Equation for Distribution of Prime Numbers

Abstract: An equation for distribution of prime numbers is found that agree well with actual values of prime numbers in the range x. We find that Riemann hypothesis may be wrong. We need to study the variation of new variable r with the given number x.

It is found that the equation for distribution of prime numbers in the range from 2 to x is given by

$n=(e^{(nr/x)})\, x/\log x$ ....1)

This is an implicit equation.

Where $r=f(x)$, x is a prime number and n is the number of prime numbers in the range 2 to x.

It is proved that limit as $x\to\infty$ $\pi(x)/(x/\log x) =1$

Here $n=\pi(x)$ is a prime counting function.

Now, we study how the function r varies with x. The actual prime number density is given by $d=n/x$ It is proved that for large x, the approximate prime number density is $d'=1/\log x$

This yields $d=d'\, e^{(dr)}$

Therefore $r= (\log d-\log d')/d$

It is proved that limit as $x\to\infty$ then $d\approx d'$ therefore r approaches 0.

Therefore at $x=\infty$, then $r=0$

For small values of x in the range $1\leq x\leq 100$ the known prime number distribution formula yields values that are not approximate to the actual value.

For eg. $n=x/\log x$

As $x\to 1$ then $n\to\infty$ In other words the number of primes are infinite as x approaches 1. This means that this is not a correct equation for small values of x. This indicates that there is some missing term.

From equation 1), we check for value $x=1$

It is known that, at $x=1$ the number of primes $n=0$

Therefore $e^{(nr/x)}=0$ yields $r=-\infty$

Therefore we can infer that the value of r is negative as x approaches 1 and the value of r approaches 0 as x approaches ∞ . This indicates that the value of r changes from negative to positive as x increases. At some value of x the value of r is maximum and then decreases to 0 at infinity. We don't know the nature of the function r=f(x). We need to study the variation of r with x. If we are able to get exact equation for r then we can easily verify the assumed equation.

Riemann zeta function is derived from general Dirichlet series. The prime number theorem is derived from Riemann zeta function. But the prime numbers distribution formula is approximate and it is applicable for large value of x. This indicates that there are two possibilities exists. If we say that Riemann zeta function is right then in the derivation of prime numbers distribution formula there is some approximation or error exists. The second possibility is that Riemann zeta function may be wrong. In other words Riemann hypothesis may be wrong. There must exist some general form of Riemann zeta function.

If we are able to get exact equation for the distribution of prime numbers then we can easily check whether the given number is prime or not. Or conversely we can easily create prime numbers of any digit, even million digits. But to find the factors of the product of two prime numbers is not easy, that depends on the digits of the two prime numbers. We have to make continuous division of prime numbers that range from 2 to square root of the given number. This will be useful in cryptography..

References:

Wikipedia.