Biostatistics and Biometrics
Open Access Journal
ISSN: 2573-2633

Juniper Publishers — key to the Researchers

Clinical Image
Volume 3 Issue 1 - September 2017
DOI: 10.19080/BBOAJ.2017.03.555601

Biostat Biometrics Open Acc J

The Normal Distribution Theorem of Prime Numbers

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Submission: August 23, 2017; **Published:** September 20, 2017

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key words: Prime Number; Sieve Method; Prime Number Theorem; Normal Distribution

Introduction

Let $Pi(N)$ be the number of primes less than or equal to N, $Pi\ (2 \le Pi \le Pm)$ be taken over the primes less than or equal to √N, then exists the formula as follows:

$$Pi(N) = INT\left\{N \times \prod\left(1 - \frac{1}{Pi}\right)\right\} + m - 1 \approx Li(N) - \frac{1}{2} \times Li\left(\hat{N}\left(\frac{1}{2}\right)\right) \approx R(N)$$

Where the INT { } expresses the taking integer operation of formula spread out type in { }.

One: The Prime Numbers

Let Ni is a natural integer less than or equal to N, then exists the formula as follows: $Ni \le N$ (1)

In terms of the above formula we can obtain the array as follows:

(1), (2), (3), (4), (5), ... , (N).

From the above arrangement we can obtain the formula as follows:

$Ni(N) = N =$ Total of integers Ni less than or equal to N (2)

If Ni can be divided by the prime anyone less than or equal to $\sqrt{N}$, then sieves out the positive integer Ni; If Np can not be divided by all primes less than or equal to $\sqrt{N}$, then the number Np is a prime (Figure 1).

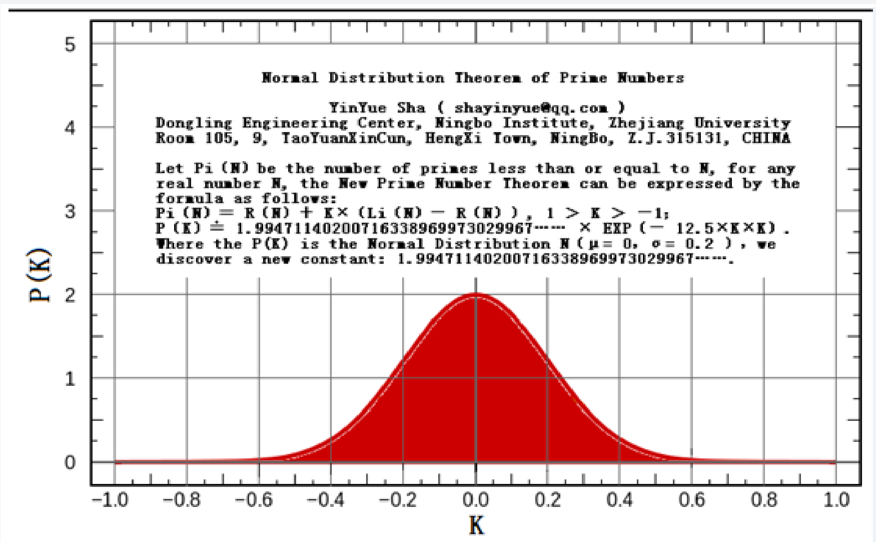

Figure 1.

Two: The Sieve Method

Let Pi be a prime less than or equal to √N, the number of integers Ni can be divided by the prime Pi is $INT(N/Pi)$, the number of integers Ni can not be divided by the prime Pi is:

$$Np(N,Pi) = N - INT(N/Pi) = INT\{N - N/Pi\} = INT\left\{N \times \left(1 - \frac{1}{Pi}\right)\right\} \quad (3)$$

Where the expresses the taking integer operation of formula spread out type in { }.

Three: The Prime Number Theorem

Let $Pi(N)$ be the number of primes less than or equal to N, Pi $(2 \le Pi \le Pm)$ be taken over the primes less than or equal to √N, then exists the formulas as follows:

$$Np(N) = INT\left\{N \times (1 - 1/P1) \times \ldots \times \left(1 - {}^{1}\!/_{Pm}\right)\right\} = INT\left\{N \times \Pi\left(1 - {}^{1}\!/_{Pi}\right)\right\} \quad (4)$$

$$Pi(N) = Np(N) + m - 1 = INT\left\{N \times \Pi\left(1 - {}^{1}\!/_{Pi}\right)\right\} + m - 1 \quad (5)$$

Where the INT { } expresses the taking integer operation of formula spread out type in { }.

Four: The Normal Distribution Theorem of the Prime Numbers

From above we can obtain that:

Let $Pi(N)$ be the number of primes less than or equal to N, for any real number N, the New Prime Number Theorem can be expressed by the formulas as follows:

$$Pi(N) \approx Li(N) \times \left(1 - (1 + 1/(Ln(N) - 5))/\sqrt{N}\right) \approx Li(N) - 1/2 \times Li\left(\hat{N}(1/2)\right) \approx R(N) \quad (6)$$

Where $Li(N)$ is the logarithmic integral function, the $Li(N)$ denotes the natural logarithm of N.

$$Pi(N) \quad = R(N) + K \times \left(Li(N) - R(N)\right), 1 > K > -1. \quad (7)$$

$$P(K) = 1.99471140200716338969973029967\ldots \times EXP(-12.5 \times K \times K) \quad (8)$$

Where the $R(N)$ is the Riemann Prime Counting Function, the $R(N)$ is the logarithmic integral function, the $P(K)$ is the Normal Distribution N $(\mu=0, \sigma=0.2)$.

How to cite this article: YinYue S. The Normal Distribution Theorem of Prime Numbers. Biostat Biometrics Open Acc J. 2017; 3(1): 555601. DOI: 10.19080/BBOAJ.2017.03.555601.