

The Normal Distribution Theorem of Prime Numbers

YinYue Sha*

Dongling Engineering Center, Ningbo Institute of Technology, Zhejiang University, China

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***Corresponding author**

YinYue Sha, Dongling Engineering Center, Ningbo Institute of Technology, Zhejiang University, China, Email(s): shayinyue@qq.com (or) shayinyue@126.com

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Abstract

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:

$$\pi(N) = R(N) + K \times (Li(N) - R(N)), 1 \geq K \geq -1$$

$$P(K) = 1.99471140200716338969973029967... \times \text{EXP}(-12.5 \times K \times K)$$

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

Introduction

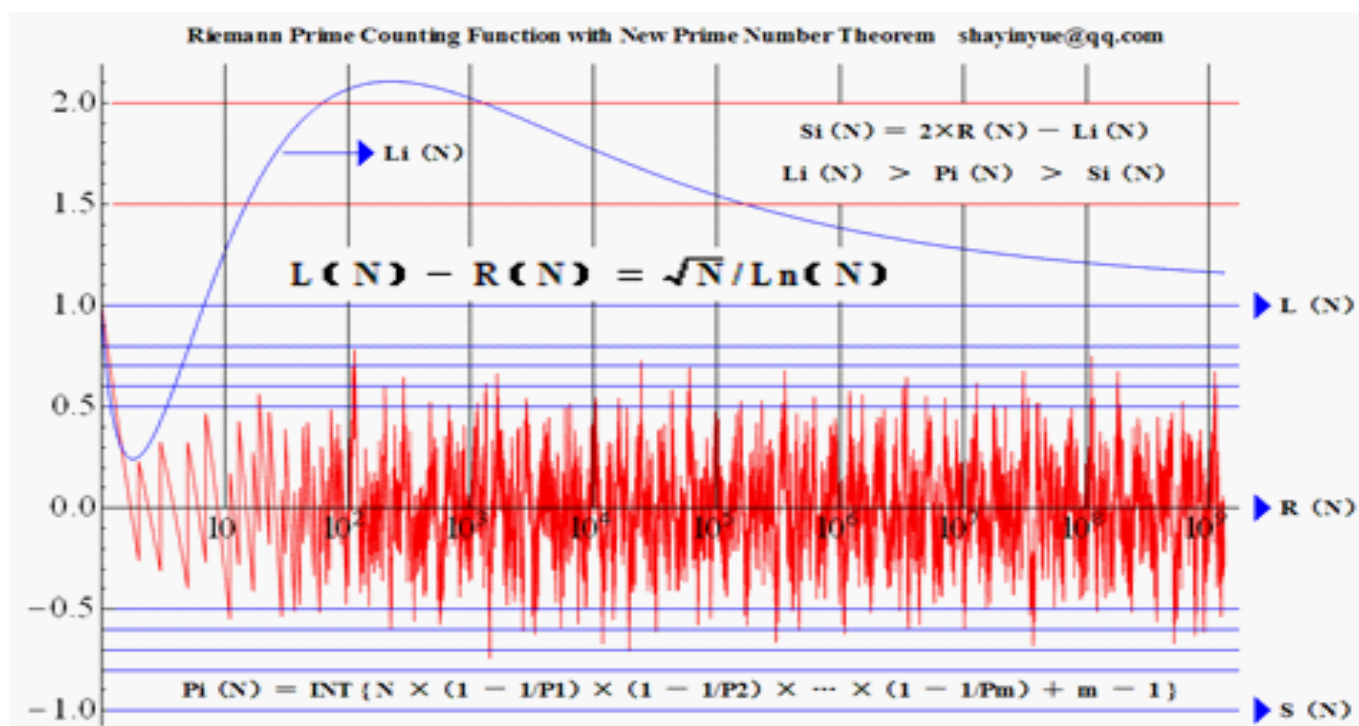
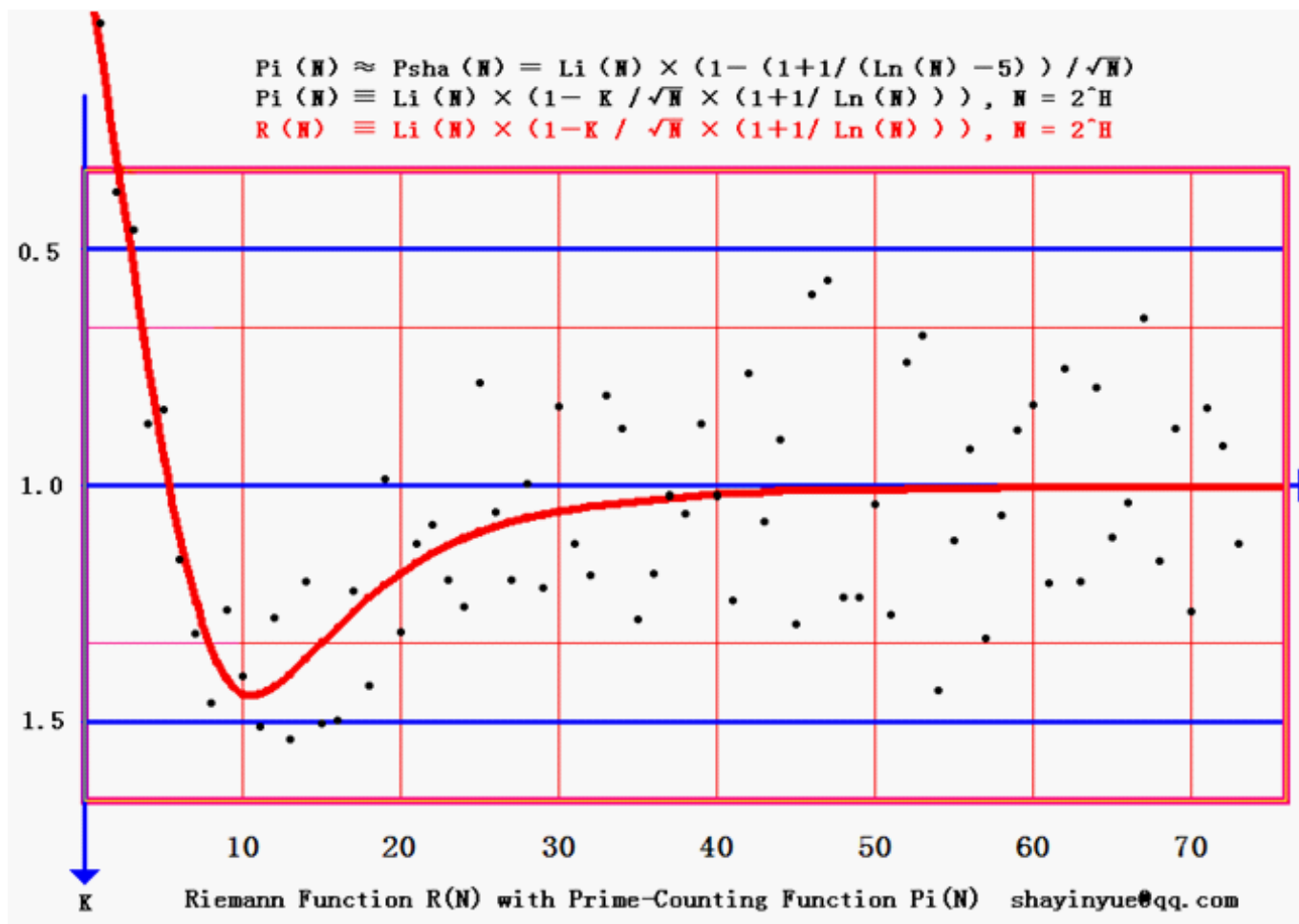
Everyone believes in normal distribution: experimenters think of it as a mathematical theorem, and mathematical researchers think of it as an empirical formula.

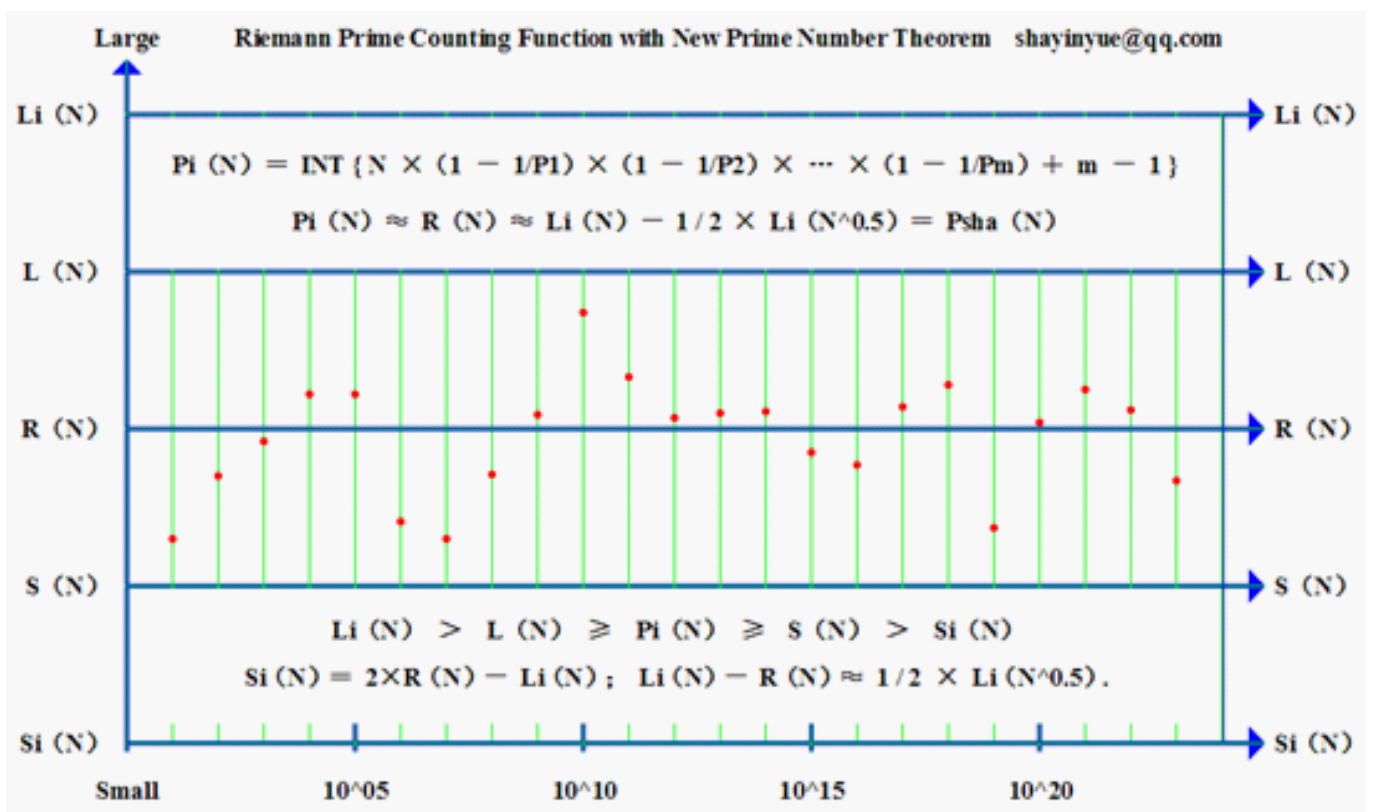
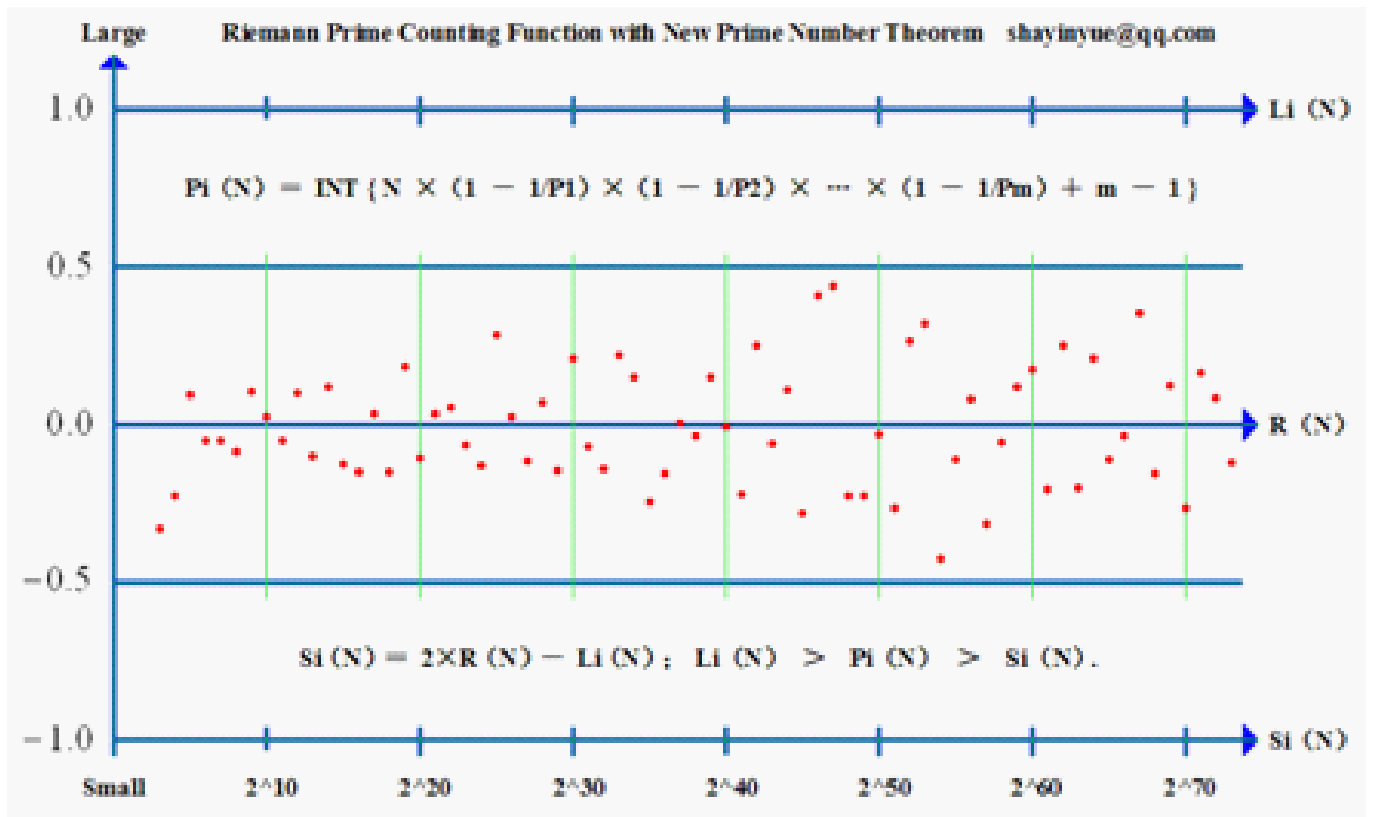
Jules Henri Poincaré

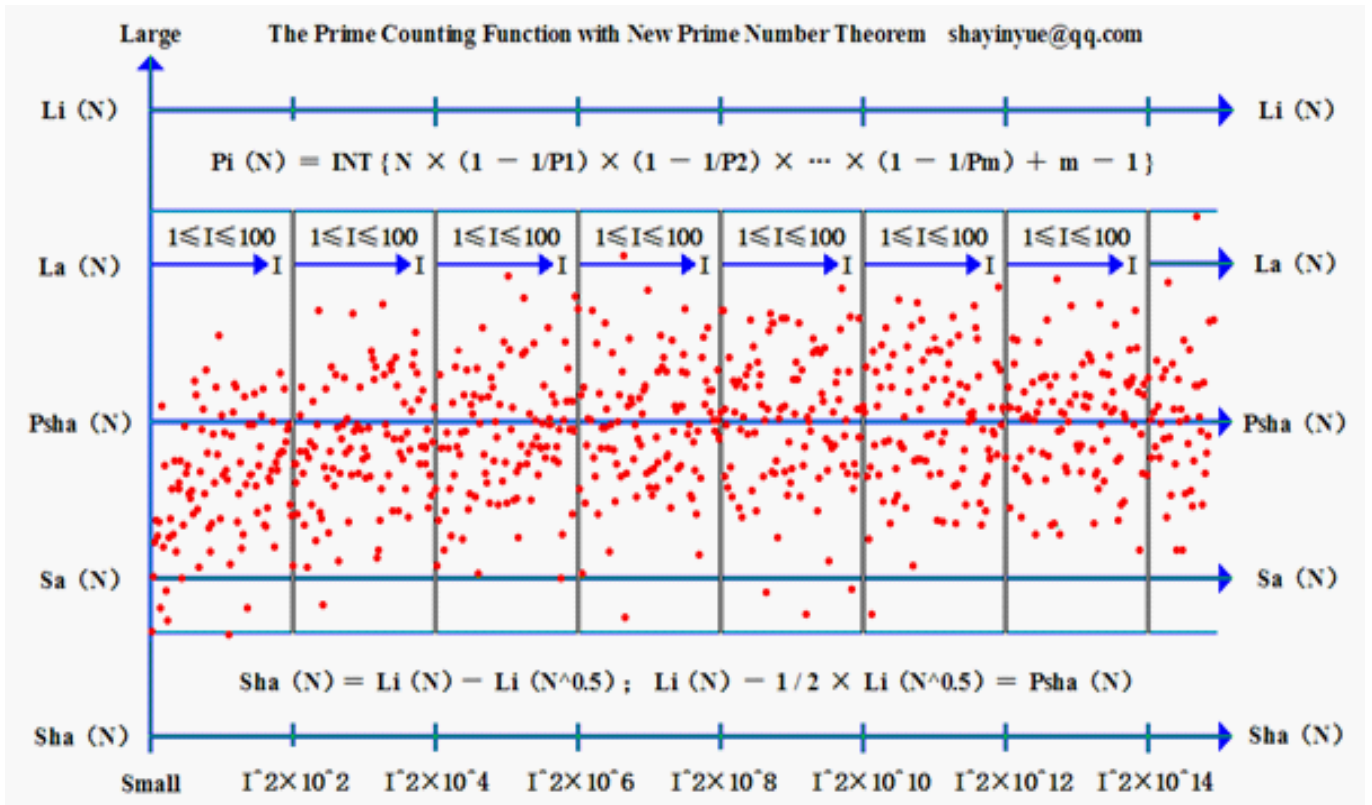
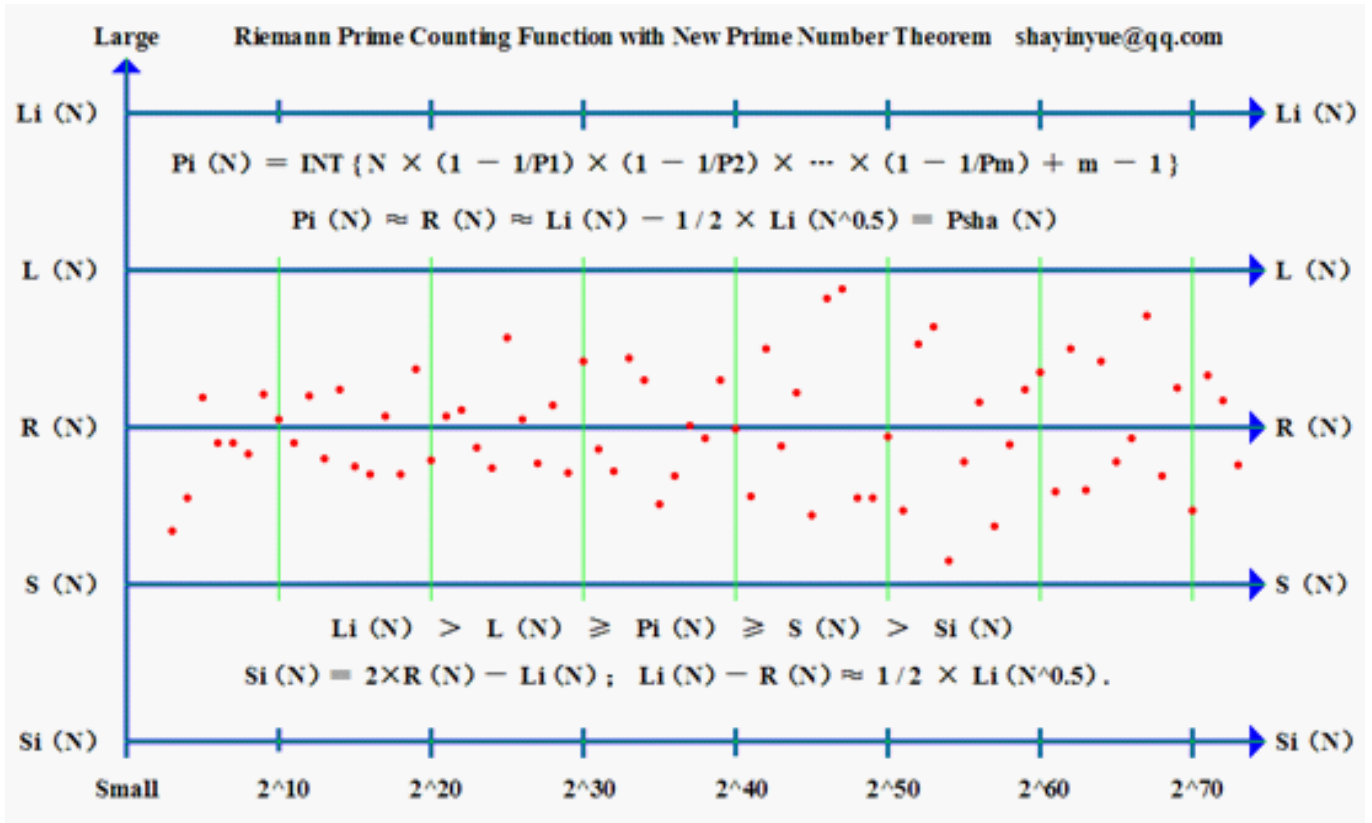
$$\pi(N) = Li(N) - H \times Li(N^{1/2}) = Li(N) - 1/2 \times Li(N^{1/2}) \pm 1/2 \times Li(N^{1/2})$$

$$Li(N) - R(N) \approx 1/2 \times Li(N^{1/2})$$

N H	N = 1×10 ¹⁸	N = 26×10 ¹⁸	N = 51×10 ¹⁸	N = 76×10 ¹⁸
1	0.431659494	0.416029155	0.37869833	0.590945678
2	0.421882381	0.378969472	0.339757862	0.498523589
3	0.53424342	0.292715401	0.47075642	0.583294191
4	0.70528764	0.382276937	0.566423885	0.617090188
5	0.394550658	0.571483469	0.715763273	0.571721766
6	0.494458909	0.564388043	0.667099645	0.662618598
7	0.480763702	0.529022001	0.771390298	0.696457771
8	0.433586507	0.438392848	0.520334679	0.690908803
9	0.608387124	0.578149499	0.546449856	0.634222585
10	0.657607999	0.547065729	0.537224895	0.531895223
11	0.415280016	0.607825447	0.673751802	0.481170922
12	0.368262014	0.59432731	0.64516798	0.388207904
13	0.578024184	0.529126009	0.419718735	0.448999949
14	0.535363726	0.540895309	0.280001584	0.482588273
15	0.530004084	0.335341739	0.328470217	0.451963206
16	0.579218196	0.469832499	0.424596802	0.539530025
17	0.545093702	0.452804815	0.45373287	0.510862736
18	0.359576279	0.425869045	0.439856864	0.57707007
19	0.428445692	0.490829683	0.349965757	0.460005436
20	0.513699868	0.463680331	0.427484501	0.468422536
21	0.665714012	0.532187785	0.436859065	0.616305183
22	0.541566436	0.5138144	0.472876704	0.568213304
23	0.606247678	0.456031341	0.471425341	0.376799224
24	0.420849382	0.63169528	0.476931225	0.417216181
25	0.568477728	0.408941709	0.379028941	0.489488837
N H	N = 25×10 ¹⁸	N = 50×10 ¹⁸	N = 75×10 ¹⁸	N = 100×10 ¹⁸

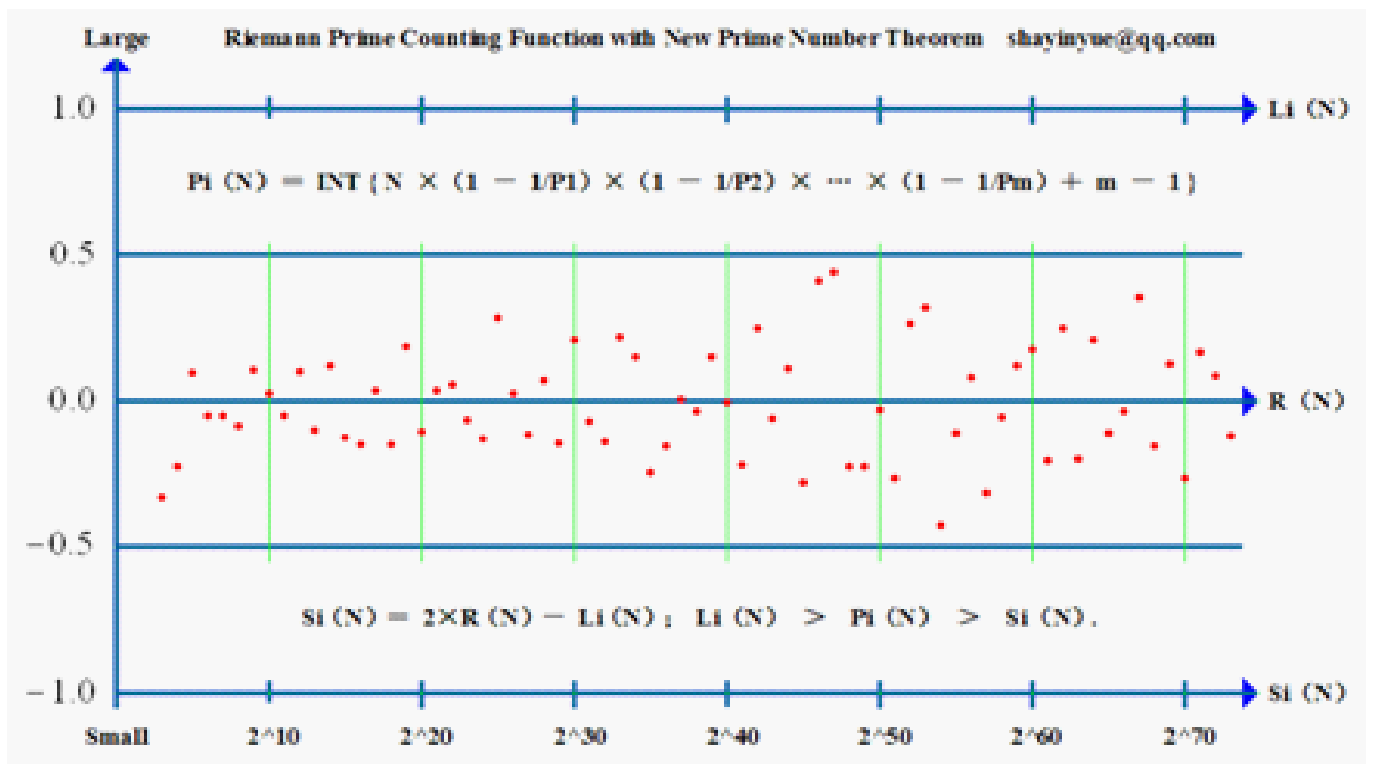
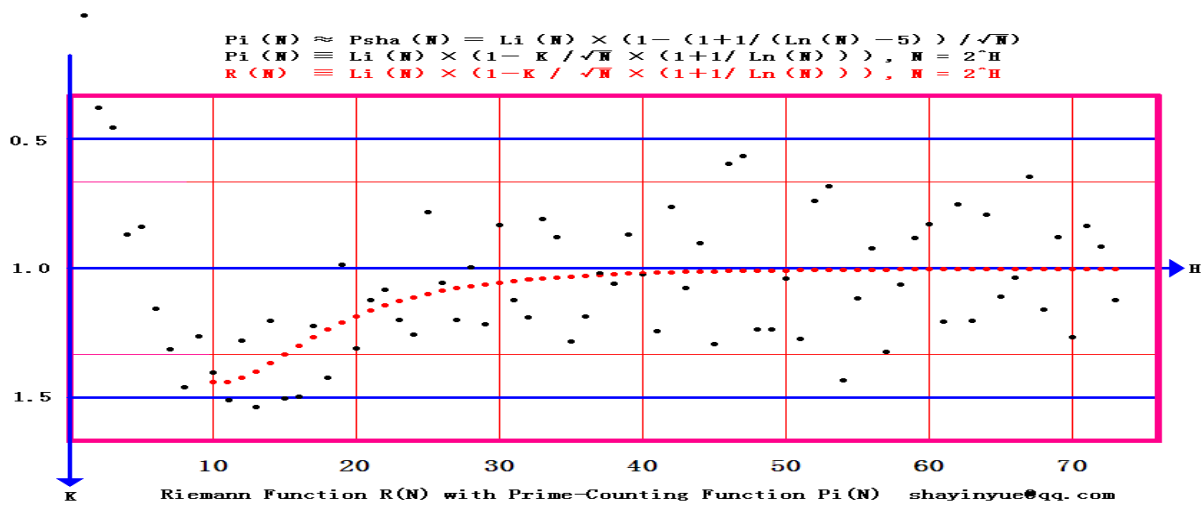


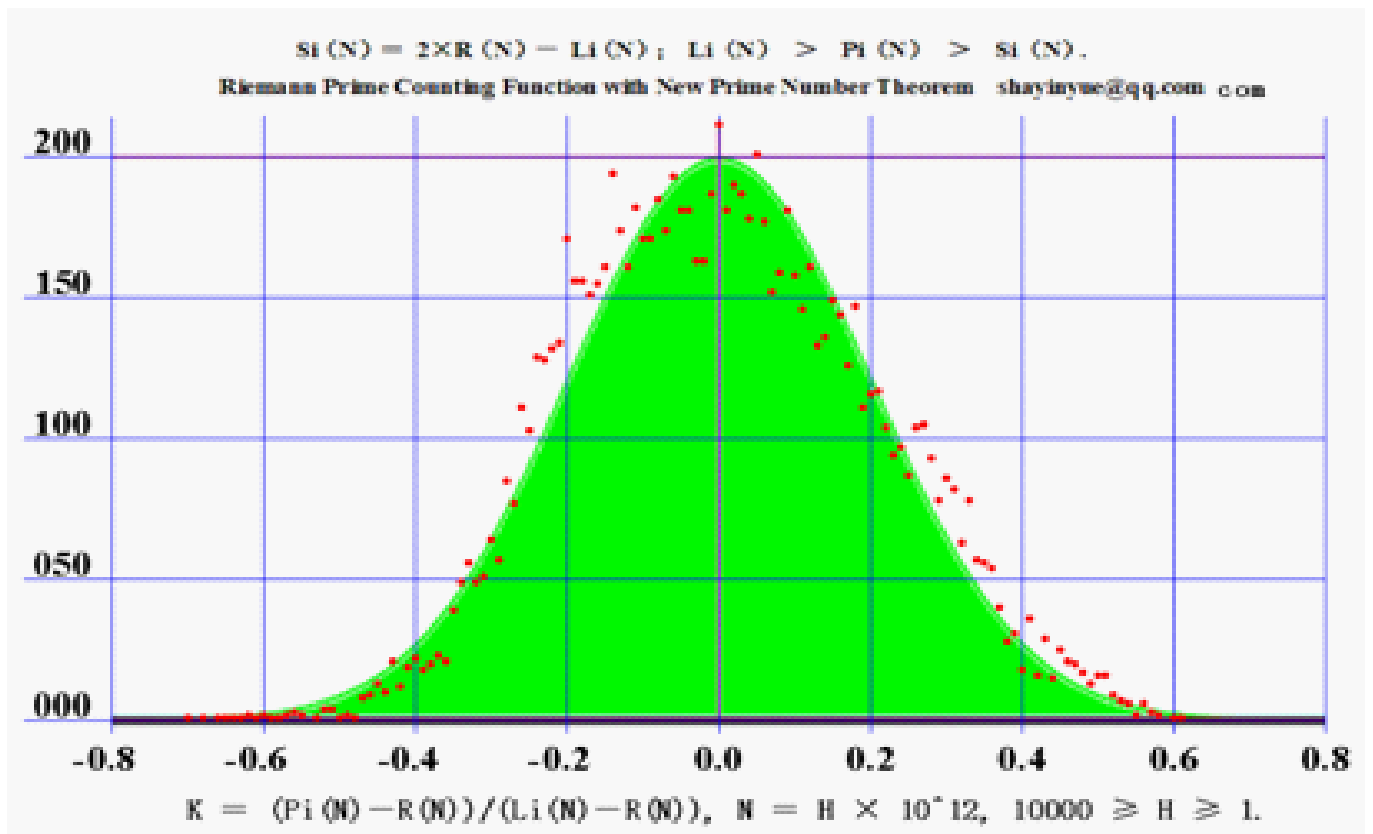
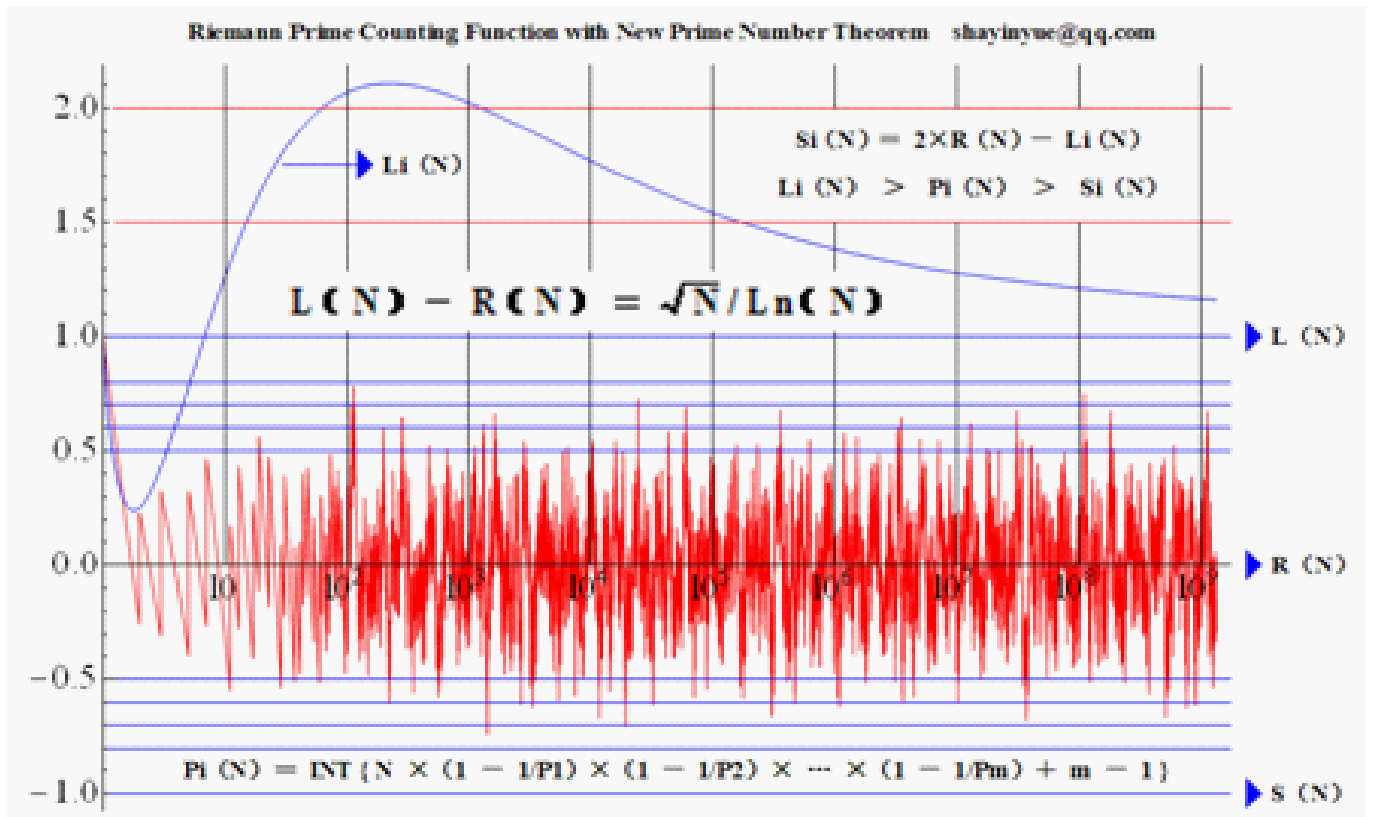


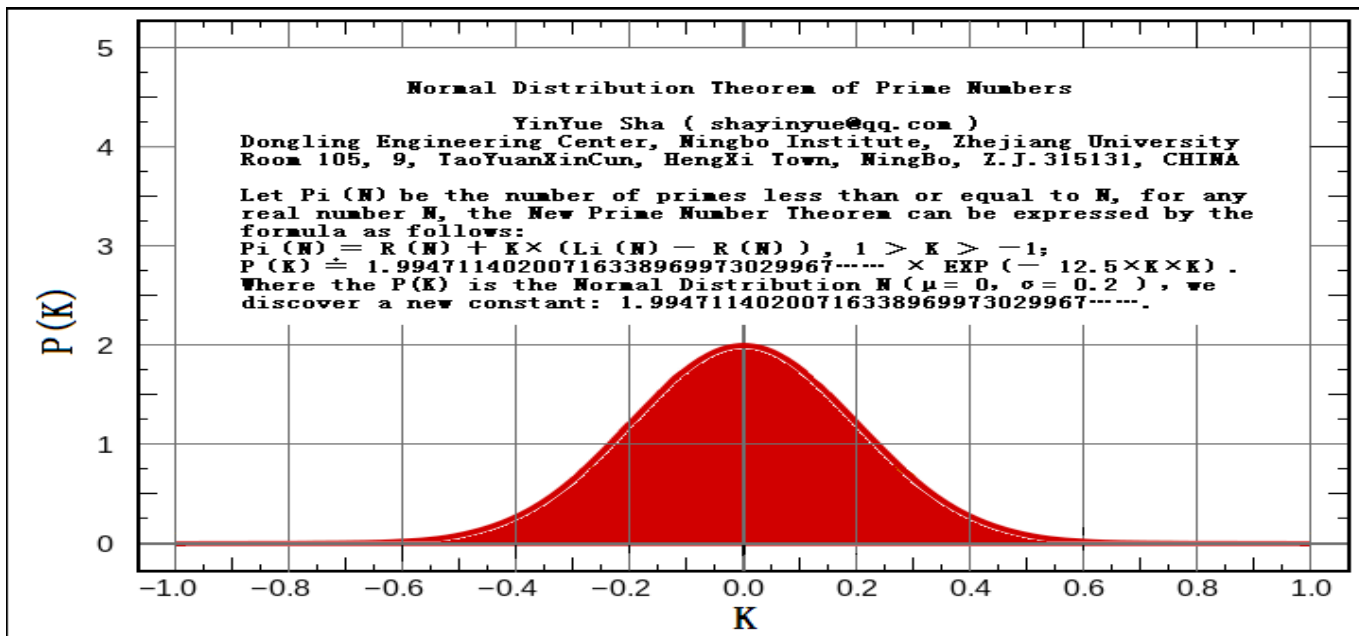
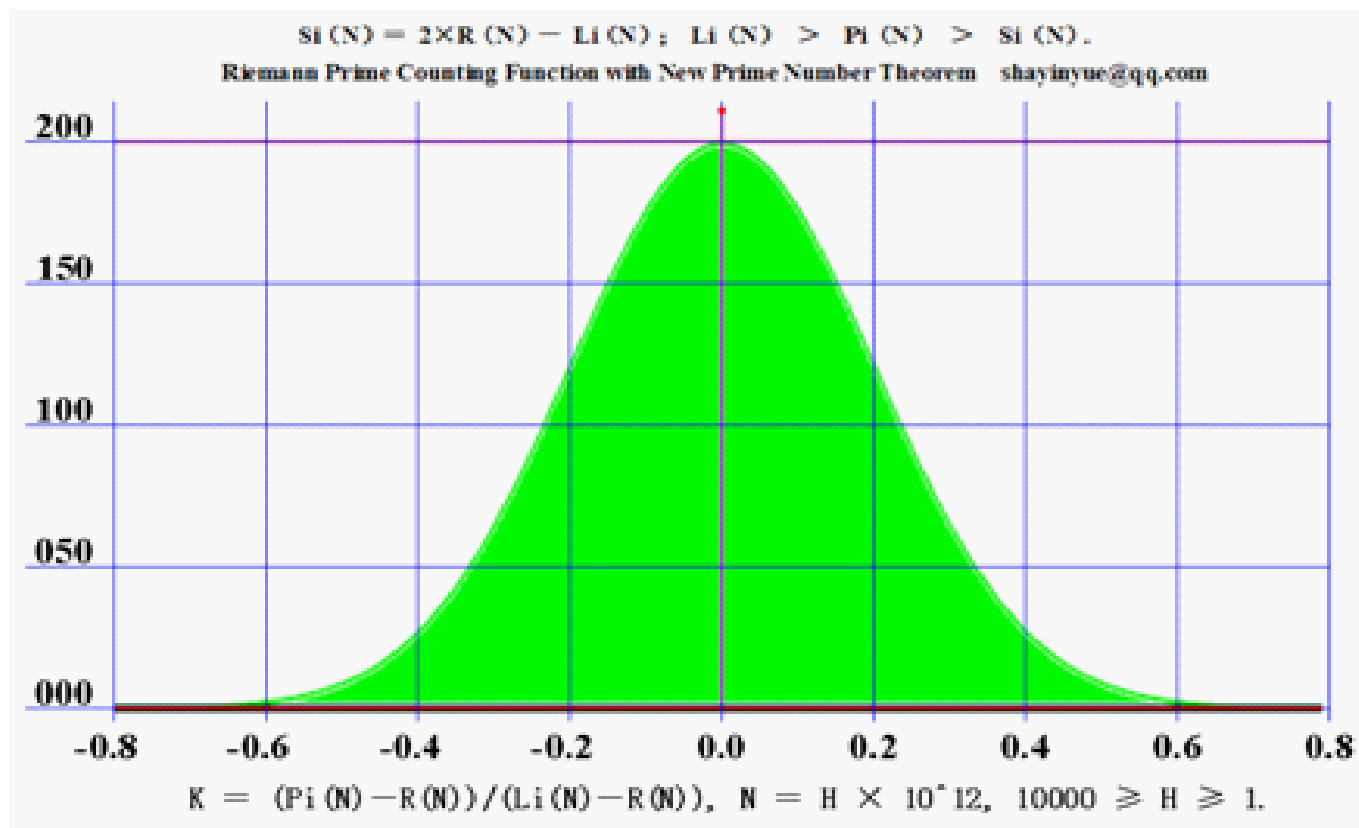


$$Li(N) - R(N) \approx 1/2 \times Li(N^{1/2})$$

Results







Normal distribution, also known as Gaussian distribution, is a very important probability distribution in the fields of mathematics, physics and engineering, and has a significant influence on many aspects of statistics.

$$\frac{x \cdot \pi(x) \cdot \ln(x) \cdot x^2}{\pi(x^2) \cdot \ln(x^2) \cdot (\ln(x^2) - \pi(x^2)) / \ln(x)}$$

$$\frac{1 \times 10^7}{1 \times 10^{14}} = \frac{664579}{3204941750802} = \frac{664918.405}{3204942065691.953} = 0.47357683383722849422403941427971$$

$$\frac{2 \times 10^7}{4 \times 10^{14}} = \frac{1270607}{12273824155491} = \frac{1270905.036}{12273824722982.966} = 0.44652586143344230166383572344268$$

$$\frac{3 \times 10^7}{9 \times 10^{14}} = \frac{1857859}{26944926466221} = \frac{1858213.097}{26944927645955.202} = 0.63487562535460915438806639731697$$

$$\frac{4 \times 10^7}{16 \times 10^{14}} = \frac{2433654}{47090114439072} = \frac{2434016.439}{47090115604543.606} = 0.47882651379249784927192104309366$$

$$\frac{5 \times 10^7}{25 \times 10^{14}} = \frac{3001134}{72623478149504} = \frac{3001557.426}{72623479251024.811} = 0.36698308733274257202234184407705$$

$$\frac{6 \times 10^7}{3562683.477} = \frac{3562115}{36 \times 10^{14}} = \frac{103480631416721}{103480632879570.289} = \frac{0.410603214808}{12818219382894676388}$$

$$\frac{7 \times 10^7}{4118584.929} = \frac{4118064}{49 \times 10^{14}} = \frac{139610257999130}{139610260363719.795} = \frac{0.574126753669}{76753194446509372928}$$

$$\frac{8 \times 10^7}{4670090.745} = \frac{4669382}{64 \times 10^{14}} = \frac{180969812069916}{180969813788334.846} = \frac{0.367962624246}{6087240880797916915}$$

$$\frac{9 \times 10^7}{5217810.223} = \frac{5216954}{81 \times 10^{14}} = \frac{227523023599978}{227523026094113.835} = \frac{0.478004321430}{83713683007209670224}$$

$$\frac{10 \times 10^7}{5762209.375} = \frac{5761455}{100 \times 10^{14}} = \frac{279238341033925}{279238344248556.792} = \frac{0.5578818093}{5372554038788290298806}$$

$$\frac{11 \times 10^7}{6303655.689} = \frac{6303309}{121 \times 10^{14}} = \frac{336087875323188}{336087879424491.114} = \frac{0.6506229585}{4084361618120732355247}$$

$$\frac{12 \times 10^7}{6842446.079} = \frac{6841648}{144 \times 10^{14}} = \frac{398046666469692}{398046669853121.353} = \frac{0.4944765824}{876586506455391243135}$$

$$\frac{13 \times 10^7}{7378825.220} = \frac{7378187}{169 \times 10^{14}} = \frac{465092140443755}{465092143795479.668} = \frac{0.4542355413}{0477154736021786405723}$$

$$\frac{14 \times 10^7}{7912998.069} = \frac{7912199}{196 \times 10^{14}} = \frac{537203711844563}{537203716473758.685} = \frac{0.5850116030}{1496340476359593055778}$$

$$\frac{15 \times 10^7}{8445138.699} = \frac{8444396}{225 \times 10^{14}} = \frac{614362475868239}{614362480010409.786} = \frac{0.4904799001}{6913279354063572615339}$$

$$\frac{16 \times 10^7}{8975396.712} = \frac{8974458}{256 \times 10^{14}} = \frac{696550954611151}{696550959929878.319} = \frac{0.5925896636}{846061674114890087323}$$

$$\frac{17 \times 10^7}{9503901.994} = \frac{9503083}{289 \times 10^{14}} = \frac{783752915810159}{783752920532206.114} = \frac{0.4968535152}{1734137108148297683298}$$

$$\frac{18 \times 10^7}{10030768.328} = \frac{10030385}{324 \times 10^{14}} = \frac{875953201478257}{875953206944525.564} = \frac{0.54495013}{594735272605929135760616}$$

$$\frac{19 \times 10^7}{10556096.175} = \frac{10555473}{361 \times 10^{14}} = \frac{973137610582917}{973137615226406.077} = \frac{0.43988696}{199994596960935703108067}$$

----- 20×10^7 -----11078937-----
 11079974.852----- 400×10^{14} -----1075292778753150-
 -----1075292784292011.040-----0.499898-
 34038298411112675330465633

----- 30×10^7 -----16252325-----
 16253409.147----- 900×10^{14} -----2367751438410550-
 -----2367751447445538.401-----0.555882-
 6655559194771558284700824

----- 21×10^7 -----11601626-----
 11602484.270----- 441×10^{14} -----1182406097160412-
 -----1182406105049057.219-----0.679910-
 01197883976963150840798339

----- 31×10^7 -----16764521-----
 16765290.608----- 961×10^{14} -----2523874569626307-
 -----2523874577077762.794-----0.444457-
 29980035905858960342335391

----- 22×10^7 -----12122540-----
 12123696.323----- 484×10^{14} -----1294465637399893-
 -----1294465643302592.875-----0.486872-
 95670726443351545502085404

----- 32×10^7 -----17275206-----17276328.074-
 ----- 1024×10^{14} -----2684850676548829-
 -----2684850687987600.634-----0.66210-
 664586850331886097291069537

----- 23×10^7 -----12642573-----
 12643676.021----- 529×10^{14} -----1411460069059532-
 -----1411460073792784.213-----0.374357-
 2838420169133816498318199

----- 33×10^7 -----17785475-----17786550.579-
 ----- 1089×10^{14} -----2850672326283859-
 -----2850672334654983.899-----0.47064-
 352707508751407801565502185

----- 24×10^7 -----13161544-----
 13162482.421----- 576×10^{14} -----1533378617163401-
 -----1533378623333747.139-----0.468782-
 85885917385644195421790034

----- 34×10^7 -----18294605-----18295985.306-
 ----- 1156×10^{14} -----3021332310392132-
 -----3021332322469827.996-----0.66012-
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----- 25×10^7 -----13679318-----
 13680169.400----- 625×10^{14} -----1660211015612683-
 -----1660211021462683.184-----0.427626-
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----- 35×10^7 -----18803526-----18804657.754-
 ----- 1225×10^{14} -----3196823683914269-
 -----3196823692012847.417-----0.43066-
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----- 26×10^7 -----14195860-----
 14196786.294----- 676×10^{14} -----1791947449524635-
 -----1791947457340412.605-----0.550531-
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----- 36×10^7 -----19311288-----19312591.890-
 ----- 1296×10^{14} -----3377139699455147-
 -----3377139704749185.476-----0.27412-
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----- 27×10^7 -----14711384-----
 14712378.448----- 729×10^{14} -----1928578535624154-
 -----1928578541896665.260-----0.426342-
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----- 37×10^7 -----19818405-----19819810.281-
 ----- 1369×10^{14} -----3562273819739551-
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----- 28×10^7 -----15226069-----
 15226987.666----- 784×10^{14} -----2070095265429589-
 -----2070095274407563.169-----0.589609-
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----- 38×10^7 -----20325373-----20326334.209-
 ----- 1444×10^{14} -----3752219719043216-
 -----3752219732852674.970-----0.67938-
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----- 29×10^7 -----15739663-----
 15740652.613----- 841×10^{14} -----2216489007481365-
 -----2216489012843667.750-----0.340665-
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----- 39×10^7 -----20831210-----20832183.779-
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 -----3946971263485006.647-----0.51068-
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-----40×10⁷-----21336326-----21337378.011-
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 -----2500×10¹⁴-----6404808986671971-
 -----6404809000840265.529-----0.53755-
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-----41×10⁷-----21840713-----21841934.926-
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-----51×10⁷-----26854252-----26855832.874-
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 -----1764×10¹⁴-----4560000677650623-
 -----4560000690444689.498-----0.57254-
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-----52×10⁷-----27352687-----27354345.805-
 -----2704×10¹⁴-----6913537699208139-
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-----43×10⁷-----22848050-----22849204.326-
 -----1849×10¹⁴-----4773916581447328-
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-----53×10⁷-----27850698-----27852381.250-
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 -----7175005928552175.360-----0.57751-
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-----54×10⁷-----28348381-----28349949.106-
 -----2916×10¹⁴-----7441204334309712-
 -----7441204345884800.277-----0.40829-
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-----45×10⁷-----23853038-----23854118.834-
 -----2025×10¹⁴-----5216075141285524-
 -----5216075152549221.379-----0.47219-
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-----55×10⁷-----28845356-----28847058.887-
 -----3025×10¹⁴-----7712128784736510-
 -----7712128798465774.537-----0.47593-
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-----46×10⁷-----24354548-----24355729.359-
 -----2116×10¹⁴-----5444307472899358-
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-----56×10⁷-----29342150-----29343719.741-
 -----3136×10¹⁴-----7987775189004870-
 -----7987775202435600.884-----0.45770-
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-----47×10⁷-----24855718-----24856793.450-
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-----57×10⁷-----29838286-----29839940.476-
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-----59×10⁷-----30829544-----30831095.203-
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-----70×10⁷-----36252931-----36254242.043-
 -----4900×10¹⁴-----12340517539367328-
 -----12340517556521947.585-----0.473-
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-----61×10⁷-----31819444-----31820587.324-
 -----3721×10¹⁴-----9436699008653365-
 -----9436699025925156.542-----0.54278-
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-----71×10⁷-----36743905-----36745070.926-
 -----5041×10¹⁴-----12686551614932295-
 -----12686551634316338.581-----0.527-
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-----62×10⁷-----32313388-----32314728.766-
 -----3844×10¹⁴-----9740595660090958-
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-----73×10⁷-----37724170-----37725716.587-
 -----5329×10¹⁴-----13392614268572638-
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-----64×10⁷-----33300450-----33301837.898-
 -----4096×10¹⁴-----10362471837954005-
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-----74×10⁷-----38213987-----38215543.552-
 -----5476×10¹⁴-----13752636812514383-
 -----13752636830979537.316-----0.483-
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-----65×10⁷-----33793395-----33794819.082-
 -----4225×10¹⁴-----10680444386121518-
 -----10680444406595522.239-----0.605-
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 -----5625×10¹⁴-----14117316234940151-
 -----14117316252546998.224-----0.454-
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-----66×10⁷-----34286170-----34287426.640-
 -----4356×10¹⁴-----11003102037851650-
 -----11003102048647644.399-----0.314-
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-----76×10⁷-----39192219-----39194230.144-
 -----5776×10¹⁴-----14486649627815456-
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-----67×10⁷-----34778319-----34779666.788-
 -----4489×10¹⁴-----11330441425731907-
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-----77×10⁷-----39680979-----39683099.121-
 -----5929×10¹⁴-----14860634139996613-
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-----68×10⁷-----35270167-----35271545.545-
 -----4624×10¹⁴-----11662459290746815-
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 -----4761×10¹⁴-----11999152382171384-
 -----11999152403482701.953-----0.595-
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 -----6241×10¹⁴-----15622545244886093-
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-----80×10⁷-----41146179-----41147862.233-
 -----6400×10¹⁴-----16010466340023598-
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-----90×10⁷-----46009215-----46011648.633-
 -----8100×10¹⁴-----20144452682923654-
 -----20144452706097097.993-----0.503-
 64298349396203866294964106378

-----81×10⁷-----41634187-----41635516.157-
 -----6561×10¹⁴-----16403027499831350-
 -----16403027526035212.920-----0.629-
 36322972891636391776988821059

-----91×10⁷-----46494557-----46496533.794-
 -----8281×10¹⁴-----20583273545957069-
 -----20583273560901496.235-----0.321-
 40949046245801967231260834402

-----82×10⁷-----42121502-----42122876.663-
 -----6724×10¹⁴-----16800226068635424-
 -----16800226095098142.383-----0.628-
 22676130864514693555747669569

-----92×10⁷-----46979583-----46981160.722-
 -----8464×10¹⁴-----21026706967473729-
 -----21026706985373770.347-----0.381-
 00466382512974814279429969167

-----83×10⁷-----42608404-----42609947.674-
 -----6889×10¹⁴-----17202059418719234-
 -----17202059439620488.272-----0.490-
 5252273931717572190886704068

-----93×10⁷-----47463433-----47465532.492-
 -----8649×10¹⁴-----21474750639896670-
 -----21474750661413530.232-----0.453-
 31547129754677818858082389592

-----84×10⁷-----43095410-----43096733.016-
 -----7056×10¹⁴-----17608524942608335-
 -----17608524964006209.042-----0.496-
 50803076084378618273685434755

-----94×10⁷-----47947424-----47949652.113-
 -----8836×10¹⁴-----21927402264616041-
 -----21927402298267097.423-----0.701-
 79980333739694759148919208343

-----85×10⁷-----43581966-----43583236.420-
 -----7225×10¹⁴-----18019620087512765-
 -----18019620106591941.797-----0.437-
 76411217237455446407621327356

-----95×10⁷-----48431471-----48433522.526-
 -----9025×10¹⁴-----22384659606795512-
 -----22384659631914879.155-----0.518-
 6359745260209942880667857373

-----86×10⁷-----44067840-----44069461.522-
 -----7396×10¹⁴-----18435342319160251-
 -----18435342338805718.101-----0.445-
 7841421818314905436207158565

-----96×10⁷-----48915316-----48917146.606-
 -----9216×10¹⁴-----22846520396114703-
 -----22846520424478815.552-----0.579-
 83988274003211592803344961318

-----87×10⁷-----44553888-----44555411.873-
 -----7569×10¹⁴-----18855689147182043-
 -----18855689164356150.423-----0.385-
 45502557473350819853614059756

-----97×10⁷-----49398798-----49400527.167-
 -----9409×10¹⁴-----23312982441835873-
 -----23312982463649038.692-----0.441-
 55734650887273192486901543676

-----88×10⁷-----45039361-----45041090.934-
 -----7744×10¹⁴-----19280658098695104-
 -----19280658118450645.642-----0.438-
 61152632711229702649546396975

-----98×10⁷-----49881580-----49883666.959-
 -----9604×10¹⁴-----23784043539366292-
 -----23784043562128927.767-----0.456-
 3144041858207932391708998219

-----89×10⁷-----45524412-----45526502.087-
 -----7921×10¹⁴-----19710246747578222-
 -----19710246767041286.232-----0.427-
 5106441256254205752637971165

-----99×10⁷-----50364709-----50366568.677-
 -----9801×10¹⁴-----24259701527735010-
 -----24259701557097787.257-----0.582-
 98149006939546135085623990641

-----100×10⁷-----50847534-----
 ---50849234.957-----10000×10¹⁴-----
 24739954287740860-----24739954309690415.022-----0.4-
 3165949380676736304274777409804

Conclusion

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:

$$\pi(N) = \text{Li}(N) - \frac{1}{2} \times \text{Li}(N^{1/2}) \pm \frac{1}{2} \times \text{Li}(N^{1/2})$$