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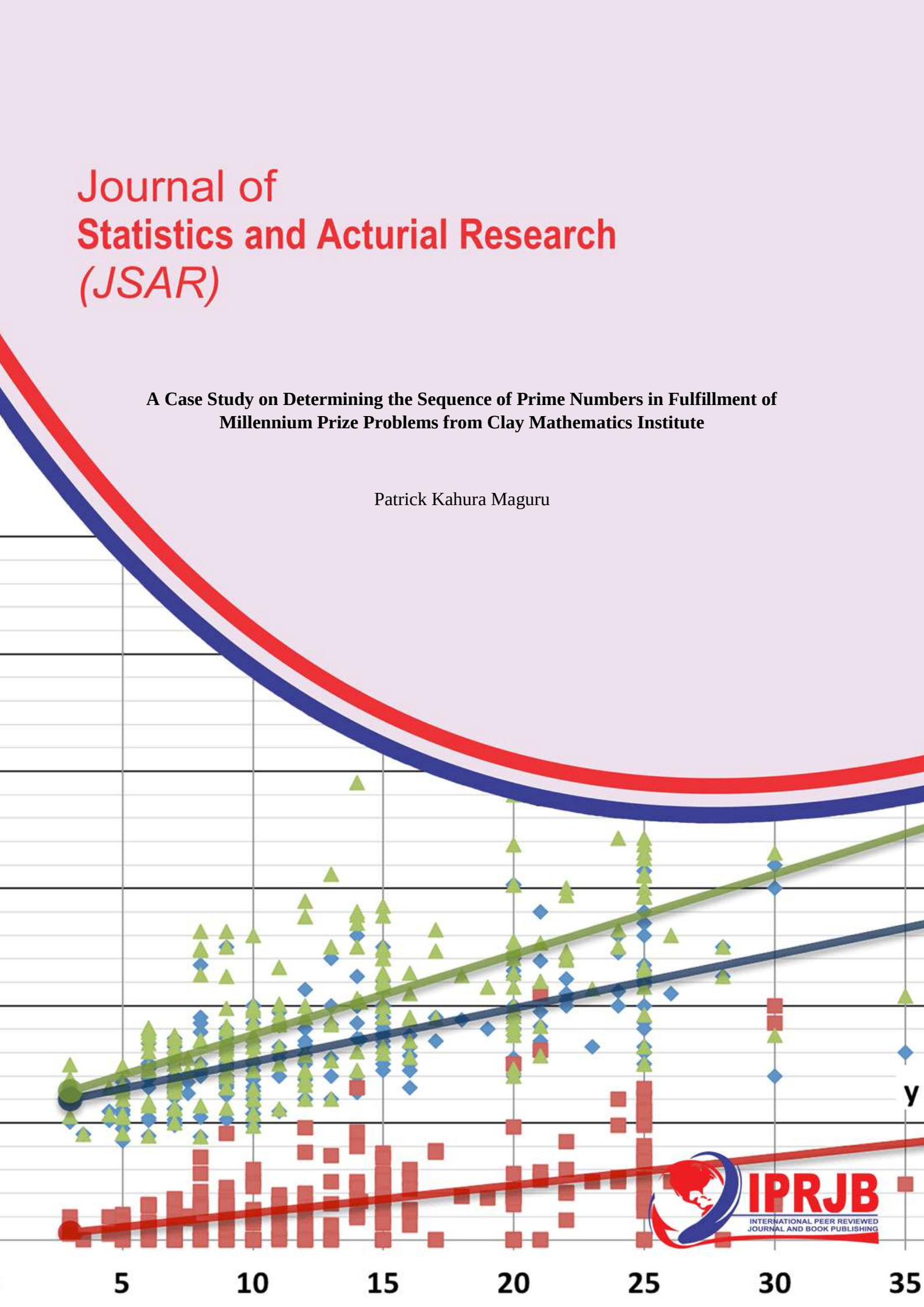

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Abstract

Purpose: I have been serving as a civil servant in the Ministry of Environment and Natural Resources, department of Kenya Forestry Research Institute (KEFRI). Over the years, I developed a flare for research as a result of liaising at work for many years with various research programs that have been complementarily successful. After leaving KEFRI, I became instigated to come up with an idea that could bring a solution to one of the unsolved millennium prize problems hence, the research on the sequence of prime numbers. The seven millennium problems were selected by the Clay Mathematics Institute in the year 2000 to record as the most difficult problems, sequence of prime numbers being among them. This study is meant to bridge the gap that has been there for a long time which would be a pertinent thing to alleviate distress that has prevailed for quite some time to mathematicians.

Methodology: Using a structured interview, about two hundred people from diverse back ground were selected with a view to gauging them on their understanding towards prime numbers and their sequence. Those who were targeted in the survey were a group of elites both retired and in-service officers like teachers, accountants as well as students both for high school as well as those in higher learning institutions. The survey was conducted in a span of six months, from September 2023 to February 2024. Even though most of the people were not willing to disclose their names since the issue of prime numbers seems to be a bit difficulty and confusing to them, this did not hinder me from conducting on the survey I substituted their names with numbers, numbering them from number 1 to 200 respectively.

Findings: Majority of the people have an impression that since the sequence of prime numbers does not have a wholesome related movement like even and odd numbers, this made them think that prime numbers have no sequence. Such assumptions need not be embraced at all since, the sequence of prime numbers is determined by the intervals that are between numbers no matter how big or small the gaps are.

Unique Contribution to Theory, Practice and Policy: Since mathematicians proclaim that prime numbers in certain sense are the building blocks of the natural numbers and help in solving problems, this study would act as a reinforcement to back up what mathematical researchers could be having at hand. This study is meant to bridge the gap that was noted by the Clay Mathematic Institute. Any idea that may come across needs to be embraced and if possible, documented or incorporated in school syllabus and review done from time to time once a new idea crops up.

Keywords: *Mathematics, Sequence, Prime Numbers, Millennium Prize*

INTRODUCTION

Using a structured interview on the sequence of prime numbers to about two hundred people of diverse backgrounds, the response received confirmed that this might have been a global challenge since there is no one who had an answer that could relate to an idea on how the sequence of prime numbers follow each other. In that respect, the objective of this study is to bring the idea into tangible facts that would solve the problem when the aspect of the sequence of prime numbers arises. It is my conviction that its effectiveness will be of paramount importance to the world, especially in the field of mathematics.

For many years, the sequence of prime numbers has been so complicated since it does not resemble those that have a steady flow hence, the essence of this study. However, the study does not necessarily mean that there is an intension of proposing neither a new conjecture nor algorithm but its main objective is to express the natural reality of the sequence of prime numbers with a view to relieving mathematicians from distress they have been experiencing and going through for many years.

The mathematical fraternity would feel comfortable to learn and understand the intricate and the nature of the sequence of prime numbers that hinder it from flowing just like any other sequence.

In essence, it would be possible for an examiner to examine scholars on those sequences that steadily flow such as even and odd numbers among others with a view to expecting students to come up with a solution, unlike the sequence of prime numbers where the examiner is not sure of the concrete answer to the question.

In this scenario, this calls for corrective responsibility in research with a view to bridging the gap that has persisted for ages. The conclusion of this study needs to be taken with meticulous, since it can apply as a pertinent tool that could relief mathematicians from puzzlement.

Problem Statement

As far as it is concerned, the sequence of some patterns like even and odd numbers among others are clearly known and understood. This is a conspicuous proof that the research gap of the sequence of prime numbers still dominates in the field of mathematics and this could be the main reason that made the Clay Mathematics Institute select it as one of the seven millennium problems that have never been solved hence, the study of the sequence of prime numbers. While bridging the gap, simple mathematical theories needs to be improvised that could assist scholars in understanding with a wider perspective more about prime numbers.

Many a scholars are not aware that after integer 7, the subsequence prime numbers ends with either 1, 3,7or 9.

Just like any other mathematical rule, it should further be understand that not all odd numbers ending with integer 1, 3, 7, and 9 are prime numbers whereas not all prime numbers that ends with 1, 3, 7, or 9 since, there is integer 2 and 5 which are prime numbers independently alone, ending with 2 and 5 respectively.

Good examples are:-

Number 9 whose factors are 1,3and 9

Number 21 whose factors are 1, 3, 7 and 21

Number 27 whose factors are 1, 3, 9, 27 and

Number 33 whose factors are 1, 3, 11 and 33

With a lot of such understanding and ideas, it will not only be assisting scholars to achieving in their academic examinations but will also expose them mentally to another facet in life for approaching research and innovations.

Questions were verbally posed to people and the response was as per the tabulation below:-

Questions

Q1 Is integer 1 a prime number?

Q2 is integer 1 an odd number?

Q3 Is integer 2 a prime number?

Q4 Is integer 2 an odd number?

Q5 Is integer 2 an even number?

Q6 Are all prime numbers odd numbers?

Q7 Are all odd numbers prime numbers?

Q8 Do even numbers have a related sequence?

Q9 Do odd numbers have a related sequence?

Q10 Do prime numbers have a related sequence?

Q11 Do even numbers have an end?

Q12 Do odd numbers have an end?

Q13 Do prime numbers have an end?

Q14 Is there two consecutive prime numbers?

Q15 Are odd numbers predictable?

Q16 Are even numbers predictable

Q17 For large numbers, are prime numbers predictable?

Q18 Could prime numbers be a reflection of a certain system?

Q19 Have prime numbers ever appeared in a regular pattern?

Q20 Is it necessary to do research on the sequence of prime numbers?

Table 1: Schedule

Questions	Yes / No	Number of people	Percentage
Q1	Yes	10	5%
	No	190	95%
Q2	Yes	200	100%
	No	0	0%
Q3	Yes	185	92,5%
	No	15	7.5%
Q4	Yes	0	0%
	No	200	100%
Q5	Yes	200	100%
	No	0	0%
Q6	Yes	5	2.5%
	No	195	97.5%
Q7	Yes	0	0%
	No	200	100%
Q8	Yes	200	100%
	No	0	0%
Q9	Yes	200	100%
	No	0	0%
Q10	Yes	0	0%
	No	200	100%
Q11	Yes	0	0%
	No	200	100%
Q12	Yes	0	0%
	No	200	100%
Q13	Yes	0	0%
	No	200	100%
Q14	Yes	180	90%
	No	20	10%
Q15	Yes	200	100%
	No	0	0%
Q16	Yes	200	100%
	No	0	0%
Q17	Yes	0	0%
	No	200	100%
Q18	Yes	0	0%
	No	200	100%
Q19	Yes	0	0%
	No	200	100%
Q20	Yes	200	100%
	No	0	0%

Presentation

After the analysis, a group of elites were converged that could discuss about the analysis exhaustively. After a lengthy deliberation, there was no objection from the audience as they had no any alternative at hand that could have substituted the concept. The audience accepted the whole concept of the study anonymously.

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The Sequence of Prime Numbers

A sequence is a set of related movement that follows each other in a particular order and consistency. Several mathematical sequences can be extracted from the number line, such as odd numbers (2n+1), even numbers (n (n+1), Fibonacci sequence with a (golden ratio: Fn = (Φn - (1-Φ) n)/√5 where phi is 1.618 among others. Such sequences are stable and have a steady flow that access prediction or calculation of the next number without constraint.

These sequences differ from the sequence of prime numbers that slip away at some point and portray sporadic behavior. Numbers with no decimals are whole numbers and therefore prime numbers are whole numbers starting from integer **2** that can only be divisible to one and itself. Numbers that are evenly divisible by another number without a remainder are factors while a composite numbers have more than two factors.

Below are the first one hundred prime numbers or terms, where each term is independently positioned without any decimal numbers:-

2,3,5,7,11,13,17,19,23,29,31,37,41,43,47,53,59,61,67,71,73,79,83,89,97,101,103,107,109,113,127, 131,137,139,149,151,157,163,167,173,179,181,191,193,197,199,211,223,227,229,233,239,241,251, 257,263,269,271,277,281,283,293,307,311,313,317,331,337,347,349,353,359,367,373,379,383,389, 397,401,409,419,421,431,433,439,443,449,457,461,463,467,479,487,491,499,503,509,521,523 and 541

The word sporadic refers to sequences that do not appear in regular patterns and have no continuity in them. Such characteristics appear when trying to establish the sequence of prime numbers, making it hard to predict the next prime number.

The genesis of sporadic behavior within the lineage of prime numbers is integer **2**, which is normally referred to as an odd prime number. This odd prime number is the only number in the lineage that has duo properties, one being a prime number and the other one being an even number.

Apart from integer **2**, all other prime numbers are odd numbers that, when added to integer **1**, give a sum of an even number, unlike integer **2**, which is the first prime number and, when added to integer **1**, gives a sum of **3**, which is an odd number as well as a prime number.

The first two prime numbers discern themselves from other prime numbers since there is no any other set of two consecutive prime numbers that has ever appeared in the linage of the number line apart from integers **2** and **3**. This clearly depicts that there is no continuity with the sequence since there is no other set of two consecutive numbers that will ever appear in the number line. After the integer **3**, the sequence of prime numbers slips away hence, crippling the flow of the sequence. From this perspective, it is realized that the mystery revolving around integer **2** and **3** forms the beginning of the sporadic behavior in the sequence of prime numbers.

Assumptions have been there that Orion's belt could be a replica of **1**, **2**, and **3** as the first three integers in the number line. Surrounded by Betelgeuse, Bellatrix, Rigel, and Salph stars in a rectangular manner, Alnitak, Alnilam and Mintaka stars form a constellation of Orion's belt in the universe that is visible at different locations in different times of the year when observed from planet Earth.

Referring to Keith Devlin, an American mathematician who published the book The Language of Mathematics: Making the Invisible Visible There is certainly no simple pattern. No matter how high up through the numbers you go, you keep finding groups of two or more primes clustered closely together, as well as long stretches that are barren of primes altogether. Moreover, these clusters and barren regions seem to occur in a random fashion (p39).

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Devlin argued that the prime number sequence is a fundamental pattern in the universe and that Orion's belt may be a reflection of the pattern.

Though the efficiency error could not have been scientifically proven, Keith Delvin's observation seems to imply that the sequence of stars slips away after the Mintaka star, just in the same manner the sequence of prime numbers slips away after the integer **3**.

However, this observation depends on his perception that probably, it could form his research basis in detecting whether the sequence of prime numbers is a replica of the alignment of stars in the universe.

Another wonderful thing with the sequence of prime numbers is that apart from integer **3**, **5** and **7** that have a related movement with equal interval of two, prime numbers that occur after **7** are unevenly distributed with neither continuity nor regular related movement.

The above analysis shows that the sequence of prime numbers can be written down as follows:-

1, 2, 2, 4, 2, 4, 2, 4, 6, 2, 6, 4 …

The above sequence has been derived by subtracting **lesser terms** from the **next greater terms** as shown below:-

1, 2, 2, 4, 2, 4, 2, 4, 6, 2, 6, 4

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 4…

Formulae

The next greater term **(subtract)** the previous lesser term = Sequence

Examples that have been extracted from the above sequence:-

(I)	3-2= 1	(iv)	11- 7= 4	(vii)	19-17= 2	(x)	31-29= 2
(ii)	5-3= 2	(v)	13-11= 2	(viii)	23-19= 4	(xi)	37-31= 6
(iii)	7-5=2	(vi)	17-13= 4	(ix)	29-23= 6	(xii)	41-37= 4

CONCLUSION AND RECOMMENDATION

Conclusion

Majority of the people have an impression that since the sequence of prime numbers does not have a wholesome related movement like even and odd numbers, this made them think that prime numbers have no sequence. Such assumptions need not be embraced at all since, the sequence of prime numbers is determined by the intervals that are between numbers no matter how big or small the gaps are.

Since the gaps between the numbers are not equal some being larger than others, the magnitude should not create any adverse impression. It should be ignored and the intervals considered as the sequence.

From the above analysis, it should now be prudent to construe that the sequence of prime numbers is ***sporadic,*** meaning that it has no ***regular*** pattern, has no ***continuity*** and apart from the first few smaller numbers depending on the mental capability of an individual, the subsequent large numbers cannot be ***predicted***.

Recommendation

The conclusion of this study should not be viewed as the last resort to the puzzle. Since research is an indefinite activity, nothing should dampens the enthusiasm of those researchers who would like to further with research on the aspect of sequence of prime numbers. Research should continual with a view to innovations and developments not only for personal benefit but also for betterment of the whole World at large.

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