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Neurobiology, epistemology, and the methodology of the t-squared test and tri-center analysis in biostatistics are all part of biotrichology.

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ABSTRACT

This book lays forth the theoretical, methodological, and systemic foundations for a new kind of parametric statistical analytics called "Biotrichotomy" that have its origins in the field of neurology. This emerging field of statistics seeks to investigate biological events by providing dual metrics for both the pre- and post-hoc results. The distinctive instrumentation of the qualitative to quantitative "Tri-Squared Test" and its related Post Hoc statistic "Tri-Center Analysis" comprise the data analysis technique of "Biotrichotomy" as "Biotrichotometrics" for comprehensive data analytic psychometrics. By combining these two resources, researchers may conduct longitudinal studies with ease. The conventional parametric statistical measures of central tendency may also be accessed using these processes and used within the context of trichotomous study designs. As for post hoc measurements, Tri-Center Analysis looks at the results of a separate, statistically significant Tri-Squared Test by computing parametric measures with a normal distribution. This research concludes that the two statistical analysis methods originally published in the i-manager Journal of Educational Technology and the i-manager Journal on Mathematics are both practical, practical, and viable.

Keywords: Acrophase, Antimode, Batiphase, Biostatistics, Biotrichotomy, Biotrichotometrics, Categorical, Cognition, Gaussian Curve, Investigation, Mathematical Model, Mean, Median, Mode, Normal Curve, Normal Distribution, Neurobiology, Neuroscience, Outcomes, Post Hoc, Research, Results, Systemology, Trichotomous, Trichotomous Calculations, Tri–Squared, Tri–Squared Test,Statistics, and Variables.

INTRODUCTION

According to biostatistics expert Jerrold H. Zar (2010), research in science entails systematically gathering, organizing, analyzing, and presenting information. According to him, a lot of research in the biological sciences is quantitative, and data is information in the form of numerical observations (a "datum" is one numerical observation). Valid and meaningful data display and analysis need approaches tailored to the specific data type. Biometry, which means "biological measurement" in its literal sense, is another name for biostatistics, which is essentially statistics applied to biological issues (Zar, 2010). In this story, the writer suggests a new set of statistical measures based on the tripartite structure of the physical world. "The design of the data collection, the questions asked of the data, the limitations of the data, the data collection, and of the data analysis should be appreciated when formulating conclusions" (Zarr, 2010) is what Zar says while discussing biostatistics. Therefore, this paper's main objective is to provide two simply implementable statistics that are both up-to-date and published within the last year; these statistics will be helpful for researchers doing biological analyses of natural events. Biotrichotomy or biometrics is a general term that may be used to aggregate these dual statistical measurements.

Review of Related Literature

Biotrichotomy: A Neuroscientific, Neurobiological, and Cognitive Definition

The study of the nervous system and its components, including their structure, function, biochemistry, and molecular biology, with a focus on how these systems relate to cognition and behavior is known as neuroscience (Neuroscience, 1963). Scientists who study the brain and how it influences thought and action are known as neuroscientists. For many academics, the terms "Neuroscience" and "Neurobiology" are interchangeable. Neuroscience encompasses all fields pertaining to the nervous system, while neurobiology focuses on the biology of the nervous system (Nordqvist, 2012). A person's cognitive abilities are defined as those that allow them to learn and understand new information. Among these functions include reasoning, understanding, recalling, evaluating, and solving problems. Language, creativity, perception, and planning are all part of these higher-level cognitive processes (Cherry, 2014). There are one million billion connections in the brain, which is a result of the 100 billion neurons and the 10,000 connections per neuron

(Restak, 2011, pp. 14). Neurons are constantly forging new connections with one another. Enriched settings may enhance neurogenesis, the process by which new neurons or nerve cells are produced in the brain, but stress, sadness, lack of sleep, and anxiety can hinder it (Restak, 2011, pp. 17). What we do and what we learn may build upon what our environment does to improve our cognitive abilities (Restak, 2011, pp. 24). Synaptic cell-to-cell bridges proliferate in response to an increase in the number of input channels. Consequently, brain cells become more robust and less susceptible to attrition and pruning (Willis, 2007, as referenced in McGuckin & Ladhani, 2010).

Technological advancements in the field of neuroscience have made it possible to study learning patterns in the brain with better precision (Kumar & Yap, 2010). Learning is defined by cognitive neuroscientists as "neuronal modulation," or the establishment and maintenance of synaptic connections by means of novel and repetitive mental operations (Hirumi, 2013). Education is according to Koizumi (2000 a &b; 2004 as referenced in Koizumi, 2011), learning is the act of forming connections between neurons in reaction to inputs from the outside world, while education is the act of manipulating or introducing new stimuli and fostering a desire to learn. Motivating pupils to study is a crucial skill for instructional designers and educators. To do this, we need to think outside of the box and try new things, which calls for fresh perspectives and original conceptions. Online education necessitates the use of well-grounded web design concepts that use multimedia tools to captivate and engage students (Siragusa, Dixon & Dixon, 2007). But before the researcher can comprehend the method for creating an interesting virtual classroom, they need to examine the sensory brain's reactions to different stimuli and baseline visual data. By sifting through the available research, we find the following important considerations that may be made when designing online learning environments with cognitive and neuroscience research in mind. The transition from electromagnetic to metabolic energy is the basis for our learning. When our senses pick up on anything outside of ourselves, the information goes through our neural networks and activates certain chemicals called neurotransmitters (Feidakis & Daradoumis, 2013). As Mahan and Stein (2014) point out, learning is more like a web of interconnected processes than a simple one-step procedure. According to Pascual-Leone, Freitas, Oberman, Horvath, Halko, Eldaief et al. (2011), neuroplasticity—also called brain plasticity—occurs when there are alterations in neuronal pathways and synapses as a consequence of changes in behavior, environment, neurological processes, thinking, emotions, and even physical injuries. According to Mahan and Stein (2014), there are two main ways in which information may be taken in by the brain: implicitly and explicitly. In contrast to explicit learning, which occurs in the conscious mind, implicit learning occurs in the subconscious. There are always going to be unconscious and conscious steps to the learning process (Kumar & Yap, 2010).

According to the stages of learning, the sensory brain is the first site in the cortex where our concrete experiences are recorded. In order to reflect, the sensory brain collects raw resources, concept, and deed. For any real-life event, our eyes play a key role. Ours is essentially a "seeing" brain, according to Zull (2002). Sound is also processed by the brain in a manner similar to how vision is processed. We pay close attention to novel noises for a brief while before moving on to others (Zull, 2002). Just as it is important to understand that the building blocks of nature, the proton, neutron, and electron, make up the trichotomous elements, so too does understanding this aspect of the brain, namely how sound is processed, to biological researchers, as it begins to demonstrate the presence of trichotomy in nature. When we hear the same sound again, our brains eventually get used to it. Synapses fire less often, and neural networks disengage, as the brain starts to disregard the sound. Nothing shows habituation more than a lecture, and this process lays the scene for boredom (Zull, 2002). More connections are created when information is delivered visually in the occipital lobes and orally in the temporal lobes, increasing the likelihood that the knowledge will remain (McGuckin & Ladhani, 2010). According to this neurobiological explanation, biotrichotomy is a method of visually distributing statistical data in relation to natural trichotomy. Biotrichotomy and its groundbreaking "systemology" have clear connections to this as well.

Biotrichotomy: A Systematic Review

According to Kurabatov, Glagolev, and Fursova (2013), "systemology" is a form of contemporary multidisciplinary analysis that focuses on the development and implementation of ideal engineering solutions in relation to the structure and behavior of objects as whole units. By taking a fresh, entrepreneurial approach to the design and execution of research tools, "Biotrichotomy" aims to provide biologists with the means to optimize their work in the biological sciences via the generation of quantitative and qualitative data. cognitive testing tools developed by researchers via exploration and inquiry. "Innovative activity is system activity for creation and implementation in the public practice of innovation, a priori assuming the transformation of scientific values, ideas, discoveries, and inventions into products, services, production, and management technologies of varying degrees of novelty," Kurabatov et al. (2013) explain further within the innovation framework, defining systemology as follows. By "systematic," we imply that all the work that goes into making innovations, no matter what they are or where they're used, is included. In terms of the application of researcher-designed trichotomous metrics, this is in direct alignment with the theoretical and conceptual frameworks of biometric measurement instruments. Technological, organizational, managerial, and social innovations all come together in innovative activity, which shapes the innovative model of economic evolution. Research into new ideas and theories, as well as the principles and practices of innovation and forecasting, as well as the planning and organization of creative endeavors, form the theoretical foundation of innovation. According to Kurabatov, Glagolev, and Fursova (2013), systemology is the bedrock of innovation in this context.

Defining Biotrichotomous Metrics: A Justification

"Tri-Square" or "Tri-Squared" is short for "The Total Transformative Trichotomous-Squared Test" in the context of biotrophic analysis. Osler (2014) states that it offers a mechanism for turning qualitative research results into quantifiable values that may be utilized to evaluate hypotheses. The "Law of Trichotomy" in mathematics provides the foundation for this. According to Apostol's calculus book, "The Law of Tricohotomy" states that all real numbers may be either negative, zero, or positive. “For arbitrary real numbers a and b, precisely one of the connections ab holds" is one way to express the law (Apostol, 1967). The assertion that for any (actual) x and y, only one of these relationships holds. The rule of trichotomy remained unproven but implicitly accepted until the late 1800s (Singh, 1997). The logicians sought evidence, and they found it. The law was shown to be true. The axiom of choice and the rule of trichotomy are interchangeable when dealing with cardinal numbers. In a broader sense, a binary relation R on X is trichotomous if and only if xRy, yRx, or x = y holds for all x and y in X. Strict total orders, a subset of strict weak orders, are defined when such a relation is also transitive. The relation R produced by the cyclic aRb, bRc, cRa is a non-transitive trichotomous relation, in contrast to the tight total order given by aRb, aRc, bRc in the case of three elements. As y= 0, where 0 is the zero of the integral domain or field, the rule of trichotomy is often considered more fundamental than the law of complete order when defining an ordered integral domain or field. Trichotomy is often described in set theory as a property of binary relations < where every element of those relations satisfies precisely one of the aforementioned relations. In this view, a strict inequality is a trichotomous connection. According to Sensagent (2012), trichotomous relations in this context are anti-symmetric and lack reflexivity.

Discussions on higher cognition, general thinking, and descriptions of intelligence provide the comprehensive historical history upon which the core notion of a "Trichotomy" rests. By dividing higher cognition into three stages—"understanding," "judgment," and "reason"—philosopher Immanuel Kant modified the Thomistic acts of intellect and linked them to the faculties of the soul as (a) mental abilities, (b) emotional responses, and (c) the capacity to want something (Kant, 2007). For the purpose of testing hypotheses, the Total Transformative Trichotomous-Squared Test offers a way to convert qualitative study findings into quantifiable numerical values. This research process lends itself well to educational and social behavioral settings since it is a static means of comprehensively evaluating categorical variables. It is a thorough testing methodology. Pure experimental designs with well-established procedures are readily manipulated (Osler, 2012a). The 3 x 3 Table based on trichotomatous categorical variables and trichotomatous outcome variables is the static foundation of the Tri-Squared Test. In order to establish if differences really exist in the study setting, the three unique variables provide a rigorous and comprehensive examination that produces sufficient results (Osler, 2013a).

The Mathematical Basis of the Biotrichotomous Tri2 Regime

The work of two early mathematicians, as well as the author's own investigation into the two-dimensional fundamental techniques that support further investigations into three-dimensional instructional design, form the basis of Tri-Squared (Osler & Waden 2012b). Mathematician Auguste Bravais developed the first mathematical formula for correlation in his work on observational errors, and optical pioneer Ernst Abbe derived the distribution that would later become known as the "chi square distribution" in his original dissertation. In order to test the validity of a pre-existing research hypothesis, the Tri-Squared research procedure employs a novel set of mathematical formulae that, taken as a whole, accomplish the following: (1) convert qualitative data into quantitative data; (2) analyze inputted trichotomous qualitative outcomes; (3) convert inputted trichotomous qualitative outcomes into outputted quantitative outcomes; and (4) generate a standalone distribution for the analysis of possible outcomes using the inputted trichotomous qualitative outcomes (Osler, 2012a).

Biological Tri2 Psychometrics: A Purpose

If "biological psychometrics" yields qualitative results that "applied biostatistics" may employ, then biotrichotometrics is necessary to put a numerical value on those results. "Psychometrics" describes the steps used to create evaluation and assessment tools. In its broadest sense, psychometrics is the study of psychological evaluation, according to Rust and Golombok (1989). As part of its study design, the author's groundbreaking Tri-Squared Test incorporates a one-of-a-kind event-based "Inventive Investigative Instrument" (Osler, 2013b). The Trichotomous-Squared Test revolves on this. All of the steps in the process revolve on the Inventive Investigative Instrument-based qualitative results entered as trichotomatous categorical variables (Osler, 2013c). The original definition of the Tri-Squared formula was given by Osler (2012a) in an article published in the i-manager Journal on Mathematics titled "Trichotomy-Squared - A novel mixed methods test and research procedure designed to analyze, transform, and compare qualitative and quantitative data for education scientists who are administrators, practitioners, teachers, and technologists" (Osler, 2012a).

Data Tools and Instrumentation: A Methodological Approach

The 'Tri2 3×3 Standard Table' presents the mathematical analytics and technical computations that comprise this study approach, outlining the basic methodology of Biotrichotomy. Following a brief summary of each section in Figure 1, the mathematical operations are offered in a sequential format, demonstrating how to perform pre and post hoc "Biotrichotomous Analytics" using a set of trichotomous psychometric tables (Tables 1 and 2, respectively). Following the preliminary "pre" data collection and analysis section, the following sections show sample data to demonstrate how the aforementioned calculations are used in a biometric analysis: Table 3, Summary: Post Hoc Measures and Metrics Section (Figures 2, 3, 4, and 5 respectively), and the research section that follows in a sequential format to explain everything. Following the introductory Tri2 Mathematical Model Illustrated in Tabular Format is Table 1.

TRICHOTOMOUS CATEGORICAL VARIABLES

	a_1	a_2	a_3
b_1	a_1b_1	a_2b_1	a_3b_1
b_2	a_1b_2	a_2b_2	a_3b_2
b_3	a_1b_3	a_2b_3	a_3b_3

$Tri^2\, d.f. = [C-1][R-1] = [3-1][3-1] = 4 = Tri^2_{[M]}$

Table 1. Biotrichotomy Tri–Squared Test 3 × 3 Table Calculation Procedures

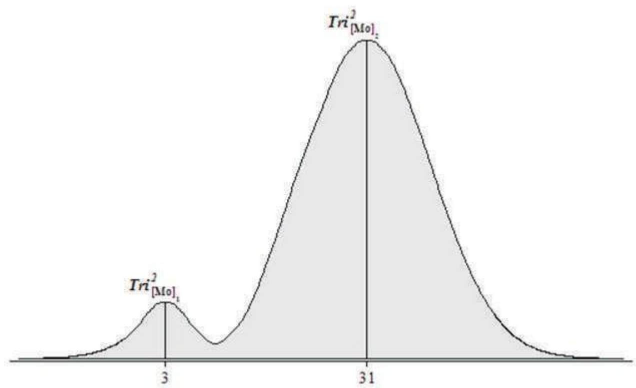

Figure 1. The Tri–Squared Test Tri–Center Analysis Post Hoc Bimodal Distribution A Curve of the Sample Data Statistically Significant Results(Osler, 2014)

and 3.) Tri–Squared Standard Deviation = $Tri^2_{[s]} = \sqrt{Tri^2_{[s^2]}}$

$$= \frac{T^2_{Tri^2} - \frac{[T_{Tri^2}]^2}{n_{Tri^2}}}{n_{Tri^2} - 1}$$

The Elements of Tri–Squared Standard Deviationare as follows:a.) T2Tri2= 2646; b.) [TTri2]2= 10404; and c.) nTri2–1 = 8 (Osler, 2014).

The Elements of the Tri–Squared [Gaussian] Normal Curve are as follows: (1) $Tri^2_{[\bar{x}]} = T_{Tri^2}/n_{Tri^2} = \frac{T_{Tri^2}}{n_{Tri^2}} = 11.3$; (2) $Tri^2_{[s-3]} =$ 11.33 – 3(13.65) = –29.62;3.) $Tri^2_{[s-2]} =$ 11.33 – 2(13.65) = –15.97;4.) $Tri^2_{[s-1]}$ = 11.33 – 1(13.65) = –2.32;5.) $Tri^2_{[s+3]}$ = 3(13.65) + 11.33 = 52.38;6.) $Tri^2_{[s+2]}$= 2(13.65) + 11.33 = 38.63; and7.) $Tri^2_{[s+1]}$ = 1(13.65) + 11.33 = 24.98.

Plotting

Using the previously supplied statistically significant sample data and results, the next section interprets data on the tri-squared (Gaussian) normal curve. Take note of the following Normal Curves, which show the plotting of normal distribution data obtained from the 3 by 3 Tri-Squared Test Table (Figure 4). This data was compiled by Osler (2014). Figure 5 follows and illustrates the plotted Tri–Center Analysis Data Points on the Tri–Squared [Gaussian] Normal Curve for the statistically significant sample data. Between -2.32 and 24.98, the range of the Tri-Squared Test sample data, is dominated by values between -1sd and +1sd. Outcome data and trichotomous categorical records with values of 0–5 are included in this set. Half of the findings from the Tri-Squared Table may be explained by this. This is in agreement with the conventional normal curve for a Gaussian distribution, which has

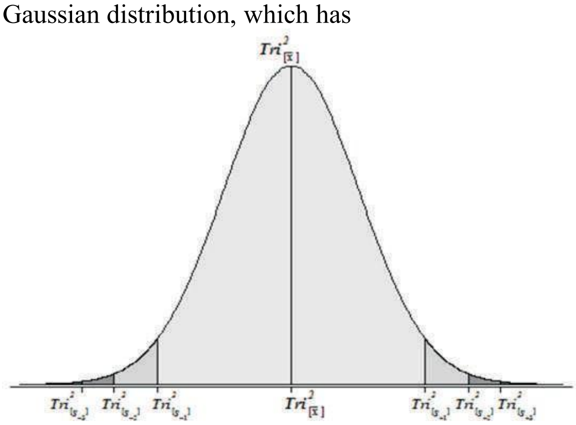

Figure 2. Tri–Squared [Gaussian] Normal Curve Indicating Where to Plot DataPoints (Osler, 2014)

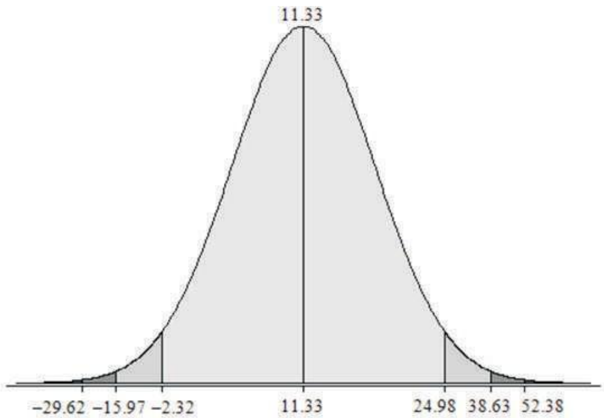

Figure 3. Tri–Squared [Gaussian] Normal Curve with Sample Data

over 68% of all scores (rounded to 68.2% from 34.1% and 34.1%) fell within the range of -1 to +1 standard deviations. Between +1sd= 24.98 and +2sd= 38.63, you may find the remaining statistically significant sample data. The remaining one-third of the findings from the Tri-Squared Table (26, 31, and 31) are accounted for by this. Osler (2014) found that 14% of all scores fell between +1 and +2 standard deviations, which is the same as 13.6% rounded to 14%. This aligns with the classic Gaussian Normal Curve.

Discussion

Researchers are able to make sense of the deep and complex Tri-Squared research data thanks to the Tri-Center Analysis, a plausible statistical measure made possible by the ergonomically viable Biotrichotometrics in the form of the Tri-Squared Test (Osler, 2014).The original intent of the Tri-Squared Test was to examine outcome and trichotomous categorical variables by converting qualitative data into quantitative data (Osler, 2012a). According to Osler (2014), the quantitative data may be further transformed into measures of Tri-Central data using Tri-Center Analysis. This data can then be used to assess the within-group differences in 3 × 3 Tri-Squared Test data. Center measurements provide the basis of biotrichotomy findings. These metrics lend themselves to further analysis and potential generalization (Osler, 2014). Tri-Center Analysis provides a Post Hoc extra measurable form for statistically significant data, allowing it to be advanced as a parametric norm-referenced data distribution. After transforming the data into this new format, researchers may use a z-score or a t-score to evaluate it, as per their preference. Since Tri-Center Analysis is based on conventional parametric statistics, it permits a more stringent set of data analysis processes. Another benefit is that it eliminates the possibility of bias by basing results on subjective observations rather than strictly quantitative data (Osler, 2014).
Advice and Consequences

The author suggests the following actions based on the results:

(1) More study should be conducted by examining different types of data to show how useful and practical biometric statistics are. (2) The Trichotomous-Squared instrument, which combines quantitative and qualitative methodologies, is state-of-the-art and is leading the way in research. Researchers in the field of education may rest easy knowing that their data is more statistically sound when they use this kind of quantitative technique to transform qualitative information (Nash, 2014). The field of "Biostatistics" may benefit from disseminating this study's technique to the biological sciences. According to educational researcher Nash, "Putting science to education is a paradigm shift" (Nash, 2014). Lastly, regarding the Biotrichotomous metric, it would be beneficial for the education and sciences sectors to work together. This would allow for innovative research using newer statistical metrics to improve "the body of knowledge" in both fields.

Conclusion

The "Parametric Normal Curve" or Gaussian Normal Distribution is the basis of Biotrichotomous Tri-Center Analysis. Assuming symmetrical data, the Normal Distribution is a useful tool for assessing the results of the Post Hoc Tri-Squared Test (Osler, 2014). The Normal (or Gaussian) Distribution is a frequently occurring continuous probability distribution in statistical probability theory, according to mathematical and statistical historians John Aldrich and Jeff Miller (2007), who argue in favor of using the Normal Distribution as a Post Hoc Tri-Squared Test Metric (Osler, 2014). Additionally, according to Aldrich and Miller (2007), it is a function that indicates the likelihood of an observation in a given context falling between any two real values. Because its primary purpose is to establish the relative distribution of Post Hoc Tri-Squared Test results, this is well suited for use in Tri-Center Analysis. The research methodology and data analysis process of Tri-Center Analysis are accurately described as follows: "The distribution of values in the Tri-Squared 3 × 3 Table are based on a given set of Trichotomous Categorical and Outcome Variables administered to a selected sample size (determined at the research outset according to the established interval extracted from the "Tri-Squared Distribution Sample Size Table"). The results of this analysis can be plotted on the Gaussian Normal Curve, also known as "The Normal Distribution." For real-valued random variables whose distributions are unknown, normal distributions are often used in both the social and natural sciences (Aldrich and Miller, 2014). According to the article "Tri-Center Analysis: Determining Measures of Trichotomous Central Tendency for the Parametric Analysis of Tri-Squared Test Results" (2014), the approach of Tri-Center Analysis is shown in this case. Within its own set of

Trichotomous values, it permits clearly observations and generalizations about the location and percentile values of the Post Hoc statistically important Tri-Squared outcomes. By using the Tri-Squared Test and Tri-Center Analysis, biotrichotomy allows researchers in the field of biological sciences to get fresh trichotomous understanding of the natural world.

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