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Sum of Digits of Prime Numbers Is Evenly Distributed: New Mathematical Proof of Hypothesis

ScienceDaily (May 13, 2010) — On average, there are as many prime numbers for which the sum of decimal digits is even as prime numbers for which it is odd. This hypothesis, first made in 1968, has recently been proven by researchers from the Institut de Mathématiques de Luminy (CNRS/Université de la Méditerranée).

A prime number is an integer greater than or equal to 2 that has exactly two distinct natural number divisors, 1 and itself. For example, 2, 3, 5, 7, 11,..., 1789, etc. are prime numbers, whereas 9, divisible by 3, is not a prime number.

Numerous arithmetical problems concern prime numbers and most of them still remain unresolved, sometimes even after several centuries. For example, it has been known since Euclid that the sequence of prime numbers is infinite, but it is still not known if an infinity of prime numbers p exists such that p+2 is also a prime number (problem of twin prime numbers). In the same way, it is not known if there exists an infinity of prime numbers, the decimal representation of which does not use the digit 7.

Two researchers from the Institut de Mathématiques de Luminy (CNRS/Université de la Méditerranée) have recently made an important breakthrough regarding a conjecture formulated in 1968 by the Russian mathematician Alexandre Gelfond concerning the sum of digits of prime numbers. In particular, they have demonstrated that, on average, there are as many prime numbers for which the sum of decimal digits is even as prime numbers for which it is odd.

The methods employed to arrive at this result, derived from combinatorial mathematics, the analytical theory of numbers and harmonic analysis, are highly groundbreaking and should pave the way to the resolution of other difficult questions concerning the representation of certain sequences of integers.

Quite apart from their theoretical interest, these questions are directly linked to the construction of sequences of pseudo-random numbers and have important applications in digital simulation and cryptography.

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 Christian Mauduit, Joël Rivat. Sur un problème de Gelfond: la somme des chiffres des nombres premiers. Annals of Mathematics, 2010; 171 (3): 1591 DOI: <u>10.4007/annals.2010.171.1591</u>

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