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Birkás-Bölcsföldi Prime Numbers

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Abstract
After defining, Birkás-Bölcsföldi prime numbers will be presented from 337 to 33575737373. How many Birkás-Bölcsföldi prime numbers are there in the interval (10^{p-1}, 10^p) (where p is a prime number)? On the one hand, it has been counted by computer among the prime numbers with up to 13-digits. On the other hand, the function (1) gives the approximate number of Birkás-Bölcsföldi prime numbers in the interval (10^{p-1},10^p). Near-proof reasonig has emerged from the conformity of Mills' prime numbers with Birkás-Bölcsföldi prime numbers. The set of Birkás-Bölcsföldi prime numbers is probably infinite.

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I. Introduction

The sets of special prime numbers within the set of prime numbers are well-known. For instance, the Erdős-primes (the sum of the digits is prime) [8], Fibonacci-primes (F_0=0, F_1=1, $F_n=F_{n-1}+F_{n-2}$), Gauss-primes (in the form 4n+3), Leyland-primes (in the form x^y+y^x, where $1\leq x\leq y$), Pell-primes (P_0=0, P_1=1, $P_n=2P_{n-1}+P_{n-2}$), „All digits are 1" prime numbers (11, 1111111111111111111, 11111111111111111111111, …), Bölcsföldi-Birkás-Ferenczi primes (all digits are prime and the number of digits is prime), etc. Question: Which further sets of special prime numbers are there within the set of prime numbers? We have found a further set of special prime numbers within the set of prime numbers. It is the set of Bölcsföldi-Birkás prime numbers.

II. Birkás-Bölcsföldi Prime Numbers [3], [9], [10], [11].

Definition: a positive integer number is a Birkás-Bölcsföldi prime number, if

a/ the positive integer number is prime, b/ all digits are uneven prime (3, 5, 7), c/ the number of digits is prime, d/ the sum of digits is prime.

The set of prime numbers meeting the conditions a/ and c/ is well-known: it is the set of prime-long prime numbers [3], [9]. Positive integer numbers meeting all the four conditions (a/, b/, c/, d/) at the same time are Birkás-Bölcsföldi prime numbers (Fig.1, Fig.2).

Birkás-Bölcsföldi prime number p has the following sum form:

2.1 $p=\sum_{j=0}^{k(p)} e_j(p).10^j$ where $e_j(p)$ € {3, 5, 7} and k(p)+1 is prime and $e_0(p)$ € {3, 7} and $\sum_{j=o}^{k(p)} e_j(p)$ is prime.

The Birkás-Bölcsföldi prime numbers are as follows (the last digit can only be 3 or 7):
337, 353, 373, 557, 577, 733, 757, 773,
33353, 33377, 33533, 33773, 35353, 35533, 35537, 35573, 35753, 37337, 53353, 53777, 55333, 55337, 55373, 55733, 57557, 57737, 57773, 73553, 73757, 75353, 75377, 75533, 75557, 75577, 75773,77377, 77557, 77573, 77773, 3333773,3335537, 3335573, 3335737, 3335753, 3337777, 3353333, 3353773, 3355337, 3355357, 3355553, 3355733, 3355777,3357337, 3357353, 3357577, 3373553, 3373753, 3375577, 3377377, 3377557, 3533357, 3533377, 3533557, 3533573, 3535373, 3535573, 3535733, 3537337, 3537733, 3553553, 3553777, 3555353, 3557377, ……. 33575337353, 33575337533, 33575357537, 33575373353, 33575373737, 33575375333, 33575375777, 33575377373, 33575533373, 33575533553, 33575537537, 33575555333, 33575555357, 33575555777, 33575557553, 33575557777, 33575573333, 33575577377, 33575577533, 33575577757, 33575733353, 33575733377, 33575737337, 33575737373, etc.
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T(p) is the factual frequency of Birkás-Bölcsföldi prime numbers in the interval (10^{p-1}, 10^p).
, T(3)=8, T(5)=31, T(7)=171, T(11)=7453, T(13)=63660, etc.
S(p) function gives the number of Birkás-Bölcsföldi prime numbers in the interval (10^{p-1},10^p). We think that

$S(p)=1{,}263\times 2{,}3^p$, where p is prime. (1)

The factual number of Birkás-Bölcsföldi primes and the number of Birkás-Bölcsföldi primes calculated according to function (1) are as follows:

Number of digits p	The factual number of Birkás-Bölcsföldi primes in the interval $(10^{p-1},10^p)$ T(p)	The number of Birkás-Bölcsföldi primes according to function $S(p)=1{,}263\times 2{,}3^p$	T(p)/S(p)
3	8	15,37	0,52
5	31	81,29	0,38
7	171	430,03	0,40
11	7453	12033,99	0,62
13	63660	63659,79	1,00

Fig.1

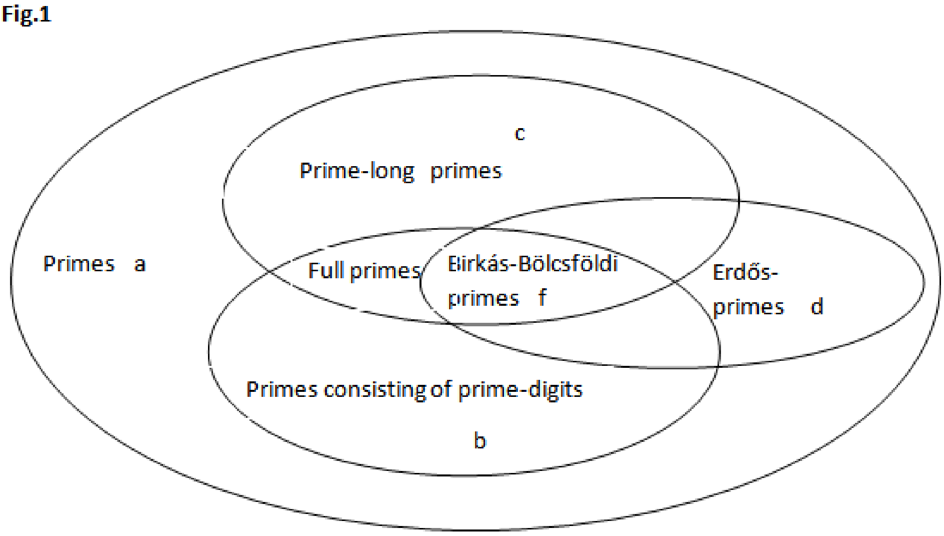
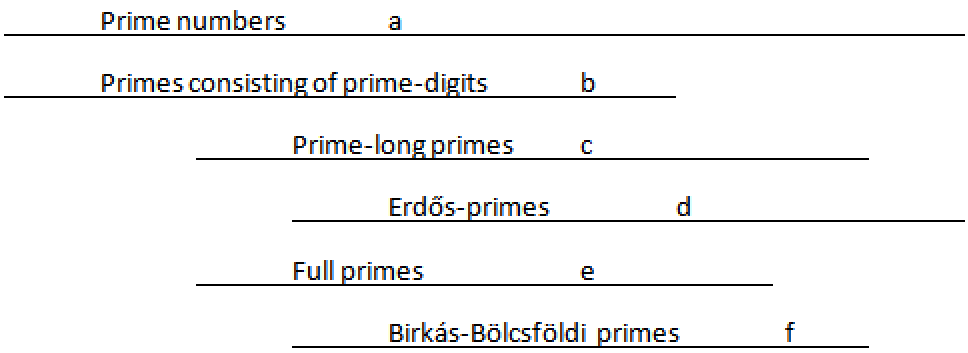


Fig.2



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III. Number Of The Elements Of The Set Of Birkás-Bölcsföldi Prime Numbers [3], [9],[10], [11].

Let's take the set of Mills' prime numbers!

Definition: The number $m=[M \text{ ad } 3^n]$ is a prime number, where M=1,306377883863080690468614492602 is the Mills' constant, and n=1,2,3,… is an arbitrary positive integer number. It is already known that the number of the elements of the set of Mills' prime numbers is infinite. The Mills' prime numbers are the following: m=2, 11, 1361, 2521008887,…

The connection n→m is the following:1→2, 2→11, 3→1361, 4→2521008887,… The Mills' prime number $m=[M \text{ ad } 3^n]$ corresponds with the interval $(10^{m-1},10^m)$ and vice versa. For instance:2→$(10, 10^2)$, 11→$(10^{10},10^{11})$, 1361→$(10^{1360},10^{1361})$, etc. and vice versa. The number of the elements of the set of Mills' prime numbers is infinite. As a consequence, the number of the intervals $(10^{m-1}, 10^m)$ that contain at least one Mills' prime number is infinite. The number of Birkás-Bölcsföldi primes in the interval $(10^{m-1},10^m)$ is

$S(m)=1,263x2,3^m$. The number of Birkás-Bölcsföldi prime numbers is probably infinite: $\lim_{p\to\infty} T(p)=\infty$ is probably where p is prime.

IV. Conclusion

Countless different sets of special prime numbers have been known. We have found the following set of special prime numbers within the set of prime numbers. There may be further sets of special prime numbers that we do not know yet. Finding them will be task of researchers of the future.

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