Demonstration of the Goldbach strong conjecture by the analysis of populations of prime numbers in the interval [0 - N] and [N - 2N] by CONVENTIONAL STATISTICAL LAWS

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ABSTRACT.

In this article I apply classical statistical laws to analyze prime numbers assimilated to populations. The statistical analysis focuses on prime numbers in the intervals [0 - S/2] and [S/2 – S] with S an even > 4. The results show that the even number S > 4 is enclosed by two populations of prime numbers P in the interval [0 - S/2] and Q in [S/2 - S] which have approximately the same standard deviation relative to their means. Two other subpopulations P' included in P and Q' included in Q which satisfy the strong Goldbach conjecture (P' + Q' = S) also have the same standard deviation and superimpose or overlap with a slight variation. This result shows that an even number is enclosed by two populations P' and Q' of prime numbers which are symmetric with respect to S/2 and therefore S = P' + Q'. This result also shows that any natural number N > 4 is enclosed by at least two equidistant and symmetric prime numbers. Therefore for every N > 4 there exists a number t < N such that N – t = P' and N + t = Q' are primes and so 2N = P' + Q'.

INTRODUCTION

I have already reported various works on the Goldbach Strong Conjecture (GSC) according to which an even number denoted here S is the sum of two prime numbers p and q such that $p < S/2$ and $q > S/2$ and therefore $S = p + q$ (***references 1 - 8***). In this article, I use a completely different approach based on the conventional laws of statistics. Indeed, the GSC is certainly a function of the distribution of prime numbers, which remains unresolved. Here is my method. I posit an even number $S > 4$ as resulting from two intervals of numbers [0 – S/2] and [S/2 – S]. I consider the prime numbers as being equivalent to a population in the conventional statistical sense. We therefore have the population P of the interval [0 - S/2] and the population Q of the interval [S/2 – S]. We will therefore compare the populations P and Q of even numbers taken at random and try to understand how the distribution of prime numbers induces the GSC. Note that the populations P and Q correspond to the set of prime numbers < S/2 and > S/2, respectively. While the populations P' and Q' correspond to the prime numbers that satisfy the GSC such that P ' + Q' = S. Therefore P' and Q' are subsets included in P and Q.

METHODS

So I will compare the populations P and Q of randomly chosen even numbers and try to understand how the distribution of prime numbers induces the GSC. I therefore calculate the mean (M) as well as the standard deviation (SD) of the populations P and Q. I also calculate the same parameters for the prime numbers P' and Q' which are known to satisfy the GSC. The list of prime numbers is obtained from the site ***https://compoasso.free.fr*** and the mean and standard deviation are calculated on the site ***https://miniwebtool.com/fr/standard-deviation-calculator/.***

RESULTS

I- The value of an even number S is linearly correlated to the standard deviation of the populations of prime numbers P < S/2 and Q > S/2

Table 1 shows SD values of populations P < S/2 and Q > S/2 of a randomly chosen sample of even numbers S. Note that the SD values have been rounded to integer values.

Table 1 : SD values of P and Q.

S	SD (P)	SD (Q)
40	5	5
60	8	8
100	14	13
200	28	32
400	61	55
600	88	86
1000	149	142
2000	296	289,69
3330	491	530
4000	591	575

Figure 1A and 1B show correlation coefficients between SD (P) or SD (Q) and S from Table 1.

Figure 1A :

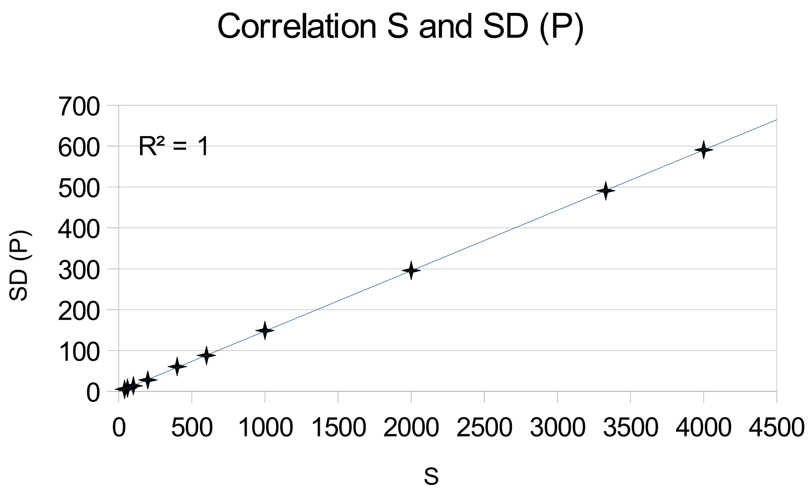
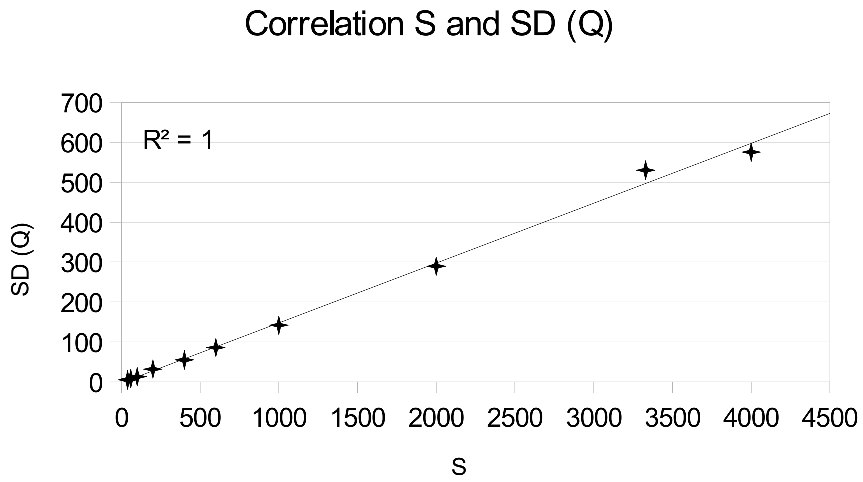


Figure 1B :



II - The prime numbers P′ and Q′ that satisfy the GSC such that P′ + Q′ = S have the same dispersion with respect to their respective means

The prime numbers P' and Q' for an even number S are calculated on the site *https://www.dcode.fr/conjecture-goldbach*. Then the population P' mean (M1) and Q' (M2) as well as the standard deviations are calculated and the scatter plot is plotted. The graphs show (M1 - SD) or (M2 - SD) as a function of the natural rank or position of each P' and Q' (or their order of appearance one after the other).
Here are two examples including S = 1200 (**Figure 2A**) and S = 2446 (**Figure 2B**). In Figure 2A, population P' is on the left and Q' on the right. In Figure 2B the two populations overlap.

Figure 2A (S = 1200 = P' + Q')

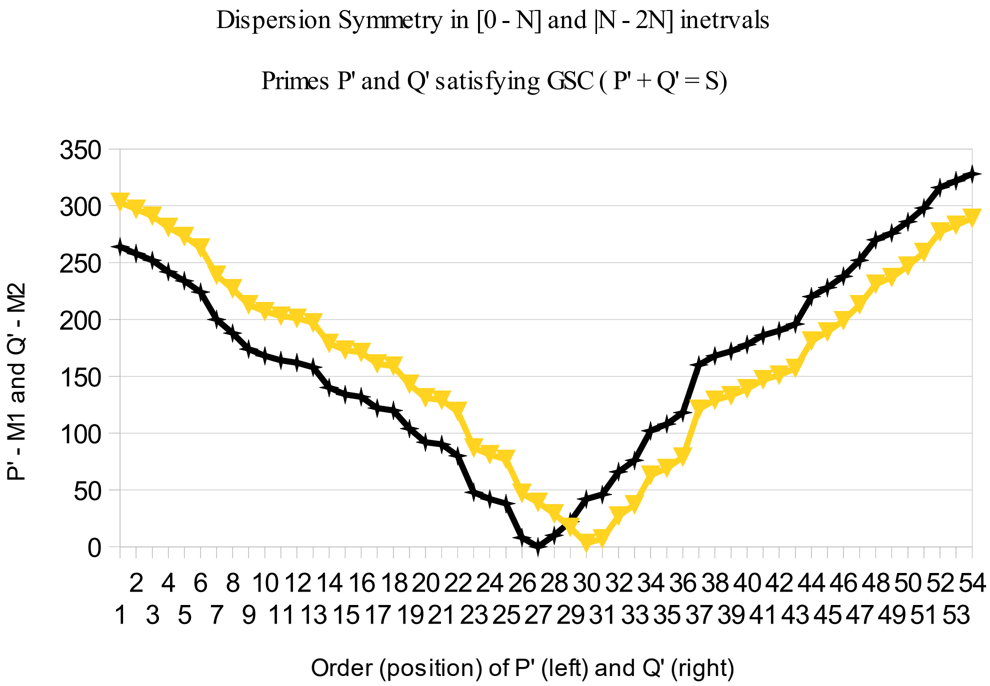
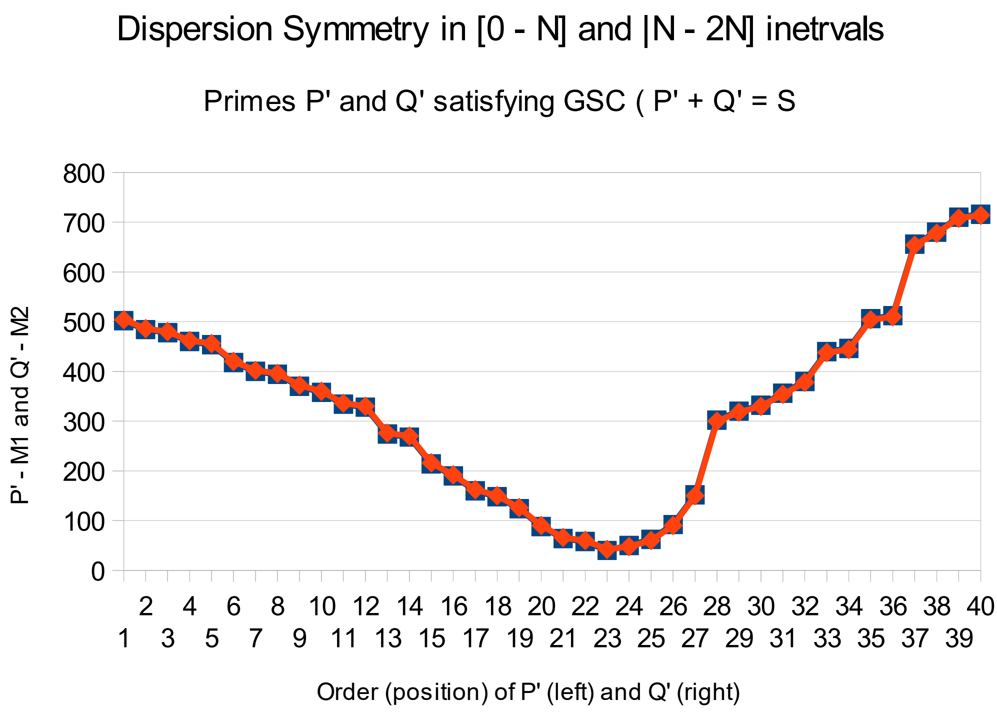


Figure 2B (S = 2446 = P' + Q')



Remarks

- A quasi-linear correlation exists between the value of the even number S and the standard deviation of the populations of primes P and Q.
- The standard deviations of the populations P and Q increase with the value of the even number but remain close.
- The standard deviations of the populations P' and Q' are very close and the two populations overlap.
- Since P' and Q' have the same standard deviation at their respective means, they are also symmetrical with respect to S/2 and are therefore equidistant from S/2. Note that the sum of the means M1 (P) + M2 (Q) = S (with some variations that can be neglected).
- This result also shows that any natural number N > 4 is enclosed by at least two equidistant and symmetric prime numbers. Therefore for every N > 4 there exists a number t < N such that N – t = P' and N + t = Q' are primes and so 2N = P' + Q'.
- As en even tends to infinity these rules will very likely remain the same ; which means GSC is true. We can use these statistical results to deduce new undiscovered primes numbers that verify GSC in infinity by using SD of primes < S/2 (see Table 1 ; Figure 1A and 1B).

CONCLUSION

Every even number gives two subpopulations P' and Q' of prime numbers each having its mean, having a standard deviation approximately the same, and equidistant with respect to S/2 and therefore S = P' + Q'. GSC means that every even number has its own two symmetric subpopulations P' and Q'. Note P' is in [0 – S/2] and Q in [S/2 – S].

An even number
S > 4

Two prime numbers populations P < S/2 and Q > S/2
Populations P and Q have close SD ad each has a Mean

Two symmetrical prime numbers subpopulations

Subpopulation P' of [0 – S/2]

Subpopulation Q' of [S/2 S]

P′ and Q′ are equidistant at S/2
S = P + Q'

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