# Simple Prime Number Attributes and Prime Number Boundaries

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## Abstract
Four simple attributes of Prime Numbers are shown, including one that although obvious by deduction, provides a deeper understanding for Goldbach's Strong Conjecture and reveals the nature of Prime Number Boundaries.

## Additional Prime Number Definitions
Prime numbers have a simple definition and although it can be stated in slightly different ways, never-the-less states that prime numbers are only divisible by themselves and one. This is not a particularly useful definition in that it doesn't state anything else about prime numbers in terms of its behaviour, merely a label to put on an entity that is undefined and may always be undefined.

## Definition Number 1 (Trivial)
If a positive integer is not the square of a another number then it is a number that is a sum of a square and another number. The more factors a number has, the more pairs of squares and other non-square numbers that sum together to form that higher number.

Example – the number 21 has the following pairs of squares and numbers that produce this sum.

2^2 + 17
3^2 + 12
4^2 + 5

The middle one has both the square and number being divisible by 3 and so 21 is not a prime number.

Therefore a prime number can be defined as; **a number where all the pairs of squares and numbers that sum together to produce it have no factors in common between each pair.**

This is a trivial definition but serves a useful example to demonstrate that looking for alternative definitions for prime numbers is not a fruitless exercise.

This definition has a utility by allowing a a variation in the way that a number is tested to see if it is a prime. The first test is to see if the test number is a square of another number. If it is not then subtract 4 from it and test the remainder to see if it is divisible by 2 which it can never be.

The difference between consecutive squares (2^2, 3^2, 4^2) is an odd number that grows by 2 at each step. Therefore it is a simple matter to successively subtract the square component of the square and simply test the remainder to see if it is divisible by the square root of the accompanying square. Note that all powers of 2 do not need testing, neither do powers of 6. In fact only the odd squares need testing as all even squares will have factors that have already been tested.

As the remainder grows smaller, it takes less time to divide into. Division is a slower procedure than addition and subtraction and this technique has the potential to speed up resolution of primeness.

## Definition Number 2

When an odd number has a factor that is greater than one, that factor is reproduced an odd number of times. At the mid-point of that odd number, the factor sits perfectly in the middle or straddles the centre-point.

Example – the number 15 has 5 sets of 3, the middle set taking up positions 7,8 and 9

| | | | | | |
|---|---|---|---|---|---|
| Set | 123 | 123 | 123 | 123 | 123 |
| Range | 1,2,3 | 4,5,6 | 7,8,9 | 10,11,12 | 13,14,15 |

Therefore a prime number can be defined as; **a number that has no other number that evenly straddles the mid-point.**

This is also a trivial definition but does again have a utility for testing primeness of numbers. This one is slightly more complicated.

For any number to test, take the midpoint and subtract successively half of a square less 1 (i.e. 4, 12, 24 ...) and test the remainder beneath it to see if it is also divisible by the square root of the square.

There is also a variation of this definition that is related to the first one above. A prime number is; **a number that has no common factors for all pairs of squares straddled across the mid-point and the remainder sitting below them.**

Both these definitions provide alternative means to testing primeness that save processing time on a computer and can be sped up additionally by missing out the divisional step for multiples of low prime numbers such as 3, 5, 7, 11, 13 …. This can be simply achieved by having simple counters for each one that are activated after each counter's factor has been used. When deciding to test for division, the active counters are decremented by one and checked to see if any are zero in which case the division is ignored and the zero value counters reset to their starting value.

This leads to better results for much larger numbers where unnecessary divisions cost significant time.

There is also an additional slight improvement possible by utilising the type of odd number relative to multiples of 4 and multiples of 6.

I'm going to describe odd numbers that are 1 more than a multiple of 4 as Over4 numbers and odd numbers that are 1 less than a multiple of 4 as Under4 numbers. Likewise I am going to describe odd numbers that are 1 more than a multiple of 6 as Over6 Numbers and odd numbers that are 1 less than a multiple of 6 as Under6 numbers.

Look at various prime numbers and see their behaviour using this method of testing for primeness.

### Table 1: 97 (Over4 and Under6)

| Factors | Remainder | Square |
|---|---|---|
| 4 x 11 | 44 | 9 |
| 4 x 9 | 36 | 25 |
| 4 x 6 | 24 | 49 |
| 4 x 2 | 8 | 81 |

The number in the title, is the number being  test. The last column represents the square straddling the midpoint, while the number in the 2nd column represents the remainder on the low side once half the square has been removed from the left-hand side of the number. The first column shows that the difference is divisible by 4 This is the same for all Over4 and Under6 odd numbers.

### Table 2: 101 (Under 6 and Over4)

| Factors | Remainder | Square |
|---|---|---|
| 2 x 23 | 46 | 9 |
| 2 x 19 | 38 | 25 |
| 2 x 13 | 26 | 49 |
| 2 x 5 | 10 | 81 |

### Table 3: 103 (Over6 and Under4)

| Factors | Remainder | Square |
|---|---|---|
| | 47 | 9 |
| 3x13 | 39 | 25 |
| 3x9 | 27 | 49 |
| | 11 | 81 |

### Table 4: 107 (Under 6 and Under4)

| Factors | Remainder | Square |
|---|---|---|
| 7x7 | 49 | 9 |
| | 41 | 25 |
| | 29 | 49 |
| | 13 | 81 |

For numbers that are Over4 and Over6, they can be halved twice, whereas Over4 and Under6 numbers can be halved before doing a division. Halving is a fast computer operation which reduces the division task by a small amount.

Finally, it is also possible to improve this method further by utilising the knowledge that depending on what channel a prime number candidate falls into, you can miss out some additional numbers. For example a number that falls into channel 7 only needs to have 30Mod1, 30Mod11, 30Mod13 and 30Mod23 factors tested.

## Definition Number 3

This definition is not exclusively one for prime numbers for it also includes the squares of primes. It is obvious that it is an attribute of prime numbers after a short consideration but apparently has not been recorded anywhere, having been overlooked. Each simple prime number attribute or definition provides additional research tools and this particular one if it had been found, would have provided useful observations.

This attribute is that prime numbers do not exist as the difference between the squares of non-consecutive numbers. Start with any number Z and add one to it consecutively, and subtract one likewise consecutively. Square each Y (the distance from Z) and subtract from the square of Z and you have the equivalent of (Z+Y) x (Z-Y) which was known by the ancient Greeks. It is clear therefore that (Z+Y) x (Z-Y) cannot be a prime number, nor the square of a prime number.

This might not seem very exciting until one literally tries to break this equation or find a way to construct a relationship that avoids the difference between squares.

A simple way of achieving this is to consider what happens when a prime number is subtracted from the square of an even number or when a prime number multiplied by 2 is subtracted from the square of an odd number.

In between two consecutive squares (i.e. N^2 and (N+1)^2), the positions that are not prime are those that are a square distance beneath (N+1)^2. For example, 1, 4, 9, 16, ... when subtracted from (N+1)^2, always give non-prime numbers. Conversely these same non-prime numbers when subtracted from squares always give squares as remainders.

All other positions that are not prime, are the difference between different pairs of squares where the larger square is more than (N+1)^2.

All the numbers less than the square of N, that do not share a common factor with N, and are neither squares nor the difference between N^2 and smaller squares can be regarded as "virgin" or potential prime number positions. Whether they are prime or not depends on where the differences between other pairs of non-consecutive squares fall.

It is clear that many of these positions beneath N^2 include prime number differences from N^2.

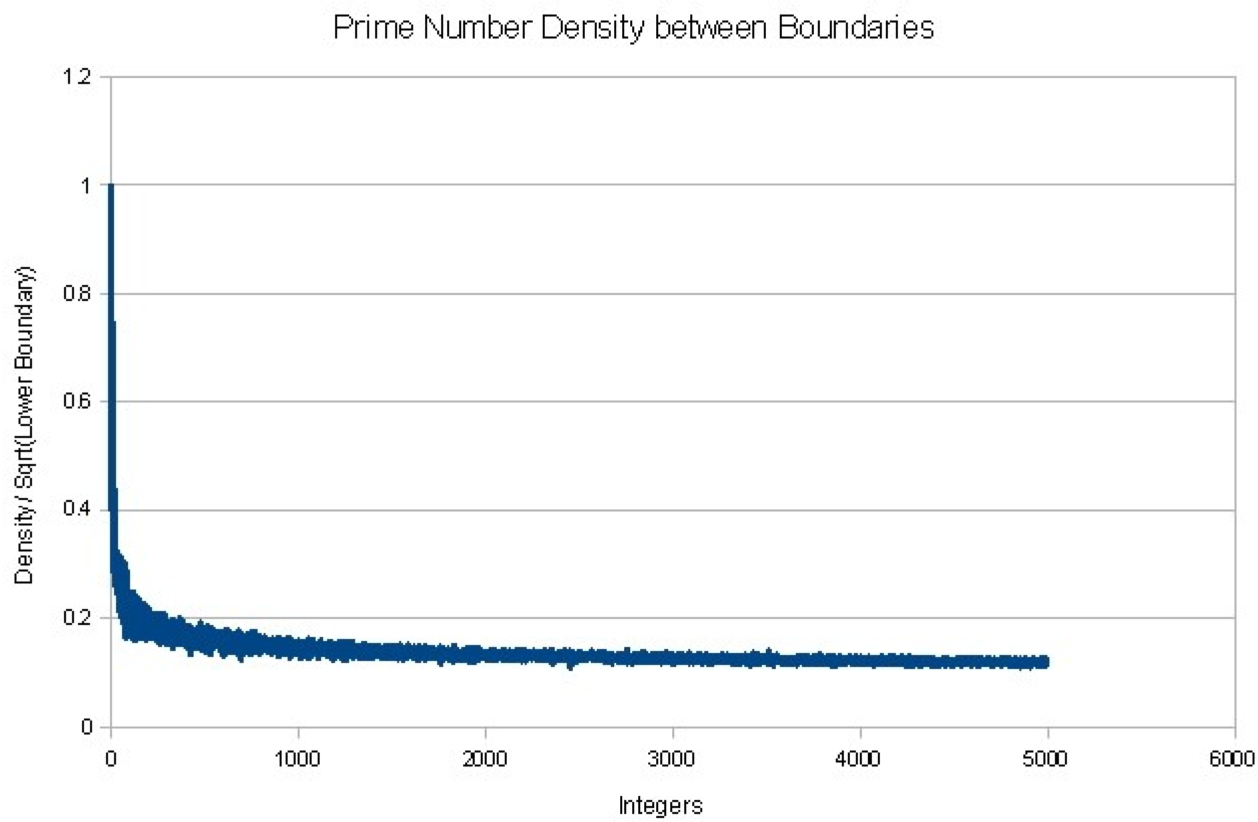
As part of this view is the concept that groups of prime numbers are generated in-between boundaries that are consecutive squares themselves. Substantiating that concept is the observation of a relationship between the number of prime numbers that exist between successive prime number boundaries and the square of the upper or lower boundary. Gauss's equation was refined several times to show an exponential relationship between the number of primes and the size of a number. This new relationship is different in that it looks at the number of prime numbers between explicit boundaries and is based on an additional attribute of prime numbers. When this relationship is plotted out over large numbers, it starts as a curve and then decreases very slowly to form an almost linear relationship. The following table uses the lower square root. Using the upper square root changes the slope at the start but makes little difference as N increases over large distances.

## Table 5: Prime Number Density between Boundaries

| SquareRoot | Primes | Primes/SquareRoot |
|---|---|---|
| **2** | **2** | **1.00000** |
| 3 | 2 | 0.66667 |
| 4 | 3 | 0.75000 |
| 5 | 2 | 0.40000 |
| 6 | 4 | 0.66667 |
| 7 | 3 | 0.42857 |
| 8 | 4 | 0.50000 |
| 9 | 3 | 0.33333 |
| 10 | 5 | 0.50000 |
| 11 | 4 | 0.36364 |
| 12 | 5 | 0.41667 |
| 13 | 5 | 0.38462 |
| 14 | 4 | 0.28571 |
| 15 | 6 | 0.40000 |
| 16 | 7 | 0.43750 |
| 17 | 5 | 0.29412 |
| 18 | 6 | 0.33333 |
| 19 | 6 | 0.31579 |
| 20 | 7 | 0.35000 |
| 21 | 7 | 0.33333 |
| 22 | 7 | 0.31818 |
| 23 | 6 | 0.26087 |
| 24 | 9 | 0.37500 |
| 25 | 8 | 0.32000 |
| 26 | 7 | 0.26923 |
| 27 | 8 | 0.29630 |
| 28 | 9 | 0.32143 |
| 29 | 8 | 0.27586 |
| 30 | 8 | 0.26667 |
| | | |
| 295 | 54 | 0.18305 |
| 296 | 49 | 0.16554 |
| 297 | 45 | 0.15152 |
| 298 | 57 | 0.19128 |
| 299 | 56 | 0.18729 |
| 300 | 56 | 0.18667 |
| 301 | 52 | 0.17276 |
| 302 | 49 | 0.16225 |
| 303 | 58 | 0.19142 |
| 304 | 57 | 0.18750 |
| 305 | 56 | 0.18361 |

| | | |
|---|---|---|
| 990 | 142 | 0.14343 |
| 991 | 140 | 0.14127 |
| 992 | 143 | 0.14415 |
| 993 | 140 | 0.14099 |
| 994 | 143 | 0.14386 |
| 995 | 148 | 0.14874 |
| 996 | 132 | 0.13253 |
| 997 | 148 | 0.14845 |
| 998 | 151 | 0.15130 |
| 999 | 139 | 0.13914 |
| 1000 | 152 | 0.15200 |

The result is asymptotic. The following graph shows the first 5000 boundaries. The first 1000




boundaries (integers) show a lot of noise, but this starts to settle down and smooth out in the next 3000 boundaries. The amplitude also grows smaller as the square of the integer or boundary increases.

Gauss's equation operates in a large space without identifiable boundaries other than a log scale. There is no obvious relationship between the log scale other than the one demonstrated by a graph. But this new graph is a representation of the boundaries between groups of prime numbers and thus is much much closer to the nature of prime numbers.

Analysis of the curve was performed on LAB Fit [1]. LAB Fit is a software application for Windows developed for the treatment and analysis of experimental data.
[1] Silva, Wilton P. and Silva, Cleide M. D. P. S., LAB Fit Curve Fitting Software (Nonlinear Regression and Treatment of Data Program) V 7.2.46 (1999-2009), online, available from world wide web: <www.labfit.net>, date of access: 2009-May-5.

This program selected over 400 points from the above graph to analyse and the following four equations were ranked highest.

## Table 6: Relative Interboundary Prime Density NonLinear Regression Results

| **No.** | **Equation** | **Reduced Chi Squared** | **Variable A** | **Variable B** |
|---|---|---|---|---|
| 12: | Y=A*(Ln(X))^B | 0.594168E-04 | 0.934850E+00 | 0.966721E+00 |
| 122 | Y=(A*X^B)/Ln(X) | 0.594225E-04 | 0.956132E+00 | 0.590109E-02 |
| 23: | Y=1/(A+B*LnX) | 0.596395E-04 | 0.153302E+00 | 0.980030E+00 |
| 10: | Y=A*X^B | 0.881275E-04 | 0.465580E+00 | 0.165611E+00 |

All odd numbers are the difference between consecutive squares. When the difference is a prime number or the square of a prime number, then there are no other pairs of squares whose difference equates to these numbers.

The second definition above represents the comparison between consecutive squares and non-consecutive squares. It is also another way of looking at the first definition because instead of the square being deducted before trial divisions, the square sits in the middle of a number and therefore just one side needs to be tested, in other words the numbers on the lower strand. Because the middle is a square of an odd number then the total of the outer strands is an even number.

Consider the non-prime 105.

The consecutive squares are 53^2 – 52^2 while the non-consecutive squares are ;
19^2 – 16^2 = 3 x 35
13^2 – 8^2 = 5 x 21
11^2 – 4^2 = 7 x 15

When each of the members of each pair are multiplied by the lessor factor, they end up being the square of that lessor factor apart and they are equidistant from the midpoint between 52 and 53.

A table will best demonstrate this.

## Table 7: Pyramid Structure for Testing Primeness

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | **105** | | | | |
| | | | 52/53 | | | | **Difference between Outers** |
| | | 48 | **3** | 57 | | | 9 |
| | 40 | | **5** | | 65 | | 25 |
| 28 | | | **7** | | | 77 | 49 |

The top number is the number to test, the pair of numbers below surround the midpoint, the bold numbers beneath that represent the factors to test, while the outer strands contain the two numbers that if a factor exists will be divisible by that factor.

As mentioned above, it is possible to speed testing for prime numbers by firstly identifying the Prime Number Channel that a number lies in and thereby missing division for numbers that don't matter (in channels 7,11,13,17,23, and 29, only four types of numbers need to be tested). Secondly, additional squares can be deducted from the left strand. So in addition to deducting half a square less one from the left strand prior to a division test, you can also deduct a full square or multiple of a full square. At some point for very large numbers, the effect of these additional squares can be removed when the number to test is greater than the remainder.

Lastly there is another trick that can be combined with the above methods and that is to take advantage of fast computer doubling of numbers. Multiply one additional square by 2 successively while it is less than the number to test and then just test the difference between this number and the binary-multiplied square.

Overall these techniques reduce the demand on division by employing simple addition and subtraction, while keeping track of the differences between successive squares of factors to test for and the diminishing number on the left strand.

**Discussion**

This attribute of Prime Numbers can be used to generate potential prime numbers by attempting to literally "break" the equation in other ways than just subtracting a prime number. For example, adding one to an even number squared is one way of putting pressure on this equation in order to force a prime number. This indeed is one method for producing large prime numbers and uses different powers of 2 with 1 added (Mersenne Prime Numbers).

It would also be possible to plot another graph where the number of prime numbers is used that occurs in-between the squares of positive numbers and this will give a similar asymptote. It is also possible to plot the distance between squares against the number of prime numbers to give a similar result to the above graph. All these graphs show an unmistakable relationship between prime number boundaries and prime number density.

## Definition Number Four

If you add a consecutive sequence of odd numbers from 1 onwards, all squares are formed by this addition. For example 1+3 = 4, 4+5 = 9, 9+7 = 16 and so on.

If a lower square that is non-consecutive relative to a higher square is deducted from that higher square then the remainder is a consecutive series of odd numbers that starts above 1. Therefore a non-prime number is the sum of a consecutive series of odd numbers starting at a number greater than 1.

Conversely, a prime number is a non-consecutive series of odd numbers that cannot be recombined into a consecutive series of odd numbers. It is also obviously a number by itself, where a prime number squared is a consecutive number of odd numbers starting at 1.

There are a simple set of rules governing what types of numbers have to be added together to form possible prime numbers.

There are three types of numbers that can be combined; Multiples of 3, Over6 (6N+1), and Under6 (6N-1). Combining equal amounts of all three produces a number divisible by 3. Combining two of 1 type, and 1 of another type produces a number that is not divisible by 3.

There is a variety of ways in which numbers can combine to form prime numbers which is expected in light of the observation that even numbers are formed by the addition of two prime numbers.

For the numbers 3 to 30, the following sets of non-consecutive odd prime numbers are shown;

| | |
|---|---|
| 3 | 1+1+1 [the only number with the same base number] |
| 5 | 1+1+3 |
| 7 | 1+1+5, 1+3+3 |
| 11 | 1+5+5, 3+3+5 |
| 13 | 1+5+7, 3+5+5, 1+1+11 |
| 17 | 3+7+7, 1+5+11, 5+5+7, 1+3+13 |
| 19 | 3+5+11, 3+3+13, 5+7+7, 1+7+11, 1+5+13 |
| 23 | 1+11+11, 1+3+19, 1+5+17, 3+3+17, 5+5+13, 5+7+11 |
| 29 | 1+11+17, 1+5+23, 3+13+13, 3+3+23, 3+7+19, 5+5+19, 5+11+13, 7+11+11 |

Multiples of 3 and 5 can also be included;

| | |
|---|---|
| 11 | 1+1+9 |
| 13 | 1+3+9 |
| 17 | 1+1+15, 1+7+9 |
| 19 | 1+3+15, 3+7+9 |
| 23 | 1+7+15, 7+7+9, 1+1+21 |
| 29 | 1+9+19, 7+7+15, 1+7+21, 1+1+27 |

## Ideas for Further Research

This attribute of prime numbers may be entirely coincidental but on the other hand may also have some role in understanding them.

Is there a method for constructing prime numbers using special patterns of non-consecutive numbers?

Is there a method for converting a consecutive range of odd numbers starting at one (i.e. the square of a number) into a smaller but higher consecutive range of numbers whose sum is the same when the number is a non-prime? For example 9^2 = 1+3+5+7+9+11+13+15+17 and 25+27+29 which is taking the last three numbers of the first series and adding 12 to each to get the smaller second set. There are obvious similarities here between the first Prime Number Attribute in this paper and this conversion. For example, taking the last three positions of the first series and find that the remaining number of positions is also divisible by 3 shows a common factor.

## A Deeper Analysis of Goldbach's Strong Conjecture

The Prime Number Channels give one way of gaining a deep understanding of this conjecture. There is a deeper level that operates on a more independent basis and this relies on the third definition of Prime Numbers presented above.

To finally prove this conjecture one must first show that there is a reason why prime numbers align at equal distances in great numbers either side of the mid-point of any even number.

The third definition above shows how both prime numbers and the squares of prime numbers do not exist as the difference between non-consecutive squares.

Subtracting a prime number or the square of a prime number from a square creates Virgin Prime Number positions because it forces the squares to be consecutive. For example, 3^2 is the difference between 5^2 and 4^2. The pair of squares are of course the two consecutive numbers that sum together to form 3^2. Because they are consecutive numbers, they share no factors in common and therefore they cannot be recombined into any other square. Also because a prime or prime number squared also cannot be recombined into another combination, they are only the difference between consecutive squares.

Consider 10^2 as an example.

Subtracting 3^2 or 7^2 leaves 91 and 51 remainder respectively. These numbers have only two factors each; 7 x 13 and 3 x 17.

Both 7+13 and 3+17 produce the same sum of 20., and the member of each pair is the same distance from 10 as the other member of each pair.

In both examples, a prime subtracted from 10 produces a prime number, and a prime number added to 10 produces a prime number.

The relevance of 10^2 is that the sum of prime number factors equidistant by another prime number from 10 is 2x10 or 20 i.e. 10-P + 10+P = 2 x 10

Instead of considering any even number N, this problem now shifts to considering both N^2 and N/2.

If instead of an even number, an odd number squared is used, something similar happens except in this case the prime number subtracted is multiplied by a multiple of 2.

This is clearly not a proof by any means but shows that when an additional behaviour of prime numbers is applied to this problem, a prime number building mechanism is revealed that depends on lower prime numbers. It also shows that this conjecture is not purely finding enough aligned prime numbers, but about what happens at the level (N/2)^2 that leads to the generation of the second pair of prime numbers which is used for N^2.

The following table shows N/2, N and N^2 for the even integers between 4 and 30. One is generally not regarded by modern convention as a prime number but is never-the-less the product of a square (1) and can therefore be used in the following table. The second reason I have used it, is that it falls in Prime Number Channel 1.

I have excluded pairs which are a straight doubling of a prime number.

| 2N | N | N^2 | Pairs | Components | Squares Pair |
|---|---|---|---|---|---|
| 4 | 2 | 4 | 1 and 3 | (2-1) + (2+1) | 2^2 - 1^2 |
| 6 | 3 | 9 | 1 and 5 | (3-(2x1)) + (3+(2x1)) | 3^2 - 2^2 |
| 8 | 4 | 16 | 3 and 5 | (4-1) + (4+1) | 4^2 - 1^2 |
| | | | 1 and 7 | (4-3) + (4+3) | 4^2 - 3^2 |
| 10 | 5 | 25 | 3 and 7 | (5-(2x1)) + (5+(2x1)) | 5^2 - 2^2 |
| 12 | 6 | 36 | 5 and 7 | (6-1) + (6+1) | 6^2 - 1^2 |
| | | | 1 and 11 | (6-5) + (6+6) | 6^2 - 5^2 |
| 14 | 7 | 49 | 3 and 11 | (7-(2x2)) + (7+(2x2)) | 7^2 – 4^2 |
| | | | 1 and 13 | (7-6) + (7+6) | 7^2 – 6^2 |
| 16 | 8 | 64 | 5 and 11 | (8-3) + (8+3) | 8^2 – 3^2 |
| | | | 3 and 13 | (8-5) + (8+5) | 8^2 – 5^2 |
| | | | 1 and 14 | (8-7) + (8+7) | 8^2 – 7^2 |
| 18 | 9 | 81 | 7 and 11 | (9-(2x1)) + (9+(2x1)) | 9^2 – 2^2 |
| | | | 5 and 13 | (9-(2x2)) + (9+(2x2)) | 9^2 – 4^2 |
| | | | 1 and 17 | (9-(2x4)) + (9+(2x4)) | 9^2 – 8^2 |
| 20 | 10 | 100 | 7 and 13 | (10-3) + (10+3) | 10^2 – 3^2 |
| | | | 3 and 17 | (10-7) + (10+7) | 10^2 – 7^2 |
| 22 | 11 | 121 | 5 and 17 | (11-(2x3)) + (11+(2x3)) | 11^2 - 6^2 |
| | | | 3 and 19 | (11-(2x4)) + (11+(2x4)) | 11^2 – 8^2 |
| 24 | 12 | 144 | 11 and 13 | (12-1) + (12+1) | 12^2 – 1^1 |
| | | | 7 and 17 | (12-5) + (12+5) | 12^2 – 5^2 |
| | | | 5 and 19 | (12-7) + (12+7) | 12^2 – 7^2 |
| | | | 1 and 23 | (12-11) + (12+11) | 12^2 – 11^2 |
| 26 | 13 | 169 | 7 and 19 | (13-(2x3)) + (13+(2x3)) | 13^2 – 6^2 |
| | | | 3 and 23 | (13-(2x5)) + (13+(2x3)) | 13^2 – 10^2 |
| 28 | 14 | 196 | 11 and 17 | (14-3) + (14+3) | 14^2 – 3^2 |
| | | | 5 and 23 | (14-9) + (14+9) | 14^2 – 9^2 |
| 30 | 15 | 225 | 13 and 17 | (15-(2x1)) + (15+(2x1)) | 15^2 – 2^2 |
| | | | 11 and 19 | (15-(2x2)) + (15+(2x2)) | 15^2 – 4^2 |
| | | | 7 and 23 | (15-(2x4)) + (15+(2x4)) | 15^2 – 8^2 |
| | | | 1 and 29 | (15-(2x7)) + (15+(2x7)) | 15^2 - 14^2 |

For the last one, the first three numbers are powers of 2. These can be extended upwards indefinitely by additional powers of 2 knowing that the result will never land on a multiple of 3 or 5.

Deducting the square of a prime number from the square of an even number, particularly if the prime number is large compared to the even number, reduces the probability that the remainder will have multiple factors. Because the difference cannot be a prime number (definition 3 above), it therefore has to be a number that has fewer factors. Many of these will be just two factors which is why prime number pairs do tend to form even integers. This is by no means any claim to a proof, but gives a simple description of why this trend occurs. The other factors that combine to strengthen this trend are that the prime number being deducted as a square and the even square cannot share common factors with difference between their squares.

There are now some simple reasons as to why prime numbers pair up to form even integers but the elusive nature of prime numbers could possibly mean that this conjecture will never be proved absolutely for that will need an absolute description of prime numbers.

**Levy's Conjecture**
This states that all odd numbers are the sum of twice one prime added to an additional prime.
This is a derivation of the deeper level of Goldbach's Strong Conjecture above.

For any occurrence, take the two different primes and turn them into the same equation as above using their mid-point and then add the other prime expressed in the same format..
For example 11+11 + 7 = (9+2) + (9-2) + (9+2)
This is based on 9^2 – 2^2 = 7 x 11

## Riemanns Hypothesis

Bernhard Riemann created a model landscape where prime numbers occupy special positions. The goal of this problem is to prove that all prime numbers do occupy these positions and that presents a challenge in more ways than one.

This problem can be restated in simple layman's language of proving that the behaviour of prime numbers matches that proposed by Riemann's model.

Unfortunately the full behaviour of prime numbers is not known, nor may ever be and therefore at this present point in time, any attempt to manipulate logic in order to solve this problem is a pointless exercise. It is akin to making a comparison between something that is known against something that is unknown and trying to show that the known matches the unknown.

In order to solve this problem, mathematicians need to understand more about prime numbers and once they understand that, then see if it matches the model. Anything less than that has no value.

With these and the previous paper on prime numbers, new attributes and behaviours of prime numbers are identified and it may be possible that one of these can be shown to be consistent with the model.

For example;

1) Prime numbers above 5 all fall into the Prime Number Channels.
2) Prime numbers are only the difference between consecutive squares, never non-consecutive squares.
3) Prime numbers occur in groups between square boundaries.
4) Prime numbers are more-or-less evenly distributed throughout the Prime Number Channels.
5) Prime numbers have no number evenly straddling their centre-points.
6) Other than 2, the most common difference between prime numbers is a multiple of 30.

That would mean taking Riemann's procedures for deriving his hypothesis and seeing if there is a simplification that makes the outcome consistent with one of the above observations.

The Prime Number Channels show that 3 and 5 are special cases and Riemann's Hypothesis makes no allowance for this, nor does it show that the first incidence of a prime number's non-prime derivative is the square of that prime number – the lesser multiples belong to a lower number's multiples. It is unlikely that this will be solved and it is improbable that it is a relevant model for prime numbers.

**General Discussion**
Like the Supersymmetry model used in particle physics, there also appears to be much symmetry in the numbers. Here are the items displaying symmetry in my first paper;

1) The mirror-symmetry of the Prime Number Channels
2) The symmetry of paired parametric equations that exist in each channel.
3) The mirror-symmetry of the sequence of channels that multiplication products fall into for each pair of channels that are equidistant from a multiple of 30.
4) The mirror-symmetry of prime numbers on opposite sides of the mid-point of an even number.

Researching prime numbers is a trying and frustrating occupation, so much work for so little return. Much of this work is based on an assumption that prime numbers can be directly derived which may be totally incorrect.

My personal belief is that prime numbers are elusive, imprecise objects. Of all the simple attributes, other than the distribution of prime numbers in the Prime Number Channels, and multiples of 30 being the important difference between prime numbers, all others are negative attributes in the sense that they are not something else – not the difference between consecutive squares, not having any number that straddles their centrepoint etc.

Picture a line of bottles stretching into the distance. Mr Magoo is taking potshots with a BB gun, knocking over what appears to be a random mixture of bottles. What remains is a by-product of the knocking out of bottles in certain positions. Is what remains, a similar result to what happens when non-prime numbers are removed from the set of all positive integers? If it is, then the logical approach is to understand non-prime numbers better, hoping that a deeper understanding of prime numbers will follow.

The observation about prime number pairs forming even integers supports the idea about prime numbers being inexact – there are many ways to combine pairs of prime numbers to form even numbers and this increases with the magnitude of the number tested.

This is precisely the basis on which I proceeded and the following observations were a direct result of this approach;

Prime Number Channels
Equations governing non-prime numbers in these channels
The repeating patterns of multiplication using consecutive blocks of 30
Phases of multiplication
A structural basis for understanding Goldbach's Conjecture
Alternative Prime Number definitions
Discovery of natural boundaries for groups of Prime Numbers
Discovery of the relationship between boundaries and Prime Number density

I've given a number of possible lines of research in both papers and one of these might well yield something else. Understanding the equations of the Prime Number Channels may provide the best approach but there will be a need to concentrate on finding other “not behaviours” as a direct result of understanding non-prime numbers more. Simple things are easy to overlook as I hope I have demonstrated and there is an excellent chance I have overlooked much as it sometimes took me quite some months to make an advancement of understanding. The symmetry of the Prime Number Channels suggests very strongly to me that some further understanding lies in these particular channels and the equations that populate them. Good luck!