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LAW OF THE THIRD: a Fundamental Research on discovering the Linear Equation regulating Randomness with Replacement

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Abstract

The foundation of **probability theories** is **randomness**, which can be broadly classified into two categories namely, randomness **without replacement** and randomness **with replacement** et. al. [1].

All the probability theories concerning **randomness with replacement** is founded on a trivial **assumption** based on observations in regard to the nature of the activity that the outcome of the next event is **independent** from the past outcomes. In other words, if there are X equally probable likely outcomes associated with a random activity with replacement, the probability of any one of the X likely outcomes occurring as the next event is 1/X.

However, there is another uninvestigated phenomenon of nature that within any X consecutive events subject to randomness with replacement, approximately X/3 probable outcomes do not occur at all. This strange phenomenon is observed by the roulette players in casinos for over a century and they have named it as **Law of the Third**.

In the **first phase** of this fundamental research, the above observation is empirically validated using data samples obtained from both real and internet based casinos with all possible modes of spinning, including the computer based random number generator (RNG). In the **second phase**, it is firmly established that this is not a phenomenon unique to the roulette table, but it is a **generic law of the nature** applicable to any random numerical activity with replacement. The **Linear Equation** underlying this strange phenomenon is empirically derived during this phase using a **non-roulette data analysis**. In the **third phase**, the generic nature of this phenomenon is further validated by applying the equation in other real applications.

In conclusion, the **probabilities of occurrence** of an **outcome** that has **already occurred** in the immediate past and **not occurred** in the immediate past are **not the same**, against the **conventional wisdom** that they are **the same**, as the **Law of the Third** is not factored into the **existing hypothesis**, upon which **probability theories** are founded.

Key Words

Randomness with Replacement, Edward Lorenz, Law of the Third, Colonne's Equation, Colonne's Threshold

1. Introduction

In 2008, this fundamental research was commenced to explore the possibility of empirically validating an observation made by **Edward Lorenz**, after the researcher having heard it for the first time in a film titled "***Chaos***", in which it was narrated as a verbatim extracted from the book titled "***Theory of Chaos***" authored by Lorenz in the early 1960s, just for the intellectual curiosity.

"***A phenomenon may appear to be random but in fact has an element of regularity, which can be described mathematically. At the initial stage, it seems unrelated and random but eventually a pattern emerges in the short term.***"

Therefore, a literature survey was carried out to identify the most unpredictable random events in the real world and Albert Einstein et. al.[2] is alleged to have said that the Roulette Table in the Casinos can be outperformed only by stealing money when the croupiers are not looking. In other words, Einstein by visually observing the nature of the activity, perceived Roulette as an activity in which perfect randomness prevails. Therefore, the **first phase** of the research was commenced with the European Roulette.

A Ball is spun either clockwise or anti-clockwise at an astronomically high speed, either manually or mechanically along the smooth edge of the wheel on which numbers ranging from 0 – 36 are placed with no evident order, which also is rotating. Upon gradually losing the speed and hitting many breakers inside, the ball falls into one of the equally sized slots (Figure 1).

Figure 1. A European Roulette Wheel and the Table Layout

In a European Roulette Wheel, there are 37 equal sized slots forming a circle to represent the range of numbers 0 – 36. The numbers do not appear to follow any logical sequence (may be except the person who designed it), but arranged according to a global convention. Out of the numbers 1 to 36, 1-18 are termed as LOW and 19-36 are termed as HIGH. Also there are 18 ODD numbers and 18 EVEN numbers and 18 RED numbers and 18 BLACK numbers and 0 is GREEN. The only order which is observed on the roulette wheel is that the colors RED and BLACK are arranged in an alternating manner.

Similarly, the Roulette Table Layout is vertically and horizontally divided into three portions each. The vertical blocks are termed as DOZENS (A, B, C) and the horizontal blocks are termed as COLUMNS (K, L, M), containing 12 numbers each. The only noteworthy asymmetry in the table layout is that the colors are not equally distributed in the top column and in the middle column.

The Roulette Players and Casinos for over a century have observed that among any 37 consecutive spin outcomes, there are only 23-24 distinct numbers and 13-14 numbers do not appear at all, which is approximately a 1/3 of equally probable likely outcomes. Thus, the roulette players have termed this phenomenon as **LAW OF THE THIRD** et. al.[3].

2. Research Methodology

In the **first phase**, 30 data samples each comprising 37 consecutive spin outcomes obtained in random visits to both real and internet casinos over a period of time, on every possible modes of spinning with and without human intervention, including the computer based random number generator (RNG). Further, in collections of 30 data sets under the four modes of spinning, the average number of distinct numbers also have been calculated (N/37). There, it can be clearly observed that the statistical distributions are perfectly maintained among all wagering categories (HIGH/LOW, RED/BLACK, ODD/EVEN, DOZENS, COLUMNS and NUMBERS) (Tables 1-4). All 120 data sets have been obtained, regardless of the alleged asymmetries favoring the casinos.

Table 1. Live spin mode in Real Casinos

AVERAGE DISTINCT NUMBERS	DOZENS			COLUMNS		
N/37	A	B	C	K	L	M
22.97	11.33	12.43	12.17	11.43	11.90	12.60
HIGH/LOW		RED/BLACK		ODD/EVEN		
H	L	R	B	O	E	
18.13	17.80	17.90	18.03	19.27	16.67	

Table 2. Live spin mode in Internet Casinos

AVERAGE DISTINCT NUMBERS	DOZENS			COLUMNS		
N/37	A	B	C	K	L	M
23.73	12.13	11.93	11.93	12.43	10.70	12.87
HIGH/LOW		RED/BLACK		ODD/EVEN		
H	L	R	B	O	E	
18.00	18.00	17.83	18.17	17.27	18.73	

Table 3. Auto spin mode in Internet Casinos

AVERAGE DISTINCT NUMBERS	DOZENS			COLUMNS		
N/37	A	B	C	K	L	M
24.00	11.80	12.07	12.23	11.77	11.67	12.67
HIGH/LOW		RED/BLACK		ODD/EVEN		
H	L	R	B	O	E	
18.53	17.57	18.20	17.90	18.53	17.57	

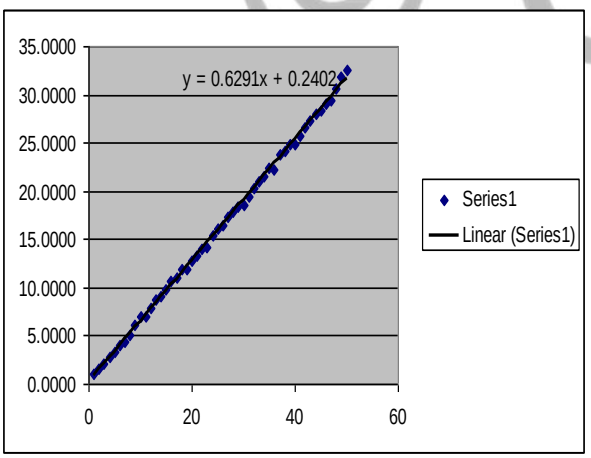
Table 4. Simulated outcomes using Computer based Random Number Generator (RNG mode) in Internet Casinos

AVERAGE DISTINCT NUMBERS	DOZENS			COLUMNS		
N/37	A	B	C	K	L	M
23.60	11.63	12.80	11.27	11.77	11.33	12.60
HIGH/LOW		RED/BLACK		ODD/EVEN		
H	L	R	B	O	E	
17.63	18.07	18.27	17.43	17.67	18.03	

Importantly, the salient most observation made in such analysis is that while maintaining the perfect statistical distributions, the nature has hidden approximately 1/3 of the likely outcomes that could occur within 37 consecutive spins. This fact cannot be attributed as caused by any phenomena of nature such as the gyroscopic effect, as the computer based random number generator also is in strict compliance with this observation (Table 4).

After having validated the observation made by the roulette players in the first phase, the **second phase** was commenced to verify whether this is a phenomenon specific to the roulette table or it is common to all random numerical activities with replacement. Homogeneous chips printed with numbers from 1 – 50 taken from a Tombola set were used in the experiment and 30 data samples for each number have been obtained[1]. For example, if the number concerned is 43, chips containing numbers from 1 – 43 (**X**) were placed in a container and the numbers were drawn 43 times in quick succession, with replacement. Then, the number of distinct numbers (Y) was counted and the process was repeated until 30 such data sets were obtained. Thereafter, the average of the 30 such recorded distinct numbers was assumed as Y, if X = 43. Using these X and Y values for the range of numbers 1 – 50, a simple linear regression analysis was performed and it yielded a linear equation **Y = .6291X +.2402** with no extreme outliers observed (Figure 2). After having published this equation in a six page book authored by the researcher in December 2009 [5], it was termed as **Colonne's Equation**. When X was equated to 37, Y became 23.51, which is consistent with the observations made by the roulette players for decades on the roulette tables. Any Y value derived from the equation from here onwards is termed as **Colonne's Threshold** (which used to be referred to as Colonne's Value).

Figure 2. Final outcome of the Regression Analysis



As there are no extreme outliers in Figure 2., it clearly establishes the fact that the Law of the Third is not specific to Roulette but it is a **generic** phenomenon applicable to any random numerical activity, with replacement.

Thereafter, the **Third Phase** was commenced in search of other real applications. Exactly, 200 consecutive draws of the most **popular lottery** in Sri Lanka was analyzed in 2012. In the draws held in frequent intervals, an alpha-numeric number (e.g. N923591) is drawn from a machine comprising 7 compartments, one containing 25 letters in the alphabet except "I" and the other six containing ten single digit numbers 0 – 9. The analysis revealed that the alphabetic character (with 1/25 probability), the first two numbers, the middle two numbers and the last two numbers (each with 1/100 probability), are in strict compliance with the Law of the Third, compared with the Colonne's Threshold values derived from the equation, specifically 15.968 and 63.150 (when X = 25 and X = 100 respectively), within any 100 consecutive draws within those 200 draws (Table 5.).

Table 5. (A) – letter, (B) first two numbers, (C) middle two numbers & (D) last two numbers

A	B	C	D
15.665	62.465	60.178	62.198
15.968	63.150	63.150	63.150

Being inspired by the authentic revelation of the linear equation underlying the concept of Law of the Third, the students of the writer carried out numerous practical experiments to validate the concept in regard to its applicability to reality which can be classified as the **extended phase** of the research. In 2017, a young school boy carried out an experiment to analyze the numbers on the license plates of randomly selected samples comprising 100 vehicles plying on the road. Every automobile in Sri Lanka has a four digit number in its license plate and these four digit numbers were recorded and analyzed in two samples of 100 vehicles each, one with a mix of vehicles and the other being cars only, going in the same direction on a highway, one after the other. Astonishingly, the first two digits and the second two digits in both cases were also in strict compliance with the Law of the Third.

Table 6. (A) first two numbers & (B) last two numbers

A	B
63	65
62	66
63.150	63.150

In May 2019, the experiment was repeated by another researcher in a Sri Lankan University by generating 10,000 random numbers using python algorithms in five occasions on a computer and the final outcome was found to be in strict compliance with the equation.

Table 7. Number of Distinct Numbers in Five Samples Tested

A	B	C	D	E
6312	6301	6324	6336	6282
6291	6291	6291	6291	6291

[1] The original data sets used in the experiment are available in the author's website www.neworiginalthinking.com

In October 2019, the original experiment was simulated using MATHLAB by a Ph.D. student in Queensland University in Australia for 30 samples and 10,000 samples respectively and the resultant equation was found to be very close to the equation derived (Y = .6291X + .2402) in the fundamental research in 2009. The two linear equations yielded in that experiment are Y = .6295X +.2362 and Y = .6313X + .2133 respectively.

3. Analysis

There are some powerful **inferences** that can be drawn from the above experiment. The first being, as Edward Lorenz stated that occurrences of a repeated activity may appear to be random and unrelated at the outset is correct. If an activity is repeated, the behavior is random until the number of outcomes reaches the Colonne's Threshold. Thereafter, the event becomes subject to the Law of the Third and being regulated by the Colonne's Equation of Law of the Third stated above. This regulation appears to be happening through short term pattern creations.

Upon reaching the Colonne's Threshold:

Within the next X – Y forthcoming consecutive events to be repeated in quick succession, the probability of occurrence of a number which is not among the N distinct numbers within the past Y consecutive spins is (Y – N) / (X – N), in contrast to the probability of (X – Y) / X, under the conventional wisdom in the current context. It infers that the probability of occurrence of a number which is among the N distinct numbers within the past Y consecutive spins is (X – Y) / (X – N) as well, during the forthcoming X – Y events.

For Example, if X = 37, Y = 24 (Colonne's Threshold of 23.51 being rounded up) and N = 20, there are 17 numbers (= X – N) which are not among the N distinct numbers within the Colonne's Threshold. As per the Law of the Third, N shall reach the value 24 within the next 13 (= X – Y) consecutive events, leaving room for only 4 (= Y – N) numbers to occur from the set of 17 numbers that have not surfaced yet. Therefore, the real probability of occurrence of any number out of the 17 such numbers within the next 13 events is 4/17, inferring that the real probability of occurrence of any number out of the set of N numbers within the next 13 consecutive events is 13/17, in contrast to the conceptual probability of 13/37 applicable to both such scenarios, under the conventional wisdom.

It is noteworthy to state that the practical emulation of this analysis will be effective to determine the probabilities applicable to a range of (X – Y) forthcoming consecutive events more accurately and may not be effective in making assessments in regard to the immediate next event.

4. Limitations of the Research

The scope of the research is confined to three completely unrelated applications only but the probability theories are applicable to numerous other areas. In the three applications, it is empirically established that the Law of the Third is an inherent behavioral characteristic associated with randomness with replacement, common to all three. However, it is practically impossible for the researcher to apply this to other areas owing to the rigorousness of analysis and excessive time consumption.

Further, the number of references is limited and negligible as this is an authentic fundamental research which is not influenced by any previous work, except for the citation by Edward Lorenz in the Motion Picture "Chaos", which stimulated the academic interest to investigate.

5. Conclusion

In view of all the facts presented above, a very powerful **ultimate inference** can be drawn. If **any numerical activity with replacement** with **X** equally probable and mutually exclusive likely outcomes is being repeated, upon **surpassing the Colonne's Threshold** pertaining to the respective activity, the **probability of occurrence** of a number that has **already occurred** and the **probability of occurrence** of a number that has **not yet occurred** to be the **next outcome** are **different**, in contrast to the **conventional wisdom** of **1/X**, which is **common** to both scenarios. In other words, the current assumption of the events being **independent** concerning randomness with replacement, that the next outcome does not depend on what happened in the past is not correct and in fact, it is imagination based on visual observations made on the nature of activities. Simply, the **Law of the Third** is **not factored** into the **existing probability theories**. Therefore, it is of paramount importance that the **Old Hypothesis** of **Independent Events** assumed in the conventional probability theories must be **replaced** with the **New Hypothesis** of **Dependent Events** based on immediate past outcomes**.**

6. The Implications and Benefits arising from the Research

In the contemporary world, existing knowledge exponentially advances and the frontiers of existing knowledge continue to expand, based on existing laws and hypotheses. Still, there are absolute fundamentals yet to be discovered. There are occasions that the existing knowledge is founded on wrong hypothesis and negation of such would lead to displacement of existing theories. For example, two Australian Researchers won the Nobel Prize for Medicine in 2005, for having negated a wrong fundamental hypothesis in medical sciences. This fundamental research on **Law of the Third** endeavors to correct a similar misconception in

regard to randomness with replacement that the probability of any equally probable outcome occurring as the next outcome is identically the same, based on the foundational assumptions that the events are independents. Upon general acceptance of this new theory, the implications that would arise are as follows.

- Hundreds of different new research applications will emerge in the future.
- The accuracy of probability based predictions concerning randomness with replacement will dramatically enhance.
- The probability theories concerned with randomness with replacement founded on the current assumption that the events are independent will have to be discarded and the probability theories need to be rewritten from the scratch.
- Will trigger a Paradigm Shift in the Gaming Industry as the predictability of the perceived independent events would significantly increase in favor of the players.

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