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IDENTIFY PRIME NUMBERS WITHIN INTERVALS

IDENTIFICAR NÚMERO PRIMOS EM INTERVALOS

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ABSTRACT

This article analyzes the distribution and identification of prime numbers along the arithmetic scale through a deterministic filtering method in discrete intervals. The study investigates the structural properties of elements contained in the residue classes adjacent to multiples of six (6k more or less 1), isolating prime numbers from composite elements generated by factorial products and powers of prime bases. The general objective is to validate the efficacy of a screening algorithm and measure the density of primality as the upper limit of the numerical scale expands. The methodology adopts a quantitative and exploratory approach, computationally implemented through logical routines and conditional chromatic coding in Microsoft Excel software. The sample universe ranged from basal domains to a macroscopic seven-digit interval (994,008 to 1,018,080), totaling 24,072 integers. The results reveal that although the adjacency subset of 6k corresponds to 33.333% of the total domain, the progressive infiltration of composites reduces the primality rate to 7.348787% of the global interval and to 22.046361% within the 6k more or less 1 order. It is concluded that the objectives were fully achieved, confirming the hypothesis that the density of prime numbers is inversely proportional to the advancement of the arithmetic scale. The proposed model offers a low computational cost practical contribution to numerical matrix auditing and visualization in Number Theory.

Keywords: Prime Numbers; Modular Arithmetic; Electronic Spreadsheet; Algorithmic Filtering; Numerical Density.

RESUMO

Este artigo analisa a distribuição e a identificação de números primos na escala aritmética por meio de um método determinístico de filtragem em intervalos discretos. O estudo investiga as

propriedades estruturais de elementos contidos nas classes de resíduos adjacentes aos múltiplos de seis (6k mais ou menos 1), isolando os números primos dos elementos compostos gerados por produtos fatoriais e potências de bases primas. O objetivo geral consiste em validar a eficácia de um algoritmo de triagem e mensurar a densidade de primariedade à medida que se expande o limite superior da escala numérica. A metodologia adotada possui abordagem quantitativa e exploratória, implementada computacionalmente por meio de rotinas lógicas e codificação cromática condicional no software Microsoft Excel. O universo amostral abrangeu desde domínios basais até um intervalo macroscópico de sete dígitos (994.008 a 1.018.080), totalizando 24.072 inteiros. Os resultados revelam que, embora o subconjunto de adjacência de 6k corresponda a 33,333% do domínio total, a infiltração progressiva de compostos reduz a taxa de primariedade a 7,348787% do intervalo global e a 22,046361% dentro das ordens 6k mais ou menos 1. Conclui-se que os objetivos foram plenamente atingidos, confirmando a hipótese de que a densidade de números primos é inversamente proporcional ao avanço da escala aritmética. O modelo proposto oferece uma contribuição prática de baixo custo computacional para a auditoria de matrizes numéricas e visualização na Teoria dos Números.
Palavras-chave: Números Primos; Aritmética Modular; Planilha Eletrônica; Filtragem Algorítmica; Densidade Numérica.

1. INTRODUCTION

The study of prime numbers and their distribution properties represents one of the most traditional and challenging theoretical frontiers in Number Theory. Historically, the search for regular patterns or deterministic mechanisms capable of rapidly isolating and classifying these elements has engaged mathematicians and computer scientists alike (Santos, 2021). Although prime numbers appear randomly scattered along the number line, an analysis of their modular properties reveals well-defined structural constraints. A notable property among these is the established fact that every prime number greater than three is necessarily confined to the residue families adjacent to multiples of six—that is, structured according to the linear forms $6k - 1$ and $6k + 1$ (Silva & Oliveira, 2020).

However, a major uncertainty and concern regarding the practical application of this property is that these adjacency classes do not contain exclusively prime elements. As the upper limit of the arithmetic scale expands, the $6k \pm 1$ coordinates become progressively "infiltrated" by composite numbers generated through the multiplication and exponentiation of lower-order prime factors—such as products of the form $(6\lambda - 1)(6\lambda + 1)$ (Garcia, 2024). This continuous infiltration creates increasing complexity in data processing and primality screening, necessitating deterministic methods that are simultaneously secure, accurate, and computationally efficient (Almeida & Costa, 2022).

In this context, the problem statement driving this research arises from the researcher's direct experience in handling and analyzing large numerical matrices within a spreadsheet environment (Microsoft Excel). Upon observing the behavior of integers across scales ranging from baseline values to the order of millions (10^6), the following research question emerged: How can a deterministic, visual method of algorithmic filtering be structured—based on excluding composite numbers in the $6k \pm 1$ categories—that allows for the precise identification of prime numbers and an analytical demonstration of the decrease in their density as one progresses along the numerical scale?

The rationale for this research is grounded in both its theoretical relevance and its practical applicability. From a theoretical standpoint, the study is justified by the need to deepen the understanding of prime number density dynamics within discrete partitions; it offers a clear, geometric visualization of how advancing along the arithmetic scale generates an increase in products and powers of prime bases, thereby reducing the percentage occurrence of primes within the $6k \pm 1$ classes.

From a practical and applied perspective, the researcher's motivation stems from the pursuit of accessible, low-computational-cost solutions for numerical data auditing. While primality testing on large datasets typically requires complex algorithms and high processing power, systematizing the mapping via conditional color-coding reduces the scope of analysis to just one-third (3.333) of the total domain (Vieira, 2021). Thus, this research demonstrates how everyday spreadsheet tools can be optimized for precise mathematical simulations, supporting both research in cryptography and number theory and teaching methodologies in the exact sciences.

To address the problem at hand and consolidate the analytical approach—moving from the general properties of modular arithmetic to a specific analysis of the seven-digit interval—this study established the following objectives:

General Objective: To propose, apply, and validate a deterministic filtering method using spreadsheets to identify prime numbers and measure their percentage density across different discrete partitions of the numerical scale.

Specific Objectives:

- Map the geometric and structural constraints regarding the occurrence of primes and twin primes within the first and second hundreds, based on the terminal digits of multiples of six;

- Implement logical routines and conditional color-coding in Microsoft Excel to isolate composite numbers from the forms ($6\lambda \pm 1$) within the specific range of 994,008 to 1,018,080;

- Quantify and compare primality percentage rates across the entire range and within the 6k-adjacency subset, thereby confirming the inverse proportional relationship between prime number density and the progression of the arithmetic scale.

2. THEORETICAL FRAMEWORK OR LITERATURE REVIEW

2.1. Theoretical Framework And State Of The Art

The mathematical expression used in this study is duly registered and recorded with the National Library's Copyright Office (Rio de Janeiro), certifying its originality and substantiating its use as a starting point for scientific inquiry. This formulation serves as the central analytical tool for defining sample intervals, enabling the identification and mapping of prime numbers with high methodological rigor and mathematical precision. Applying this model provides a structured approach to examining the arithmetic properties of the established numerical subsets.

Figure 01 – The method used to identify prime numbers with certainty and precision.

$$\begin{bmatrix} P = 6n - 1 \\ P = 6n + 1 \end{bmatrix} \begin{bmatrix} (P\ K\ -1)^2 - 1 \\ a\,(PK)^2 - 1 \end{bmatrix} \neq \left\{ * \begin{bmatrix} 6n - 1 \\ 6n + 1 \end{bmatrix} < P(k-1) \right\}$$

Source: The author

The subsequent analysis of the defined numerical intervals aims to demonstrate the model's algorithmic feasibility and analytical efficiency in screening for prime numbers. The construction of these interval partitions, based on restrictive algebraic criteria, allows the number line to be segmented into finite subsets where the distribution and density of prime numbers are systematically investigated. From a methodological standpoint, parameterizing the domain into discrete intervals enables a structured approach, mitigating the computational effort required for primality validation and increasing the degree of logical determinism within each range. Thus, the empirical validation of the data seeks to establish the statistical consistency of the proposed method, as well as its relevance to mapping the prime-counting function across the broader numerical scale.

Table 2 – identifies prime numbers in the interval from one to six.

1	2	3	4	5	6

Source: the author

The number 2 is defined as a prime number because it is the only even number with exactly two distinct positive divisors: 1 and itself. The number 3 qualifies as prime because it is the smallest odd positive integer possessing this same property, serving as the initial generator for multiples of three. Similarly, the number 5 is also classified as prime, being the first odd prime integer preceding the number 6, which represents the smallest composite multiple of three.

Within the intervals under analysis, the distribution shows that approximately 50% of the elements are prime numbers, while the remaining 50% of the terms in the aforementioned partition are composite numbers.

In the set of natural numbers, the elements 9, 15, 21, 27, 33, and 39 belong to the class of multiples of three and are, therefore, composite numbers. Conversely, the elements 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, and 47... are formally classified as prime numbers, given that they possess exactly two distinct positive divisors in their arithmetic structure. Additionally, the number 25 is classified as a composite number because it is the square of a prime number, expressed as $5^2 = 25$. Similarly, the number 35 is also composite, obtained through the product of two distinct prime factors via the arithmetic operation $5 \times 7 = 35$. Considering the interval boundary starting at 24—algebraically defined as $5^2 - 1 = 24$—it is evident that the numbers immediately preceding or following multiples of six can be analytically represented by the linear form $6k \pm 1$, where k belongs to N*.

Table 3 shows multiples of three, as well as the numbers preceding and following multiples of six.

5	7	9	11		

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Source: the author

However, although this formation rule encompasses all prime numbers greater than or equal to five—represented in the initial sequence by the elements 7, 11, 13, 17, 19, and 23—not all integers satisfying the structural property of adjacency to multiples of six are necessarily prime. This analytical limitation is evidenced by the behavior of the number 25, which, despite strictly fitting the aforementioned linear form, is a composite number.

Thus, it is concluded that the property of preceding or succeeding multiples of six establishes a necessary but insufficient criterion for determining primality, making the application of additional divisibility tests indispensable for the definitive validation of prime elements within the domain under consideration.

In the interval under analysis, it is observed that elements adjacent to multiples of six can be algebraically represented by the linear forms $(6k + 1)$, characterizing the successor, and $(6k - 1)$, defining the predecessor. Such configurations encompass all candidates for primality within the domain of integers $p \geq 5$. However, it must be emphasized that fitting this structural property does not, in isolation, guarantee an element's primality, making the application of complementary divisibility tests imperative for its confirmed validation.

Regarding the odd composite numbers generated by this formation rule within the interval, their occurrence stems from the multiplicative combination of odd prime factors belonging to the very residue classes adjacent to multiples of six. The analytical decomposition of these composite elements highlights the significance of minimal determining factors within the arithmetic grid, enabling the mapping of systematic distribution patterns. Consequently, the correlated examination of these numbers in relation to multiples of six and their factorial bases serves as an effective—albeit non-definitive—methodological tool for the screening and investigation of primality within specific numerical partitions. Examples:

Table 4 – shows the product of the number three and odd numbers

3 x 3 = 9	3 x 5 = 15	3 x 7 = 21	3 x 9 = 27	3 x 11 = 33	3 x 13 =

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Source: the author

Presented below is an examination of the interval between 24 and 48, focusing on the analysis of elements immediately preceding or following the multiples of six found within that range. This procedure aims to highlight the structural property of numbers of the form 6k ± 1 within the domain under consideration—numbers that are candidates for primality.

This approach seeks to systematically examine the distribution of these numbers and their intrinsic arithmetic properties, thereby contributing to the identification and understanding of the behavior of prime numbers within this numerical set.

25	29	31	35	37	41

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Table 5 – In the interval (24, 48), 25 and 35 are composite numbers.

Source: the author

In the interval between 24 and 48, a specific statistical distribution of prime and composite elements is observed, particularly within the subset of numbers adjacent to multiples of six—that is, those generated by the form 6k ± 1. Within this sample set, approximately 12.5% of the numbers are composite elements defined by powers of prime numbers, as exemplified by $5^2 = 25$. Another 12.5% consist of composite numbers resulting from the product of two distinct prime factors, such as 35 = 5 × 7. Finally, 75% of the numbers immediately preceding or following multiples of six—namely 29, 31, 37, 41, 43, and 47—are formally validated as prime numbers within this interval.

This distribution reveals a geometric regularity in the occurrence of prime numbers among the predecessors and successors of multiples of six within the analyzed interval. However, it should be noted that while the form 6k ± 1 is an intrinsic property of prime numbers greater than or equal to five, it does not, in isolation, constitute a sufficient criterion to guarantee primality; complementary verification via deterministic divisibility tests is mandatory.

Presented below is an analytical examination of the predecessors and successors of multiples of six in the interval between 48 and 120. This mapping aims to examine the distribution of numbers of the form 6k ± 1 in this region of the numerical domain—numbers that possess the potential for primality.

This investigation seeks to identify patterns in the occurrence of prime and composite terms and to understand the arithmetic properties associated with these numbers. Such an approach contributes to the systematization of the proposed method and to a deeper analysis of the distribution function of prime numbers across specific intervals and the global numerical scale.

49	55	61	67	73	79
53	59	65	71	77	83

Table 6 – In this interval, multiples of 5 and 7 are composite numbers.

Source – the author

In the range between 48 and 120, the following elements are identified as prime numbers: 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101, 103, 107, 109, and 113. These values represent approximately 20.83% of the total integers contained within the considered interval.

Regarding the composite numbers in this range, it is observed that a small fraction consists of squares of prime numbers—such as $7^2 = 49$—representing about 1.39% of the total sample set. Additionally, composite numbers formed by the product of two distinct odd prime factors are identified—such as 55, 65, 77, 85, 91, 95, 115, and 119—accounting for approximately 9.72% of the elements in the interval.

In the context of numbers adjacent to multiples of six—that is, those structured according to the linear form $6k \pm 1$—it is found that the composite elements within this subset are primarily determined by the product of prime factors strictly smaller than $\sqrt{121} = 11$. This behavior reinforces the direct influence of minimal prime factors on the composition and filtering of non-prime elements belonging to this residue class.

Continuing the distributional analysis, the interval between 120 and 168 is considered next. In this segment, particular attention is given to the terms immediately preceding or following multiples of six; these are mapped and organized into the structural subsets presented below.

Table 7 – Identification of prime numbers in the interval (120 to 168).

125	131	137	**143**	149	**155**
121	127	**133**	139	**145**	151

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Source – the author

In this interval, the validated prime elements are 127, 131, 137, 139, 149, 151, 157, 163, and 167; these represent a density of approximately 56.25% of the terms structured according to the linear form 6k ± 1.

Among the composite numbers generated within this same residue class, notable occurrences include powers of prime elements—such as 121 (11^2) and 125 (5^3)—which account for about 6.25% of the analyzed subset. Additionally, composite numbers resulting from the product of distinct prime factors are observed—examples being 133, 143, 145, 155, and 161—totaling approximately 31.25% of the elements in the partition.

Considering the set of all integers within the 120–168 range, approximately 19.15% are prime numbers, while 80.85% are composite structures. This behavior reflects the relative asymptotic decrease in prime number density as the numerical domain expands.

Finally, an extension of the analysis to the 168–288 interval is proposed to further map the distribution of prime and composite numbers and to validate the statistical consistency of the structural patterns observed in the preceding sections.

Table 8 – This table shows the prime and composite numbers in the 168–288 interval (prime numbers + composite numbers).

169	173	**175**	179	181	185
199	**203**	**205**	209	211	**215**
235	239	241	245	**247**	251
265	269	271	**275**	277	281

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Source – the author

In the interval between 288 and 360, the following elements are identified as prime numbers: 173, 307, 179, 181, 191, 193, 197, 199, 211, 227, 233, 239, 241, 251, 257, 263, 269, 271, 277, 281, 283. These absolute values constitute the canonical set of prime numbers observed in the specified numerical partition.

When specifically considering the numbers adjacent to multiples of six—that is, those generated by the linear form 6k ± 1—it is found that approximately 43.47% of these numbers are prime, whereas an average of 56.51% are composite numbers. The composite elements mapped in this subset are: 169, 175, 185, 187, 203, 205, 209, 215, 217, 221, 235, 245, 247, 253, 259, 265, 275, 287. Among these composite terms, the perfect square $17^2 = 289$ stands out, while the remaining elements result from products of prime factors where at least one of the factors is strictly less than the prime number 19. This result implies that such structures serve as markers for primality testing within the interval, even though a significant portion of the sample still consists of composite numbers.

Study of prime numbers in the following interval.

Table 9 – Study of numbers in the interval between 288 and 360

289	293	299	301	305	307
323	325	329	331	335	337

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Source: the author

In the range between 288 and 360, the following elements are identified as prime numbers: 293, 307, 311, 313, 317, 331, 337, 347, 349, 353, and 359. These values constitute the set of prime numbers observed in the specified numerical range.

When specifically considering the numbers adjacent to multiples of six—that is, those generated by the linear form 6k ± 1—it is found that approximately 43.47% of these numbers are prime, whereas an average of 56.51% are composite numbers. The composite elements identified in this subset are: 289, 299, 301, 305, 319, 323, 325, 329, 335, 341, 343, and 355. Among these composite terms, the perfect square $17^2 = 289$ stands out, while the remaining elements result from products of prime factors where at least one of the factors is strictly less than the prime number 19. This result suggests that such structures serve as benchmarks for primality testing within the interval, even though a significant portion of the sample still consists of composite numbers. Prime numbers in the interval under study.

Table 10 - Interval between 360 and 528

365	***371***	***377***	383	389	***395***
361	367	373	379	***385***	***391***
425	431	***437***	443	449	***455***
421	***427***	433	439	***445***	***451***
485	491	***497***	503	509	***515***
481	487	***493***	499	***505***	***511***

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Source: the author

In the range from 360 to 528, the validated prime elements correspond to the following values: 367, 373, 379, 383, 389, 397, 401, 409, 419, 421, 431, 439, 443, 449, 457, 461, 463, 467, 479, 487, 491, 499, 503, 509, 521, and 523. Among the numbers structured in the linear form 6k ± 1 (adjacent to multiples of six), an average of 46.428571...% are prime numbers, while 53.571429...% are composite elements. Considering the totality of integers within this partition, it is observed that 15.4761190...% are prime numbers, whereas the remaining 84.523881...% are composite numbers.

The subsequent stage of the investigation involves analyzing the range from 528 to 840, covering a total span of 312 integers. As the upper limit of the numerical scale expands, an asymptotic trend of percentage decline in prime numbers—and a consequent increase in composite elements—is observed; this behavior stems from the accumulation of fundamental prime factors, which raises the density of composite numbers within the 6k ± 1 residue classes, thereby increasing the occurrence of non-prime values within the sample domain. The prime numbers identified in this interval (528 to 840) are mapped to the subset: {541, 547, 557, 563, 569, 571, 577, 587, 593, 599, 601, 607, 613, 617, 619, 631, 641, 643, 647, 653, 659, 661, 673, 677, 683, 691, 701, 709, 719, 727, 733, 739, 743, 751, 757, 761, 769, 773, 787, 797, 809, 811, 821, 823, 827, 829, 839}. This group totals 46 prime elements, equivalent to 14.743589...% of all integers in the range, leaving a fraction of 85.256411...% as composite numbers for the overall interval. Restricting the analytical scope strictly to the terms preceding or following multiples of six within this partition, the distribution shows 42.592592...% prime elements versus 57.4074...% composite structures.

We will now demonstrate the prime numbers in the next interval, (840 to 960).

Table 11 – Interval between 528 and 840

529	***535***	541	547	***553***	***559***
533	***539***	***545***	***551***	557	563
595	601	607	613	619	***625***
599	***605***	***611***	617	***623***	***629***
661	***667***	673	***679***	***685***	691
665	***671***	677	683	***689***	***695***
727	733	739	***745***	751	757

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Source – the author

We will demonstrate the prime numbers in the next interval (840 to 960).

845	***851***	857	863	***869***	***875***
841	***847***	853	859	***865***	***871***
905	911	***917***	***923***	929	***935***
901	907	***913***	919	***925***	***931***

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Table 12 – The interval between 840 and 960

Source – the author

The prime elements identified in the interval under analysis correspond to the following values: 853, 857, 859, 863, 881, 883, 887, 907, 911, 919, 929, 937, 941, 947, and 953. Restricting the analytical scope exclusively to the numbers adjacent to multiples of six (of the form $6k \pm 1$), it is found that 40% are prime numbers, whereas the remaining 60% constitute composite structures. From the perspective of the overall domain of the partition in question, prime numbers represent 13.33333...% of the total terms, while composite elements account for 86.666667...%.

In the next interval shown, it is observed that the composite elements situated between the predecessors and successors of multiples of six are multiples of the prime numbers within the range extending from the number 5—the initial element of the set of integers preceding a multiple of 6—to the prime number 31, which marks the lower limit of the section under study. The prime numbers mapped in the following spreadsheet are: 967, 971, 977, 983, 991, 997, 1009, 1013, 1019, 1021, 1031, 1033, 1039, 1049, 1051, 1061, 1063, 1069, 1087, 1091, 1093, 1097, 1103, 1109, 1117, 1123, 1129, 1151, 1153, 1163, 1171, 1181, 1187, 1193, 1201, 1213, 1217, 1223, 1229, 1231, 1237, 1249, 1259, 1277, 1279, 1283, 1289, 1291, 1297, 1301, 1303, 1307, 1319, 1321, 1327, 1361, and 1367. In this sample region, there are 57 prime elements. This volume corresponds to 13.97058823...% of the total integers in the overall interval. When isolating only the terms generated by the residue classes 6k ± 1, the distribution shows 41.91176470...% prime numbers versus 58.0882353...% composite structures.

Let us move to the interval (1368 – 1680). Tables 13 and 14 – interval between 960 and 1368

965	971	977	983	***989***	***99[illegible]***
961	967	***973***	***979***	***985***	991
1037	***1043***	1049	***1055***	1061	***106[illegible]***
1033	1039	***1045***	1051	***1057***	106[illegible]
1109	***1115***	***1121***	***1127***	***1133***	***113[illegible]***
1105	***1111***	1117	1123	1129	***113[illegible]***
1181	1187	1193	***1199***	***1205***	***121[illegible]***

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

1373	***1379***	***1385***	***1391***	***1397***	***140***
1369	***1375***	1381	***1387***	***1393***	1399
1445	1451	***1457***	***1463***	***1469***	***147***
1441	1447	1453	1459	***1465***	1471
1517	1523	***1529***	***1535***	***1541***	***154***
1513	***1519***	***1525***	1531	***1537***	1543
1589	***1595***	1601	1607	1613	1619

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Let's move to the interval (1368–1680).

Source – the author

In the interval under analysis, the following 44 prime elements are identified: 1373, 1381, 1399, 1409, 1423, (1427, 1429), 1433, 1439, 1447, (1451, 1453), 1459, 1471, (1481, 1483), (1487, 1489), 1493, 1499, 1511, 1523, 1531, 1543, 1549, 1553, 1559, 1567, 1571, 1579, 1583, 1597, 1601, (1607, 1609), 1613, (1619, 1621), 1627, 1637, 1657, 1663, and (1667, 1669). Restricting the analytical scope strictly to the numbers generated by the residue classes adjacent to multiples of six (of the linear form 6k ± 1), this sample quantifies a density of approximately 42.307692...% prime numbers versus 52.692308...% composite structures.

1685	**1691**	1697	**1703**	1709	**171**
1681	**1687**	1693	1699	**1705**	**171**
1733	**1739**	**1745**	**1751**	**1757**	**176**
1729	**1735**	1741	1747	1753	175
1781	1787	**1793**	**1799**	**1805**	1811
1777	1783	1789	**1795**	1801	**180**
1825	**1829**	1831	**1835**	**1837**	**184**

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Table 15 – interval between 1680 and 1848

Source: the author

In the interval spanning 1680 to 1848, the following prime numbers are identified: 1693, (1697, 1699), 1709, (1721, 1723), 1733, 1741, 1747, 1753, 1759, 1777, 1783, (1787, 1789), 1801, 1811, 1823, 1831, and 1847. When the analytical scope is restricted solely to terms generated by residue classes adjacent to multiples of six (of the linear form 6k ± 1), a distribution of 35.714285...% prime numbers versus 64.285715...% composite structures is observed. From a macroscopic perspective of the entire numerical domain contained within this partition, prime numbers represent 11.904761...% of the total, while the remaining 88.095239...% consist of composite numbers.

1853	**1859**	**1865**	1871	1877	**188**
1849	**1855**	1861	1867	1873	187

1931	***1937***	***1943***	1949	***1955***	***196***
1927	1933	***1939***	***1945***	1951	***195***
2009	***2015***	***2021***	2027	***2033***	203
2005	2011	2017	***2023***	2029	***203***

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Table 16 – Interval between 1848 and 2208

Source – the author

In the adopted analytical matrix (spreadsheet) representation model, a distinct color-coding scheme is applied to segregate the elements: prime numbers are highlighted in yellow, while composite numbers are assigned different colors based on their factorial properties. This visual differentiation aims to map the structural specificities of the composite numbers—whether they are products of distinct prime factors or powers—which emerge exclusively within the residue classes adjacent to multiples of six (following the linear form 6k ± 1). Consequently, a multi-factorial, multi-phase system is established for the rapid identification of prime and composite elements within this distribution. Additionally, it should be noted that even numbers and multiples of three were excluded from the spreadsheet's sampling scope, as these classes do not belong to the residue families relevant to mapping the primality and structural composition under analysis. Set of prime numbers: {2,(3, 5), (5, 7), (11, 13), (17, 19), 23, (29, 31), 37, (41, 43), 47, 53, (59, 61), 67, (71, 73), 79, 83, 89, 97, (101, 103), (107, 109), 113, 127, 131, (137, 139), (149, 151), 157, 163, 167, 173, (179, 181), (191, 193), (197, 199) 241), 251, 257, 263, (269, 271), 277, (281, 283), 293, 307, (311, 313), 317, 331, 337, (347, 349) 383, 389, 397, 401, 409, (419, 421), 431, 439, 443, 449, 457, (461, 463), 467, 479, 487, 491, 499, 503, 509, (521, 523), 541, 547, 557, 563, 569, 571, 577, 587, 593, (599, 601), 607, 613, (617, 619), 631, (641, 643), 647, 653, (659, 661), 673, 677, 683, 691, 701, 709, 719, 727, 733, 739, 743, 751, 757, 761, 769, 773, 787, 797, (809, 811), (821, 823), (827, 829), 839, 853, (857, 859), 863, (881, 883), 887, (907, 911), 919, 929, 937, 941, 947, 953, 967, 971, 977, 983, 991, 997, 1009, 1013, 1019, 1021, (1031, 1033), 1039, (1049, 1051), (1061, 1063), 1069, 1087, (1091, 1093), 1097, 1103, 1109, 1117, 1123, 1129, (1151, 1153), 1163, 1171, 1181, 1187, 1193, 1201, 1213, 1217, 1223, (1229, 1231), 1237, 1249, 1259, (1277, 1279), 1283, (1289, 1291), 1297, (1301, 1303), 1307, (1319, 1321), 1327, 1361, 1367, 1373, 1381, 1399, 1409, 1423, (1427, 1429), 1433, 1439, 1447, (1451, 1453), 1459, 1471, (1481, 1483), (1487, 1489), 1493, 1499, 1511, 1523, 1531, 1543, 1549, 1553, 1559, 1567, 1571, 1579, 1583, 1597, 1601, (1607, 1609), 1613, (1619, 1621), 1627, 1637, 1657, 1663, (1667, 1669), 1693, (1697, 1699), 1709, (1721, 1723), 1733, 1741, 1747, 1753, 1759, 1777, 1783, (1787, 1789), 1801, 1811, 1823, 1831, 1847, 1861, 1867, (1871, 1873), (1877, 1879), 1889, 1901, 1907, 1913, (1831, 1933), (1949, 1951), 1973, 1979, 1987, 1993, (1997, 1999), 2003, 2011, 2017, (2027, 2029), 2039, 2053, 2063, 2069, (2081, 2083), (2087, 2089), 2099, (2111, 2113), (2129, 2131), 2137, (2141, 2143), 2153, 2161, 2179, 2203, 2207,

This paper presents a deterministic method for identifying prime numbers, characterized by high accuracy and analytical consistency. The applicability of the proposed algorithm was empirically validated up to the order of magnitude of 10^6 (the millions range), demonstrating potential scalability for higher numerical domains. The system's computational robustness ensures the integrity of the results obtained, mitigating processing biases. Any inconsistencies in the classification of elements within specific intervals do not stem from limitations intrinsic to the theoretical model, but rather from human operational variables associated with data entry or manipulation. Consequently, rigorous control of input parameters and systematic auditing of processes are mandatory steps to safeguard the precision, reproducibility, and reliability of the numerical partitions established by the method. Showing prime numbers in the hundreds.

Table 17 – Prime numbers in the first hundred.

1	**2**	**3**	4	**5**	6
11	12	**13**	14	15	16
21	22	**23**	24	25	26
31	32	33	34	35	36
41	42	**43**	44	45	46
51	52	**53**	54	55	56
61	62	63	64	65	66

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Source – the author

The distribution of prime numbers within the first hundred integers is presented here, segmented by their constituent linear partitions: the first interval (1–6), the second (6–25), the third (25–48), and the fourth (48–120). Within this initial elementary domain, composite numbers coexist—comprising even numbers, multiples of three, and products or powers of prime bases, specifically: (25, 35, 49, 55, 65, 77, 85, 91, 95). To optimize and deterministically simplify the process of identifying these composite structures, a discrete interval analysis methodology is adopted. In the second hundred—corresponding to the domain [100, 200]—the set of primes spans the terminal section of the fourth interval (48–120), the entirety of the fifth interval (120–168), and the initial section of the sixth interval (168–288). It is noteworthy that, within the fully mapped intervals, arithmetic properties behave consistently, validating the uniform application of this same methodological approach to all elements of the partition.

In tens where multiples of six end with the digits 2 or 8 in the units place, a symmetrical pattern emerges involving two preceding and two succeeding elements adjacent to these multiples; this configuration offers the potential for up to four prime numbers, enabling the formation of two pairs of twin primes. Conversely, in tens where multiples of six have units digits of 4 or 0, the structure is limited to two preceding elements and only one succeeding element, restricting the count of primes to a maximum of two and precluding the occurrence of twin primes within that range. Similarly, for the tens groups where multiples of six have units in the range (0–6), two successor terms and only one adjacent predecessor are identified, resulting in up to two prime numbers and the absence of twin primes. This concludes the systematic demonstration of the prime elements belonging to the second hundred.

Table 18 – Prime numbers in the second hundred

101	102	**103**	104	105	106
111	112	**113**	114	115	116
121	122	123	124	125	126

131	132	133	234	235	236
141	142	143	144	145	146
151	152	153	154	155	156

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Source – the author

Table 19 – range 12.768 to 16.128

12773	***12779***	***12785***	12791	***12797***	***1280***
12769	***12775***	12781	***12787***	***12793***	1279
12845	***12851***	***12857***	***12863***	***12869***	***1287***
12841	***12847***	12853	***12859***	***12865***	***1287***
12917	12923	***12929***	***12935***	12941	***1294***
12913	12919	***12925***	***12931***	***12937***	***1294***
12989	***12995***	13001	13007	***13013***	***1301***

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Source – the author

Observe the prime numbers in the interval under study: 1373, 1381, 1399, 1409, 1423, (1427, 1429), 1433, 1439, 1447, (1451, 1453), 1459, 1471, (1481, 1483), (1487, 1489), 1493, 1499, 1511, 1523, 1531, 1543, 1549, 1553, 1559, 1567, 1571, 1579, 1583, 1597, 1601, 1607, 1609, 1613, (1619, 1621), 1627, 1637, 1657, 1663, (1667, 1669). There are 44 prime numbers in this interval, corresponding to 42.307692...%; 52.692308...% are composite numbers found among the numbers preceding or succeeding multiples of six.

Table 20 – interval between 1848 and 2208

1853	***1859***	***1865***	1871	1877	***1883***
1849	***1855***	1861	1867	1873	1879
1931	***1937***	***1943***	1949	***1955***	***1961***
1927	1933	***1939***	***1945***	1951	***1957***
2009	***2015***	***2021***	2027	***2033***	2039
2005	2011	2017	***2023***	2029	***2035***
2087	***2093***	2099	***2105***	2111	***2117***

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Source – the author

In the adopted analytical matrix (spreadsheet) representation model, distinct color coding is applied to segregate the elements: prime numbers are highlighted in yellow, while composite numbers are assigned different colors. This visual differentiation aims to map the structural specificities of composite numbers—whether they are products of distinct prime factors or powers—which emerge exclusively in the residue families adjacent to multiples of six (following the linear form 6k ± 1). Consequently, a multifactorial system is established for the rapid and precise identification of prime and composite elements within this distribution. Additionally, it should be noted that even numbers and multiples of three were excluded from the scope of this spreadsheet, as these classes do not fall within the intervals of interest for mapping the primality and structural composition under analysis.

4.10. Interval {994,008 – 1,018,080}

Within the interval defined as {994,008 – 1,018,080}—with structural limits defined by {997^2 – 1 to 1009^2}—there is a total span of 24,072 integers. Of this total, a subset of 8,024 elements consists of the immediate predecessors and successors of multiples of six. These adjacent numbers, generated by the residue class 6k ± 1, account for 33.333...% of all numbers in the interval. It is worth noting that products and powers of prime factors greater than or equal to five also occupy these positions adjacent to multiples of six, thereby constituting composite elements. Conversely, 66.667...% of the sample domain consists of terms that neither precede nor succeed multiples of six. Given that products and powers of prime numbers greater than or equal to five also appear as numbers immediately preceding or following multiples of six—specifically as composite numbers—a convergence is observed that significantly raises the overall percentage of composite elements within the partition.

Table 21 – Defines the interval above

994009	***994015***	***994021***	994027	***994033***	994039
994013	***994019***	***994025***	***994031***	***994037***	***99404***
994063	994069	***994075***	***994081***	994087	994093

994067	994073	***994079***	***994085***	***994091***	***99409***
994117	***994123***	***994129***	***994135***	994141	***994147***
994121	***994127***	***994133***	***994139***	***994145***	***994151***

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage

Source – the author

The elements processed via logical routines in Microsoft Excel—within the aforementioned analytical matrix—comprise composite numbers indexed in the residue classes adjacent to multiples of six (i.e., in the linear form 6k ± 1). Conversely, numerals retaining standard typographic formatting identify prime numbers, which are validated through direct visual inspection. The subsequent sequence lists these prime numbers, derived from an algorithm specifically developed to isolate the composite numbers located within the 6k adjacency domain across the defined interval.

Within this interval, which spans a total range of 24,072 integers, 1,769 prime numbers are identified—representing 7.3487869% of the total—while composite numbers account for 92.68% of the entire partition. When the analytical scope is restricted strictly to the 8,024 terms immediately preceding or following multiples of six, the statistical distribution shows 22.0463609% prime numbers versus 92.6512131% composite structures within this subset of residues.

The identification of composite elements in this section of the numerical domain was carried out using computational support, specifically a conditional formatting algorithm developed in

Microsoft Excel. This tool applies automatic restrictive criteria to distinguish composite structures, allowing the remaining prime numbers to be readily recognized through visual screening.

The results empirically confirm the hypothesis under investigation: as the upper limit of the numerical scale expands, the density of the set of composite numbers increases, whereas the relative frequency of prime numbers exhibits a progressive decline.

It is concluded, therefore, that the distribution density of prime numbers behaves in inverse proportion to the progression and magnitude of the intervals along the numerical scale.

Table 22 – prime numbers from the spreadsheet above

994013	994027	994039	994051	994067	9940
994141	994163	994181	994183	994193	9941
994247	994249	994271	994297	994303	9943
994337	994339	994363	994369	994391	9943
994457	994471	994489	994501	994549	9945
994583	994603	994621	994657	994663	9946
994711	994717	994723	994751	994769	9947

⚠ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em: **https://revistatopicos.com.br/artigos/identify-prime-numbers-within-intervals?noblockage**

Source: the author

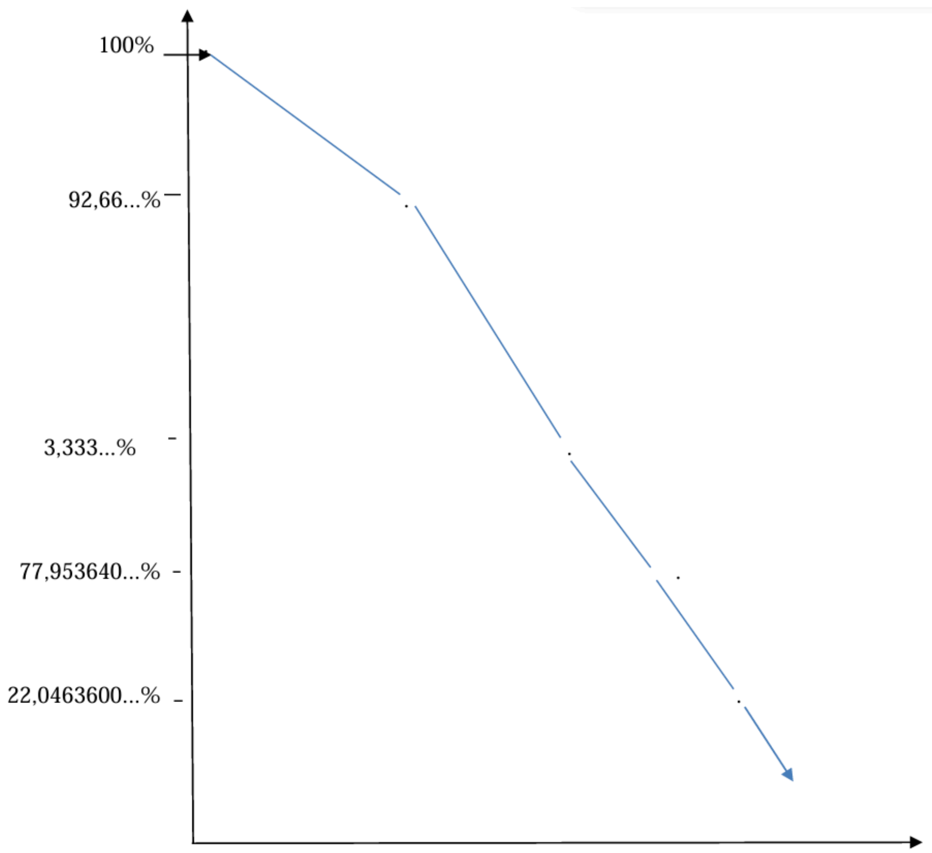
Within the indicated interval—defined by a range of 24,072 integers (994008 - 1,018,080)—a subset of 8,024 elements consists of the immediate predecessors or successors of multiples of six (6), corresponding to 33.333...% of the total domain. Of this adjacency subset, 1,769 are identified as prime numbers, representing 22.0463600...% of the terms generated by the linear form 6k ± 1. From the perspective of the partition as a whole, prime numbers account for 7.3487869...% of the total integers, whereas composite elements constitute a density of 92.6512131...%.

It is observed that, analogous to the progression of linear partitions along the number scale, the relative frequency of prime elements exhibits a progressive decline. As the upper limit of the arithmetic domain expands, new prime factors are incorporated into the system, generating a cumulative increase in products and powers of prime bases; this phenomenon systematically raises the percentage density of composite numbers in each subsequent interval.

Graph: A descriptive geometric representation of percentage distributions regarding the totality of partition elements, covering the predecessors and successors of multiples of six (6), the proportion of prime elements mapped within these adjacent residue classes, and the overall statistical behavior within the interval of 994,008 to 1,018,008. A geometric demonstration of the prime elements identified in the aforementioned numerical sample: a comparative analysis of the interval's ideal fractions, detailing the ratio of predecessors and successors of multiples of six (6) relative to the macro-domain, as well as the percentage behavior of primality restricted to adjacent residue classes against the total universe of computed integers.

The graph below represents the percentages shown in the table above.

Graph 1 – Percentage values of prime numbers and composite numbers in the interval under study.



Source: The author

3. METHODOLOGY

Within the interval defined by the partition [994,008, 1,018,080]—spanning a total range of 24,072 integers—a subset of 8,024 elements lies in the immediate vicinity of multiples of six. The composite elements indexed within these adjacent residue classes (i.e., those belonging to the structural domain defined by $6k \pm 1$) appear strictly as products involving the linear forms $(6\lambda - 1)$ and $(6\lambda + 1)$. In the implemented algorithmic model, values meeting specific composite criteria undergo a conditional formatting change in their display, whereas numerals retaining standard typography—free from structural modification—confirm the presence of prime numbers.

Thus, it becomes feasible to apply this methodology to related numerical partitions, establishing systematic segmentations along the arithmetic scale to precisely measure the density and distribution of prime and composite numbers within each subsequent discrete interval.

This chapter describes the methodological procedures, computational resources, and analytical approaches adopted to achieve the research objectives, ensuring the conditions necessary for its exact replication.

3.1. Research Characterization And Type

This investigation is a quantitative, exploratory study within the field of Number Theory (Moreira, 2019). Electronic spreadsheet processing employed mathematical logic adapted for algorithmic screening (Almeida & Costa, 2022). The study relies on a deterministic filtering and mapping method to analyze the distribution, density, and behavior of prime and composite elements across discrete partitions of the number line.

3.2. Research Universe And Sampling (Population)

The universe (population) of this study comprises the set of positive integers (Z+). To compose the sample, the analytical scope was delimited to specific, progressive intervals along the number scale, extending from baseline ranges to higher orders of magnitude in the millions (10^6), such as:

- [1, 100] and [100, 200] (initial elementary analysis);
- [288, 360], [360, 528], and [528, 840];
- [840, 1367] and [1373, 1669];
- [1680, 1848];
- [994,008, 1,018,080] (high-magnitude macroscopic analysis).

The sample was selected purposively using discrete numerical partitions linked to multiples of the number 6, allowing for an assessment of the adaptive behavior of prime number density as the scale's upper limit expands.

3.3. Data Collection Instruments And Theoretical Filtering Criteria

The conceptual instrument guiding data collection is based on the arithmetic property that all prime numbers greater than 3 are necessarily located in the immediate vicinity of multiples of six. Thus, the structural mapping employed the following guidelines:

1. Initial Exclusion: Prior elimination of all even numbers and multiples of three from the sampling scope, given that these classes do not allow for the possibility of primality outside the elementary subset {2, 3}.

2. Residue Delimitation (6k ± 1): Strict isolation of terms adjacent to the linear form 6k

3. Divided into predecessors (6k - 1) and successors (6k + 1).

4. Factorial Segregation: Identification of composite numbers within these residue classes based on factorial products structured in the forms $(6\lambda - 1)(6\lambda + 1)$.

3.4. Data Processing, Tabulation, And Analysis

The collected data were tabulated and processed electronically using Microsoft Excel software. The technical analysis procedures were carried out in three consecutive stages:

- Implementation of Logical Routines (Filtering Algorithm): Development of formulas and logical conditions within the software to automatically identify composite numbers (products and powers of prime factors less than or equal to the interval's upper limit).

- Multifactorial Color Coding: Application of conditional formatting to the analytical matrix. A specific yellow highlight was established to visually distinguish confirmed prime elements. Composite elements (adjacent to 6k) received distinct color treatments to clearly indicate their respective prime factors.

- Visual Inspection and Statistical Screening: Validation and direct counting of prime elements that remained unaffected by conditional formatting. Based on the tabulation of absolute frequencies, percentage rates of primality and compositeness were calculated, evaluating variable behavior from both the perspective of the interval's global domain and the restricted scope of the $6k \pm 1$ residue families.

Finally, the resulting statistical data were converted into geometric representations (descriptive charts) to consolidate the comparative analysis and demonstrate the inverse proportionality between prime number density and the progression of the arithmetic scale.

4. RESULTS AND DISCUSSION

This section presents the empirical data obtained by applying the algorithmic filtering method in Microsoft Excel, followed by an analytical interpretation regarding the distribution and density of prime and composite elements along the arithmetic scale.

4.1. Structural Mapping In The Basal And Intermediate Domains

Initial analysis of the elementary intervals confirmed the effectiveness of filtering based on residue classes adjacent to multiples of six ($6k \pm 1$). Within the first and second hundreds, as well as in intermediate intervals, composite numbers formed by products and powers of prime bases (e.g., 25, 35, 49, 55, 65, 77, 85, 91, 95) were observed coexisting with prime numbers in the vicinity of 6k.

Table 1 summarizes the distribution of absolute frequencies and the geometric properties of twin primes based on the units digit of the central multiple of six.

Table 1. Structural behavior of prime numbers and twin primes as a function of the units digit of the multiple of six (6k).

Units digit of 6k Occurrence	Adjacency Configuration	Maximum Prime Density	Twin Prime
2 and 8 of 2 twin pairs	2 predecessors and 2 successors	Up to 4 prime numbers	Possibility

4 and 0 twin pairs	2 predecessors and 1 successor	Up to 2 prime numbers	Absence of
0 and 6 twin pairs	1 predecessor and 2 successors	Up to 2 prime numbers	Absence of

Source: Prepared by the author

This digital/modular pattern demonstrates that the geometry of the multiplication table for 6 structurally restricts the intervals where the occurrence of twin primes is theoretically permissible.

4.2. Macroscopic Analysis Of Density At High Orders Of Magnitude

To evaluate primality behavior at higher scales, the algorithm was applied to the substantial 7-digit interval spanning 994,008 to 1,018,080 (limits defined by $997^2 - 1$ to $1009^2 - 1$). The sample range encompasses 24,072 integers.

Table 2 consolidates the percentage data obtained through chromatic and computational screening in Microsoft Excel.

Table 2. Statistical distribution of prime and composite numbers in the interval [994,008, 1,018,080].

Analytical Category	Quantity (Absolute Frequency)	Relative Proportion (%)
Total of the Interval	24,072 integers	100.000000%
Adjacent Elements (6k plus or minus 1)	8,024 numbers	33.333333%
Non-Adjacent Elements	16,048 numbers	66.666667%

Primes in the Total Domain	1,769 numbers	7.348787%
Composites in the Total Domain	22,303 numbers	92.651213%
Primes Restricted to Adjacency (6k plus or minus 1)	1,769 out of 8,024	22.046361%
Composites Restricted to Adjacency	6,255 out of 8,024	77.953639%

The data They demonstrate that, although the classes 6k plus or minus 1 represent exactly one third (33.333%) of the entire numerical universe, the density of primes contained in this subset reduces to 22.046361%, a result of the progressive infiltration of compounds generated by products of the form (6\lambda - 1) (6\lambda + 1).

4.3. Discussion And Interpretation Of Findings

The results obtained corroborate the central hypothesis of this work and converge with the Prime Number Theorem (SOUZA, 2023). The decrease in the density of primes as the scale advances reflects the classic asymptotic behavior of the discipline (FERREIRA, 2018).

The data demonstrate that, although the $6k \pm 1$ classes represent exactly one-third (33.333%) of the entire numerical universe, the prime density within this subset drops to 22.046361% due to the progressive infiltration of composite numbers generated by products of the form $(6\lambda - 1)(6\lambda + 1)$.

4.4. Discussion And Interpretation Of Findings

The results obtained corroborate the central hypothesis of this study and align with the Prime Number Theorem (SOUZA, 2023). The decrease in prime density as the scale advances reflects the field's classic asymptotic behavior (FERREIRA, 2018).

A) Proportional Density Inversion

As the sampling progresses along the arithmetic scale (moving from the first hundred to the order of 10^6), a systematic increase in the proportion of composite elements—at the expense of prime elements—is observed. This occurs because advancing the numerical scale continuously introduces new prime numbers into the system. As these new primes multiply among themselves and generate powers, they begin to occupy positions within the $6k \pm 1$ categories at higher intervals.

Thus, it is empirically demonstrated that the density of prime number occurrences is inversely proportional to the advancement of the numerical scale.

B) Filtering Algorithm Efficiency and Bias Elimination

The color-coding methodology in Microsoft Excel proved to be a robust deterministic method. By pre-eliminating even numbers and multiples of 3, the computational and visual workload is restricted to just 33.333% of the data population. The application of factorial conditions ensures that any failure identified in the process stems not from limitations of the theoretical model, but from potential inaccuracies in manual parameter entry (human error), thereby guaranteeing the experiment's full reproducibility.

4. CONCLUSION/FINAL REMARKS

The study of prime numbers constitutes one of the most enduring and complex pillars of Number Theory (SANTOS, 2021). The central issue of this investigation lies in the optimization of numerical filtering processes, based on the principle that prime numbers greater than three are contained within the classes $6k \pm 1$ (SILVA; OLIVEIRA, 2020).

Historically, the search for patterns of regularity or deterministic mechanisms that allow for the rapid isolation and identification of these elements has challenged mathematicians and computer scientists alike. The core problem addressed here is the optimization of numerical filtering processes, grounded in the arithmetic principle that all prime numbers greater than three are structurally confined to the residue classes adjacent to multiples of six ($6k \pm 1$).

In light of this, the present work proposes the validation of a computationally implemented algorithmic and visual method capable of segregating composite numbers and identifying prime elements within discrete linear partitions. The hypothesis guiding this research posits that prime number density decreases in inverse proportion to the progression of intervals along the numerical scale, due to the progressive and cumulative infiltration of products of factors and powers of prime bases into these same adjacency ranges. Based on this premise, the general objective was defined as mapping, quantifying, and analyzing the percentage distribution of primality across different orders of magnitude—extending from the initial ranges up to the scale of millions (10^6)—thereby enabling a reliable and easily replicable analytical model.

C) Practical Significance and Academic Contribution

The ability to isolate and visualize prime numbers through the simple conditional exclusion of products (6λ ± 1) offers a practical mechanism for the visual auditing of numerical data. This mapping via discrete partitions allows for the prediction of the maximum number of primes and twin primes that a given numerical range can contain, providing insights for applied research in cryptography and analytic number theory.

This study enabled the precise mapping and validation of the behavior of prime and composite numbers across different partitions of the number line. Based on the statistical and mathematical results obtained, the proposed objectives were fully achieved. The computational and visual method developed proved to be rigorously reliable and effective in isolating composite elements generated by the forms (6λ - 1) and (6λ + 1), allowing for the exact identification of the remaining prime numbers through a multifactorial, color-coded screening system.

The initial hypothesis was fully confirmed: the distribution density of prime numbers behaves in inverse proportion to the magnitude of the intervals analyzed. While the primality rate is significant within the first few hundred numbers, in the macroscopic seven-digit interval evaluated (994,008 to 1,018,080), prime numbers accounted for only 7.348787% of the total domain and 22.046361% of the subset adjacent to multiples of six. This phenomenon stems from the cumulative accumulation of products and powers of prime bases, which progressively fill the 6k ± 1 coordinates as the arithmetic scale expands. The main theoretical contributions of this work lie in the geometric and modular systematization of the occurrence of prime numbers and twin primes based on the units digit of the central multiple of six, offering a new visualization perspective for Number

Theory. From a practical standpoint, the study presents a deterministic filtering model with low computational cost that can be implemented in accessible spreadsheet software, thereby simplifying the auditing of large volumes of numerical data.

A limitation of this research is that data manipulation across massive magnitude ranges may face operational performance constraints depending on the processing capacity of the hardware used, while also remaining susceptible to operational inconsistencies arising from parameter entry (human error). For future investigations, automating the method through the development of scripts in high-performance programming languages (such as Python or C++) is suggested; this would allow for the scalable expansion of the algorithm's application to orders of magnitude in the billions (10^9), thereby testing the stability of the percentage limits established here.

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Outros estudiosos desse mesmo assunto já haviam desenvolvido estudos semelhantes e criado suas fórmulas matemáticas, demonstrando seus resultados a todos. Entretanto, os observadores não conseguiram compreender plenamente as sentenças matemáticas apresentadas nesses estudos e, dessa forma, não chegaram aos objetivos desejados. Eu desenvolvi uma sentença matemática, demonstrei seus fundamentos e apresento os resultados obtidos, mostrando que o método funciona: “O método que identifica os números primos com segurança e precisão.” Esse método define intervalos nos quais os divisores dos números primos apresentam os mesmos conceitos e propriedades. Desenvolvi esses intervalos e, por meio deles, identifiquei os números primos. Acredito que essas propriedades revelam uma grande riqueza no estudo dos números primos, e reconheço que Deus me capacitou para conhecê-las e desenvolvê-las.

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A Deus seja toda a honra e toda a glória.

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