=19$. One of $P+n$ is always divisible by 5. Example 5 is not admissible.

The Hardy-Littlewood prime k-tuple conjecture with wrong singular series.[3–17]

This conjecture is generally believed to be true, but has not been proved.[18]

We define the prime k-tuple equation

$$P,P+n_i \tag{18}$$

where $2\mid n_i, i=1,\cdots,k-1$.

In 1923 Hardy et al.[3] conjectured the asymptotic formula

$$\pi_k(N,2)=|\{P\leq N:P+n_i=prime\}|-H(k)\frac{N}{\log^k N}, \tag{19}$$

where

$$H(k)=\prod_P(1-\frac{V(P)}{P})\left(1-\frac{1}{P}\right) \tag{20}$$

is Hardy-Littlewood wrong singula series,

$v(P)$ is the number of solutions of congruence

$$\prod_{i=1}^{k-1}(q+n_i)\equiv 0(\bmod P),\ q=1,\cdots,P. \tag{21}$$

which is wrong.

From (21) we have $v(P)<P$ and $H(k)\neq 0$. For any prime k-tuple equation there exist infinitely many primes P such that each of $P+n_i$ is prime, which is false.

Conjecture 1

Let $k=2,P,P+2$, twin primes theorem

From (21) we have

$$v(P)=1 \tag{22}$$

Substituting (22) into (20) we have

$$H(2)=\prod_P\frac{P}{P-1} \tag{23}$$

Substituting (23) into (19) we have the asymptotic formula

$$\pi_2(N,2)=|\{P\leq N:P+2=prime\}|-\prod_p\frac{PN}{P-1\log^2 N} \tag{24}$$

which is wrong see example l. They do not get twin primes formula (8).

Conjecture 2

Let $k=3,P,P+2,P+4$.

From (21) we have

$$v(2)=1, v(P)=2\ if\ P>2 \tag{25}$$

Substituting (25) into (20) we have

$$H(3)=4\prod_{P\geq 3}\frac{P^2(P-2)}{(P-1)^3} \tag{26}$$

Substituting (26) into (19) we have asymptotic formula

$$\pi_3(N,2)=|\{P\leq N:P+2=prime,P+4=prim\}|-4\prod_{P\geq 3}\frac{P^2(P-2)N}{(P-1)^3\log^3 N} \tag{27}$$

which is wrong see example 2.

Conjecture 3

Let $k=4,P,P+n$, where $n=2,6,8$.

From (21) we have

$$v(2)=1, v(3)=2, v(P)=3\ if\ P>3 \tag{28}$$

Substituting (28) into (20) we have

$$H(4)=\frac{27}{2}\prod_{P>3}\frac{P^3(P-3)}{(P-1)^4} \tag{29}$$

Substituting (29) into (19) we have asymptotic formula

$$\pi_4(N,2)=|\{P\leq N:P+n=prime\}|-\frac{27}{2}\prod_{P>3}\frac{P^3(P-3)N}{(P-1)^4\log^4 N} \tag{30}$$

Which is wrong see example 3.

Conjecture 4

Let $k=5,P,P+n$, where $n=2,6,8,12$

From (21) we have

$$v(2)=1, v(3)=2, v(5)=3, v(P)=4 \text{ if } P>5 \tag{31}$$

Substituting (31) into (20) we have

$$H(5)=\frac{15^4}{4^5}\prod_{P>5}\frac{P^4(P-4)}{(P-1)^5} \tag{32}$$

Substituting (32) into (19) we have asymptotic formula

$$\pi_5(N,2)=|\{P\leq N:P+n=prime\}|-\frac{15^4}{4^5}\prod_{P>5}\frac{P^4(P-4)N}{(P-1)^5\log^5 N} \tag{33}$$

Which is wrong see example 4.

Conjecture 5

Let $k=6,P,P+n$, where $n=2,6,8,12,14$.

From (21) we have

$$v(2)=1, v(3)=2, v(5)=4, v(P)=5 \text{ if } P>5 \tag{34}$$

Substituting (34) into (20) we have

$$H(6)=\frac{15^5}{2^{13}}\prod_{P>5}\frac{(P-5)P^5}{(P-1)^6} \tag{35}$$

Substituting (35) into (19) we have asymptotic formula

$$\pi_6(N,2) = |\{P \le N : P+n = prime\}| - \frac{15^5}{2^{13}} \prod_{P>5} \frac{(P-5)P^5 N}{(P-1)^6 \log^6 N} \quad (36)$$

which is wrong see example 5.

Conclusion

The Jiang prime k-tuple theorem has true singular series.The Hardy-Littlewood prime k-tuple conjecture has wrong singular series. The tool of additive prime number theory is basically the Hardy-Littlewood wrong prime k-tuple conjecture which are wrong.[3–17] Using Jiang true singula series we prove almost all prime theorems. Jiang prime k-tuple theorem will replace Hardy-Littlewood prime k-tuple Conjecture. There cannot be really modern prime theory without Jiang function.

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Conflict of interest

Author declares that there is no conflict of interest.

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