REGULARITIES OF DISTRIBUTION DENSITY

PRIME NUMBERS

Savinov Sergey N.

OOO "Meteotechnology Laboratory"

In article the research of distribution of prime numbers is given in a natural row. The unknown regularity in distribution density of prime numbers is described earlier and definition of an algebraic form of this regularity is made.

Keywords: numbers theory

For the research given in this article publications of other authors which would contain similar or similar consideration of natural distribution density of prime numbers are not found.

1. The ratio of quantity of prime numbers in the set range to the size of this range of a natural row can be characterized as the size of distribution density of prime numbers. Distribution density of prime numbers in a natural row is uneven, ranges of the reduced and increased density of various size, various size of ranges and various ratio are found. Alternation of change of density can be characterized as "density wave". At a distribution research of "density waves" of prime numbers in the range of natural row from 0 to 1000 three sites of the same order of distribution of waves of density in the form of their concentric distribution (that is symmetric in decreasing order and an order of increase of size of numbers) rather own centers are found (further in the text it is mentioned as concentric structure, CS).

2. Concentric structures include almost equal quantity of prime numbers – about 60. Expressing changes of distribution density of prime numbers as the schedule, respectively characteristic of ranges of the increased density are maxima of ranges of the increased density (further in the text "density maxima"). The first concentric structure (see the drawing) has the center about 165, and density maxima with a radius about ±30 concerning the center – respectively sizes about 135 and about 195, also with a radius about ±65 – respectively sizes about 100 and about 230. The second concentric structure has the center about 410, and density maxima with a radius about ±55 concerning the center – respectively sizes about 355 and about 465. The third concentric structure has the center about 745, and density maxima with a radius about ±70 concerning the center – respectively sizes about 675 and about 815, also with a radius about ±105 (this size is average, maxima are displaced concerning the center on ±10)– respectively sizes about 640 and about 850. Also ranges of the increased density are characterized by the size of range and size of relative density (a ratio of the actual density to size theoretical): for a maximum of density 165 – range is equal ±15, relative density - 1.26; 135 and 195-±10, 1.6; 100, 230-±10, 1.6; 410 - ±30, 1; 355, 465-±10, 1.1; 745 - ±30, 1.054; 675, 815-±10, 1.3; 640, 850 - ± 10, 1.436.

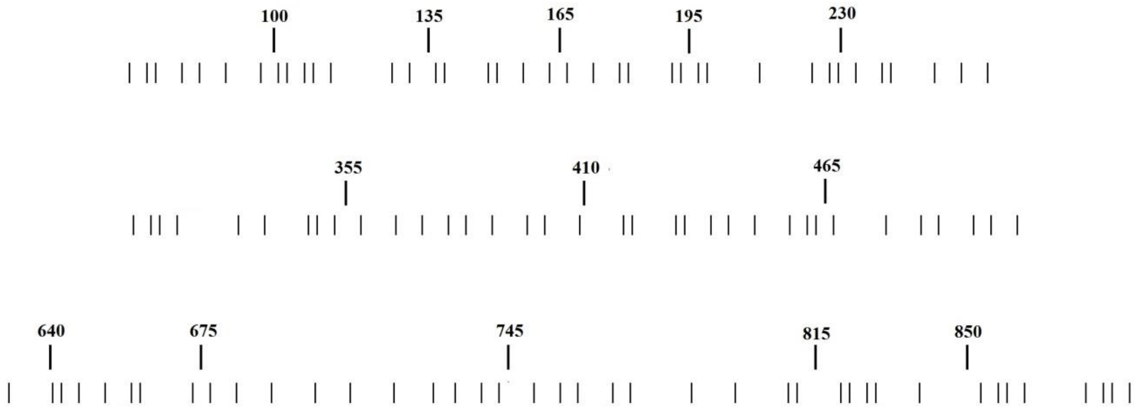

Figure 1.Concentric structures of distribution density of prime numbers in a natural row.

3. Maxima of ranges of increase in density and the centers of three specified concentric structures correspond to solutions of the equation (3),

$$\boldsymbol{a_0 * \log \nabla m - r = \pm j * \mathrm{Arcsin}\left(\frac{a_{n-1}}{a_n} * \sqrt{\pi}\right)},(3)$$

Where,**n**- serial index of the defined KS ((n-1) is the previous CS.), $\boldsymbol{a_0}$ **-** value of the center of the first CS (okolo165), $\boldsymbol{a_n}$-value of the center of the defined CS, **m**– an integer (equal, respectively, for CS with the center about 165 m = 0, for CS with center 410m = 1, for CS with center 745 m =3), **π** – geometrical constant, **j**-coefficient sinusoid step (j ≈ 57), **r**– radiuses of concentric waves of density for this CS, or the difference of numerical value of maxima of distribution density of the given CS and value of the center of this CS, respectively with signs ± (concentric symmetry in a one-dimensional straight line).

4. The left member of equation contains the logarithmic proportion (4) expressing a ratio of values of the centers of concentric structures and value of the first CS - proportions is result of a_n – the size of value of the required center. Initial size is a_0≈165, results of decisions a for the following CS about 410, 745.

$$\boldsymbol{\log {}^{a}/_{a_0} = {}^{a_0}/_{a} * m,} \quad \textbf{(4)}$$

In the equation (3) the logarithmic proportion is transformed to the functional element designated as "log ∇ m"(is not an operator), which is defined by transformations (5).

$$\boldsymbol{t \log t = m, \ t = {}^{a}/_{a_0}, \log \nabla m = t} \ \textbf{(5)}$$

At a $a_n = a_0, m = 0, \log \nabla m = 1$

The right member of equation corresponds to a ratio (6) where **b** is the size of a maximum of density $(b = a_n \pm r)$. Maxima of density of three the considered CS are interconnected by means of the specified trigonometrical equation (6) with a sinusoid step about the 57th size natural ranks. $\frac{a_{n-1}}{a_n}$ for the first KS about 165 make a ratios 0 as for $a_n \approx 165$,$a_{n-1} = 0$.

$$\sin\left(\frac{b}{\sqrt[k]{a_0}}\right) = \frac{a_{n-1}}{a_n} * \sqrt{\pi}, \quad (6)$$

Solutions of the equation (3) are defined as the minimum size of a difference of its left part: so for the first CS it corresponds to r ≈ 30 and 65, for the second CS r ≈ 55, for the third CS r ≈ 70 and 105. The sign ± in the right member of equation corresponds to structure of distribution of maxima of ranges of the increased density in concentric structures, that is, for example, for the first CS at r ≈ the 30th sizes of maxima of density – 135 and 195.

[1]Kulikov L. Algebra and theory numbers. Moscow: Vishaa shkola, 1979