CAUSATION International Journal of Science

CAUSATION, 17(1): 5–22
SEE:10.13140/RG.2.2.23903.38567
Received: January 1, 2022
Accepted: January 1, 2022
Published: January 1, 2022
ISSN: 1863-9542

Variance Of Binomial Distribution

Research article

Ilija Barukčić[1]

[1] Internist, Horandstrasse, 26441 Jever, Germany

* **Correspondence:** E-Mail: Barukcic@t-online.de; Tel: +49-4466-333; Fax: +49-4466-333.

Abstract:
Background:
What is something, what is its own other, how do both relate to each other?
Methods:
The binomial distribution is one distribution which is able to describe the relationship between two mutually exclusive outcomes of an event, between something and its own other. The variance of a binomial distribution is reinvestigated.
Results:
The variance i.e. standard deviation of a binomial distribution as mathematized by Karl Pearson in the year 1895 is found to be logically inconsistent. In other words, today's concept of the variance of a Binomial distribution is refuted.
Conclusion:
A new concept of the variance of a Binomial distribution is developed.

Keywords: Binomial distribution; Variance; Refuted

1. Introduction

The term binomial has a very long history in science. For the first time, this term has been demonstrably used in 1557 in *The Whetstone of Witte* by Robert Recorde (see Recorde, 1557). It did not take long and Jacob Bernoulli (see Bernoulli, 1713, p. 45) discovered one of the oldest known probability distributions, the binomial distribution, in his 1713 work entitled as Ars Conjectandi. Only view years later, in 1718, Abraham De Moivre writes about the "... the Coefficients of the Binomial "(see Moivre, 1718). The binomial distribution is particularly useful when there are exactly two(see Birnbaum, 1961, p. 417) mutually exclusive outcomes of a trial, something and its own other. In the course of further development of science, Karl Pearson presented a trial to define the standard deviation of the binomial distribution as follows:

"... the mean square error for any binomial distribution ... is identical with the value $\sqrt{npq}$ "(see Pearson, 1895, p. 351).

Pearson's definition of the standard deviation of a Binomial distribution is more or less generally accepted, and determines a reversal of the burden of proof for anyone who still has justified doubts about the viability of such a definition.

2. Material and methods

2.1. Methods

2.1.1. Random variables

Let a **random variable**(Gosset, 1914) X denote something like a function defined on a probability space, which itself maps from the sample space(Neyman and Pearson, 1933) to the real numbers.

Definition 2.1 (**The First Moment Expectation of a Random Variable**). *Summaries of an entire distribution of a random variable(see Kolmogorov, 1950, p. 22) X, such as the expected value, or average value, are useful in order to identify where X is expected to be without describing the entire distribution. For practical and other reasons, we shall limit ourselves here to discrete random variables, while the basic properties of the expectation value of a random variable X will not be investigated. Thus far, let X be a discrete random variable with the probability p(X). The first moment expectation value (see Huygens and van Schooten, 1657, Kolmogorov, 1950, LaPlace, 1812, Whitworth, 1901) of X, denoted by E(X), is a number defined as follows:*

$$E(X) \equiv p(X) \times X \tag{1}$$

The first moment expectation value squared of a random variable X follows as

$$\begin{aligned} E(X)^2 &\equiv p(X) \times X \times p(X) \times X \\ &\equiv p(X) \times p(X) \times X \times X \\ &\equiv (p(X) \times X)^2 \end{aligned} \tag{2}$$

Definition 2.2 (**The Second Moment Expectation of a Random Variable**). *The second(see Kolmogorov, 1950, p. 42) moment expectation value (or more or less arithmetic mean) of a (large) number of independent realizations of a random variable X follows as:*

$$\begin{aligned} E\left(X^2\right) &\equiv p(X) \times X^2 \\ &\equiv (p(X) \times X) \times X \\ &\equiv E(X) \times X \\ &\equiv X \times E(X) \end{aligned} \tag{3}$$

Definition 2.3 (**The n-th Moment Expectation of a Random Variable**). *The n-th(see Barukčić, 2020, 2021) moment expectation value of a (large) number of independent realizations of a random variable X follows as:*

$$E(X^n) \equiv p(X) \times X^n \equiv (p(X) \times X) \times X^{n\text{-}1} \equiv E(X) \times X^{n\text{-}1} \tag{4}$$

The probability p(X) of a random variable X follows as (see equation 1)

$$p(X) \equiv \frac{E(X)}{X} \equiv \frac{E(X) \times E(X)}{E(X) \times X} \equiv \frac{E(X)^2}{E(X^2)} \tag{5}$$

Definition 2.4 (The Variance of a Random Variable). *Johann Carl Friedrich Gauß (1777-1855) introduced the normal distribution and the error of mean squared in his 1809 monograph(see Gauß, Carl Friedrich, 1809). In the following, Karl Pearson (1857-1936) coined the term "standard deviation"in 1893. Pearson is writing:*

"Then σ will be termed its standard-deviation (error of mean square)."(see Pearson, 1894, p. 80)

Finally, the term variance was introduced by Sir Ronald Aylmer Fisher (1890-1962) in the year 1918.

> *"The ... deviations of a ... measurement from its mean ... may be ... measured by the standard deviation corresponding to the square root of the mean square error ... It is ... desirable **in analysing the causes** ... to deal with the square of the standard deviation as the measure of variability. We shall term this quantity the Variance... "*
>
> *(see Fisher, Ronald Aylmer, 1919, p. 399)*

The deviation of a random variable X from its population mean or sample mean E(X) has a central role in statistics and is one important measure of dispersion. The variance (see Kolmogorov, 1950, p. 42), the second central moment of a distribution, is the expectation value of the squared deviation of a random variable X from its own expectation value E(X) and follows as (see equation 3):

$$\sigma(X)^2 \equiv E\left(X^2\right) - E(X)^2 \equiv (X \times E(X)) - E(X)^2 \tag{6}$$

2.1.2. Binomial random variables

The binomial distribution with parameters n and p has been developed by the Swiss mathematician Jakob Bernoulli (1655-1705) in a proof published in his 1713 book Ars Conjectandi (see Bernoulli, 1713) Part 1. In probability theory and statistics, the probability of getting exactly k successes in n independent Bernoulli trials is given by the probability mass function as

$$p\left(X_{\mathrm{t}}=k\right)\equiv\binom{n}{k}\cdot p^{k}\cdot q^{n-k} \tag{7}$$

is $\binom{n}{k}=\frac{n!}{k!(n-k)!}$ the binomial coefficient while the cumulative distribution function is given as

$$p\left(X_{\mathrm{t}}\leq k\right)\equiv 1-p\left(X_{\mathrm{t}}>k\right)\equiv\sum_{t=0}^{k}\binom{n}{t}\cdot p^{t}\cdot q^{n-t} \tag{8}$$

or as

$$p\left(X_{\mathrm{t}}>k\right)\equiv 1-p\left(X_{\mathrm{t}}\leq k\right)\equiv 1-\sum_{t=0}^{k}\binom{n}{t}\cdot p^{t}\cdot q^{n-t} \tag{9}$$

Furthermore, it is

$$p\left(X_{\mathrm{t}}<k\right)\equiv 1-p\left(X_{\mathrm{t}}\geq k\right)\equiv\sum_{t=0}^{k-1}\binom{n}{t}\cdot p^{t}\cdot q^{n-t} \tag{10}$$

or

$$p\left(X_{\mathrm{t}}\geq k\right)\equiv 1-p\left(X_{\mathrm{t}}<k\right)\equiv 1-\sum_{t=0}^{k-1}\binom{n}{t}\cdot p^{t}\cdot q^{n-t} \tag{11}$$

The binomial distribution is the mathematical foundation of a binomial test. The random variable X_{t} is counting for different things. The discrete geometric (see Feller, 1950, p. 61) distribution describes under certain circumstances the number of Bernoulli trials needed to get one success. The probability that the first occurrence of success requires k independent trials, each with success probability p, is given by the equation

$$p\left(X_{\mathrm{t}}=k\right)\equiv p\cdot q^{k-1} \tag{12}$$

The negative (see Fisher, 1941, Haldane, 1941) binomial probability is a discrete probability distribution which defines the number of successes (k) in a sequence of independent and identically distributed Bernoulli trials (n) before a specified (non-random) number of failures (denoted r) occurs. The probability mass function of the negative binomial distribution is

$$p\left(X_{\mathrm{t}}=r\right)\equiv\binom{k+r-1}{k-1}p^{k}\cdot q^{r} \tag{13}$$

where k is the number of successes, r is the number of failures, and p is the probability of success.

Definition 2.5 (Expectation value and variance of a binomial random variable).

The variance of the binomial distribution with parameters n, the number of independent experiments each asking a yes–no question and p, the probability of a single event, is defined(see Pearson, 1904, p. 66) as

$$\sigma(X_t)^2 \equiv N \times p(X_t) \times (1 - p(X_t)) \tag{14}$$

Definition 2.6 (Two by two table of Binomial random variables).

Let a, b, c, d, A, $\underline{A}$, B, and $\underline{B}$ denote expectation values. Under conditions where *the probability of an event, an outcome, a success et cetera is* ***constant*** *from Bernoulli trial to Bernoulli trial t*, it is

$$\begin{aligned} A &= N \times E(A_t) \\ &\equiv N \times (A_t \times p(A_t)) \\ &\equiv N \times (p(A_t) + p(B_t)) \\ &\equiv N \times p(A_t) \end{aligned} \tag{15}$$

and

$$\begin{aligned} B &= N \times E(B_t) \\ &\equiv N \times (B_t \times p(B_t)) \\ &\equiv N \times (p(A_t) + p(c_t)) \\ &\equiv N \times p(B_t) \end{aligned} \tag{16}$$

where N might denote the population or even the sample size. Furthermore, it is

$$a \equiv N \times (E(A_t)) \equiv N \times (p(A_t)) \tag{17}$$

and

$$b \equiv N \times (E(B_t)) \equiv N \times (p(B_t)) \tag{18}$$

and

$$c \equiv N \times (E(c_t)) \equiv N \times (p(c_t)) \tag{19}$$

and

$$d \equiv N \times (E(d_t)) \equiv N \times (p(d_t)) \tag{20}$$

and

$$a + b + c + d \equiv A + \underline{A} \equiv B + \underline{B} \equiv N \tag{21}$$

Table 1 provide us again an overview of a two by two table of Binomial random variables.

Table 1. The two by two table of Binomial random variables

		Conditioned B_t		
		TRUE	FALSE	
Condition	TRUE	a	b	A
A_t	FALSE	c	d	$\underline{A}$
		B	$\underline{B}$	N

2.1.3. Independence

Definition 2.7 (**Independence**).

In general, an event A_t at the Bernoulli trial t need not but can be independent of the existence or of the occurrence of another event B_t *at the same* Bernoulli trial t. Mathematically, independence (Kolmogoroff, 1933, Moivre, 1718) in terms of probability theory is defined at the same (period of) time t (i.e. Bernoulli trial t) as

$$\begin{aligned} p(A_t \wedge B_t) &\equiv p(A_t) \times p(B_t) \\ &\equiv \frac{\sum_{t=1}^{N} (A_t \wedge B_t)}{N} \equiv \frac{N \times (p(a_t))}{N} \equiv 1 - p(A_t \mid B_t) \equiv 1 - p(A_t \uparrow B_t) \end{aligned} \tag{22}$$

2.1.4. Dependence

Definition 2.8 (**Dependence**).

The dependence of events (Barukčić, 1989, p. 57-61) is defined as

$$p\left(\underbrace{A_t \wedge B_t \wedge C_t \wedge \ldots}_{n}\right) \equiv \sqrt[n]{\underbrace{p(A_t) \times p(B_t) \times p(C_t) \times \ldots}_{n}} \tag{23}$$

2.2. *Axioms*

2.2.1. Axiom I. Lex identitatis

In this context, we define axiom I as the expression

$$+1 = +1 \tag{24}$$

2.2.2. Axiom II. Lex contradictionis

In this context, axiom II or **lex contradictionis**, the negative of lex identitatis, or

$$+0 = +1 \tag{25}$$

and equally the most simple form of a contradiction formulated.

2.2.3. Axiom III. Lex negationis

$$\neg(0) \times 0 = 1 \tag{26}$$

where $\neg$ denotes (logical (Boole, 1854) or natural) negation (Ayer, 1952, Förster and Melamed, 2012, Hedwig, 1980, Heinemann, 1943, Horn, 1989, Koch, 1999, Kunen, 1987, Newstadt, 2015, Royce, 1917, Speranza and Horn, 2010, Wedin, 1990). In this context, there is some evidence that $\neg(1) \times 1 = 0$. In other words, it is $(\neg(1) \times 1) \times (\neg(0) \times 0) = 1$

3. Results

Theorem 3.1 (Normalisation of Variance)**.** *In general, it is*

$$\frac{E(X)^2}{E(X^2)} + \frac{\sigma(X)^2}{E(X^2)} \equiv +1 \tag{27}$$

Proof by direct proof. The premise

$$+1 \equiv +1 \tag{28}$$

is true. In the following, we rearrange the premise. We obtain

$$\sigma(X)^2 \equiv \sigma(X)^2 \tag{29}$$

Based on equation 6, equation 29 before becomes

$$E\left(X^2\right) - E(X)^2 \equiv \sigma(X)^2 \tag{30}$$

Rearranging equation 30, it is

$$E\left(X^2\right) \equiv E(X)^2 + \sigma(X)^2 \tag{31}$$

Normalizing equation 31, it is

$$\frac{E(X)^2}{E(X^2)} + \frac{\sigma(X)^2}{E(X^2)} \equiv \frac{E(X^2)}{E(X^2)} \equiv +1 \tag{32}$$

□

Theorem 3.2 (The probability p(X) of a Random Variable X)**.** *The probability p(X) of a random variable X is given by the equation*

$$p(X) \equiv 1 - \frac{\sigma(X)^2}{E(X^2)} \tag{33}$$

Proof by direct proof. The premise

$$+1 \equiv +1 \tag{34}$$

is true. In the following, we rearrange the premise. We obtain (see equation 32)

$$\frac{E(X)^2}{E(X^2)} + \frac{\sigma(X)^2}{E(X^2)} \equiv +1 \tag{35}$$

Rearranging equation 35, it is

$$\frac{E(X)^2}{E(X^2)} \equiv 1 - \frac{\sigma(X)^2}{E(X^2)} \tag{36}$$

The probability p(X) of a random variable X follows as (see equation 5)

$$p(X) \equiv \frac{E(X)^2}{E(X^2)} \equiv 1 - \frac{\sigma(X)^2}{E(X^2)} \tag{37}$$

□

In contrast to Chebyshev's or Bienaymé(see Bienaymé, Irénée-Jules, 1853) – Chebyshev(see Tschébychef, Pafnouti Lvovitch, 1867) inequality which states something like the complement probability of X as

$$p\left(|X - E(X)| \geq \sqrt{E(X^2)}\right) \leq \frac{\sigma(X)^2}{E(X^2)} \equiv 1 - p(X) \tag{38}$$

equation 37 provides an exact probability of a random variable X.

Theorem 3.3 (Refutation of the Variance of the Binomial distribution)**.** *Today's variance of the Binomial distribution given by the equation*

$$\sigma(X)^2 \equiv N \times p(X) \times (1 - p(X)) \tag{39}$$

is logically inconsistent and refuted.

Proof by direct proof. The premise

$$+1 \equiv +1 \tag{40}$$

is true. In the following, we rearrange the premise. We obtain

$$\sigma(X)^2 \equiv \sigma(X)^2 \tag{41}$$

Today, the variance of the binomial distribution is defined as

$$\sigma(X)^2 \equiv N \times p(X) \times (1 - p(X)) \tag{42}$$

Equation 42 becomes

$$\begin{aligned} \sigma(X)^2 &\equiv N \times p(X) \times (1 - p(X)) \\ &\equiv E\left(X^2\right) - E(X)^2 \\ &\equiv (X \times E(X)) - E(X)^2 \end{aligned} \tag{43}$$

In other words, equation 43 simplifies as

$$E\left(X^2\right) - E(X)^2 \equiv N \times p(X) \times (1 - p(X)) \tag{44}$$

Today, the expectation value E(X) of the binomial distribution is defined as

$$E(X) \equiv N \times p(X) \tag{45}$$

Equation 44 simplifies as

$$E\left(X^2\right) - E(X)^2 \equiv E(X) \times (1 - p(X)) \tag{46}$$

Rearranging equation 46, it is

$$\frac{E\left(X^2\right)}{E(X)} - \frac{E(X)^2}{E(X)} \equiv (1 - p(X)) \tag{47}$$

or according to equation 3

$$\frac{X \times E(X)}{E(X)} - E(X) \equiv (1 - p(X)) \tag{48}$$

Equation 48 simplifies further. We obtain

$$X - E(X) \equiv (1 - p(X)) \tag{49}$$

Simplifying equation 49 it is

$$X \times (1 - p(X)) \equiv (1 - p(X)) \tag{50}$$

or

$$X \equiv 1 \tag{51}$$

Today's definition of the variance of the binomial distribution demand us to accept that X = 1 which does not fit with objective reality. The random variable X can take values different from 1, i. e. X = 10. In this case we obtain

$$10 \equiv 1 \tag{52}$$

or

$$10 - 1 \equiv 0 \tag{53}$$

or

$$\frac{9}{9} \equiv \frac{0}{9} \tag{54}$$

and at the end

$$+1 \equiv +0 \tag{55}$$

It is possible to derive a logical contradiction out of today's definition of the variance of the Binomial distribution. Today's definition of the variance of the Binomial distribution is logically inconsistent and refuted. □

4. Discussion

Today's definition of the variance of the binomial distribution appears not to be logically consistent (see equation 55). However, if we accept today's definition of the variance of the binomial distribution given by the equation

$$\sigma(X)^2 \equiv N \times p(X) \times (1 - p(X)) \tag{56}$$

as correct, then we need to abandon today's definition of the expectation value of the binomial distribution given as

$$E(X) \equiv N \times p(X) \tag{57}$$

or vice versa. Both definitions could no longer be upheld at the same time. It is a matter of urgency to redefine **either** the variance of the binomial distribution as

$$\sigma(X)^2 \equiv N \times N \times p(X) \times (1 - p(X)) \tag{58}$$

or the expectation value of the binomial distribution as

$$E(X) \equiv \sqrt[2]{N} \times p(X) \tag{59}$$

However, one basic property of the binomial distribution is that the probability is constant from Bernoulli trial to Bernoulli trial. Therefore, it is naturally to accept the definition

$$E(X) \equiv N \times p(X) \tag{60}$$

with the consequence that the variance of the binomial distribution follows logically without as

$$\sigma(X)^2 \equiv N \times N \times p(X) \times (1 - p(X)) \tag{61}$$

5. Conclusion

Today's Karl Pearson dominated view of all scientific thinking of the standard deviation or variance of a Binomial distribution(see Pearson, 1895, p. 351) is refuted.

Acknowledgments

No funding or any financial support by a third party was received.

6. Patient consent for publication

Not required.

Conflict of interest statement

No conflict of interest to declare.

Private note

The definition section of a paper need not and does not necessarily contain new scientific aspects. Above all, it also serves to better understand a scientific publication, to follow every step of the arguments of an author and to explain in greater details the fundamentals on which a publication is based. Therefore, there is no objective need to force authors to reinvent a scientific wheel once and again unless such a need appears obviously factually necessary. The effort to write about a certain subject in an original way in multiple publications does not exclude the necessity simply to cut and paste from an earlier work, and has nothing to do with self-plagiarism. However, such an attitude cannot simply be transferred to the sections' introduction, results, discussion and conclusions et cetera.

References

A. J. Ayer. Negation. *The Journal of Philosophy*, 49(26):797–815, January 1952. doi: 10.2307/2020959. JSTOR.

Ilija Barukčić. *Die Kausalität*. Wiss.-Verl., Hamburg, 1. aufl. edition, January 1989. ISBN 3-9802216-0-1. ISBN: 978-3-9802216-0-1.

Ilija Barukčić. Causal relationship k. *International Journal of Mathematics Trends and Technology IJMTT*, 66(10):76–115, 2020. URL http://www.ijmttjournal.org/archive/ijmtt-v66i10p512. Publisher: Seventh Sense Research Group SSRG.

Ilija Barukčić. The causal relationship k. *MATEC Web of Conferences*, 336:09032, 2021. ISSN 2261-236X. doi: 10.1051/matecconf/202133609032. CSCNS2020. Web of Science. Free full text: EDP Sciences.

Jacobi Bernoulli. *Ars conjectandi, Opus posthumus: Accedit Tractatus de seriebus infinitis ; et epistola Gallice scripta De Ludo Pilae Reticularis*. Impensis Thurnisiorum [Tournes], fratrum, Basileae (Basel, Suisse), January 1713. doi: 10.3931/e-rara-9001. Free full text: e-rara, Zurich, CH.

Bienaymé, Irénée-Jules. Considérations a l'appui de la découverte de Laplace sur la loi de probabilité dans la méthode des moindres carrés. *Comptes rendus des séances de l'Académie des Sciences des Paris*, 37:309–324, 1853. JMPA.

Allan Birnbaum. On the foundations of statistical inference: Binary experiments. *Institute of Mathematical Statistics*, 32(2):414–435, 1961. JSTOR archive.

George Boole. *An investigation of the laws of thought, on which are founded mathematical theories of logic and probabilities*. New York, Dover, 1854. Free full text: archive.org, San Francisco, CA 94118, USA.

William Feller. *Introduction to Probability Theory and its Applications. Volume I & II.*, volume 1. John Wiley and Sons Inc., 1st edition edition, 1 1950. John Wiley and Sons Inc.

Ronald Aylmer Fisher. The negative binomial distribution. *Annals of Eugenics*, 11(1):182–187, 1941. ISSN 2050-1439. doi: 10.1111/j.1469-1809.1941.tb02284.x. Wiley Online Library.

Fisher, Ronald Aylmer. XV.—The Correlation between Relatives on the Supposition of Mendelian Inheritance. *Earth and Environmental Science Transactions of The Royal Society of Edinburgh*, 52(2):399–433, 1919. ISSN 2053-5945. doi: 10.1017/S0080456800012163. Royal Society of Edinburgh.

Eckart Förster and Yitzhak Y Melamed. *"Omnis determinatio est negatio" – Determination, Negation and Self-Negation in Spinoza, Kant, and Hegel. In: Spinoza and German idealism. Eckart Forster & Yitzhak Y. Melamed (eds.)*. Cambridge University Press, Cambridge [England]; New York, 2012. ISBN 978-1-283-71468-6. URL https://doi.org/10.1017/CBO9781139135139.

Gauß, Carl Friedrich. *Theoria motus corporum coelestium in sectionibus conicis solem ambientium*. sumtibus Frid. Perthes et I. H. Besser, 1809. hrefhttp://www.e-rara.ch/doi/10.3931/e-rara-522e-rara, Zurich, CH.

William Sealy Gosset. The elimination of spurious correlation due to position in time or space. *Biometrika*, 10(1):179–180, 1914. ISSN 0006-3444. doi: 10.2307/2331746. JSTOR.

John Burdon Sanderson Haldane. The fitting of binomial distributions. *Annals of Eugenics*, 11(1): 179–181, 1941. ISSN 2050-1439. doi: 10.1111/j.1469-1809.1941.tb02283.x. Wiley Online Library.

Klaus Hedwig. Negatio negationis: Problemgeschichtliche Aspekte einer Denkstruktur. *Archiv für Begriffsgeschichte*, 24(1):7–33, 1980. ISSN 0003-8946. URL www.jstor.org/stable/24359358.

F. H. Heinemann. The Meaning of Negation. *Proceedings of the Aristotelian Society*, 44:127–152, 1943. ISSN 0066-7374. URL www.jstor.org/stable/4544390.

Laurence R. Horn. *A natural history of negation*. University of Chicago Press, Chicago, 1989. ISBN 978-0-226-35337-1. URL https://emilkirkegaard.dk/en/wp-content/uploads/A-natural-history-of-negation-Laurence-R.-Horn.pdf.

Christiaan Huygens and Frans van Schooten. *De ratiociniis in ludo alae: In: Exercitationum mathematicarum liber primus [- quintus]*. ex officina Johannis Elsevirii, Lugdunum Batavorum (Leiden, The Netherlands), January 1657. doi: 10.3931/e-rara-8813. Free full text: e-rara, Zurich, CH.

Anton Friedrich Koch. Die Selbstbeziehung der Negation in Hegels Logik. *Zeitschrift für philosophische Forschung*, 53(1):1–29, 1999. ISSN 0044-3301. URL www.jstor.org/stable/20484868.

A. Kolmogoroff. *Grundbegriffe der Wahrscheinlichkeitsrechnung*. Springer Berlin Heidelberg, Berlin, Heidelberg, January 1933. ISBN 978-3-642-49596-0. doi: 10.1007/978-3-642-49888-6.

Andreĭ Nikolaevich Kolmogorov. *Foundations of the theory of probability*. Chelsea Publishing Company, translated by nathan morrison edition, 1950. ISBN 978-0-486-82159-7. hrefhttps://archive.org/details/foundationsofthe00kolmarchive.org, San Francisco, CA 94118, USA .

Kenneth Kunen. Negation in logic programming. *The Journal of Logic Programming*, 4(4):289–308, December 1987. ISSN 0743-1066. doi: 10.1016/0743-1066(87)90007-0. URL http://www.sciencedirect.com/science/article/pii/0743106687900070.

Pierre Simon de LaPlace. *Théorie analytique des probabilités*. Courcier, 1 1812. e-rara, Zurich, CH.

Abraham de Moivre. *The Doctrine of Chances or a Method of Calculating the Probability of Events in Play*. printed by W. Pearson for the author, London, January 1718. doi: 10.3931/e-rara-10420. Free full text: e-rara, Zurich, CH.

Russell Newstadt. *Omnis Determinatio est Negatio: A Genealogy and Defense of the Hegelian Conception of Negation*. Loyola University Chicago, Chicago (IL), dissertation edition, 2015. Free full text: Loyola University Chicago, USA.

Jerzy Neyman and Egon Sharpe Pearson. IX. On the problem of the most efficient tests of statistical hypotheses. *Philosophical Transactions of the Royal Society of London. Series A, Containing Papers of a Mathematical or Physical Character*, 231(694–706):289–337, 2 1933. ISSN 0264-3952, 2053-9258. doi: 10.1098/rsta.1933.0009. The Royal Society, London, GB.

Karl Pearson. III. Contributions to the Mathematical Theory of Evolution. On the Dissection of Asymmetrical-Frequency Curves. *Philosophical Transactions of the Royal Society of London, Series A*, 185:71–85, 1894. The Royal Society.

Karl Pearson. X. Contributions to the mathematical theory of evolution. — II. Skew variation in homogeneous material. *Philosophical Transactions of the Royal Society of London. (A.)*, 186:343–414, Jan 1895. doi: 10.1098/rsta.1895.0010. Publisher: Royal Society.

Karl Pearson. III. Mathematical contributions to the theory of evolution. — XII. On a generalised Theory of alternative Inheritance, with special reference to Mendel's laws. *p 66: Standard dev binomial distribution*, 203(359–371):53–86, 1 1904. doi: 10.1098/rsta.1904.0015. Royal Society.

Robert Recorde. *The whetstone of witte, whiche is the seconde parte of Arithmetike: containyng thextraction of Rootes: The Coßike practise, with the rule of Equation: and the woorkes of Surde Nombers*. Jhon Kyngstone, London, 1557. Free full text: archive.org, San Francisco, CA 94118, USA.

Josiah Royce. *Negation*, volume 9 of *Encyclopaedia of Religion and Ethics. J. Hastings (ed.)*. Charles Scribner's Sons, New York (USA), 1917. Free full text: archive.org, San Francisco, CA 94118, USA.

J. L. Speranza and Laurence R. Horn. A brief history of negation. *Journal of Applied Logic*, 8(3): 277–301, September 2010. ISSN 1570-8683. doi: 10.1016/j.jal.2010.04.001. URL http://www.sciencedirect.com/science/article/pii/S1570868310000236.

Tschébychef, Pafnouti Lvovitch. Des valeurs moyennes. *Journal de Mathématiques Pures et Appliquées*, 12(2):177–184, 1867. JMPA.

Michael V. Wedin. Negation and quantification in aristotle. *History and Philosophy of Logic*, 11 (2):131–150, January 1990. ISSN 0144-5340. doi: 10.1080/01445349008837163. URL https://doi.org/10.1080/01445349008837163.

William Allen Whitworth. *Choice and Chance. With 1000 Exercises*. Deighton, Bell & Co., fifth eidtion edition, 1901. archive.org, San Francisco, CA 94118, USA .

I was born October, 1st 1961 in Novo Selo, Bosnia and Herzegovina, former Yogoslavia. I am of Croatian origin. From 1982-1989 C.E., I studied human medicine at the University of Hamburg, Germany. Meanwhile, I am working as a specialist of internal medicine. My basic field of research since my high school days at the Wirtschaftsgymnasium Bruchsal, Baden Württemberg, Germany is the mathematization of the relationship between a cause and an effect valid without any restriction under any circumstances including the conditions of classical logic, probability theory, quantum mechanics, special and general theory of relativity, human medicine et cetera. I endeavour to investigate positions of quantum mechanics, relativity theory, mathematics et cetera, only insofar as these positions put into question or endanger **the general validity of the principle of causality**.

[a] https://orcid.org/0000-0002-6988-2780

[b] https://cel.webofknowledge.com/InboundService.do?app=wos&product=CEL&Func=Frame&SrcApp=Publons&SrcAuth=Publons_CEL&locale=en-US&SID=F4r5Tsr3OcrmFbYrqiF&customersID=Publons_CEL&smartRedirect=yes&mode=FullRecord&IsProductCode=Yes&Init=Yes&action=retrieve&UT=WOS%3A000298855300006

[c] https://publons.com/researcher/3501739/ilija-barukcic/

[d] https://www.scopus.com/authid/detail.uri?authorId=37099674500

[e] https://www.scopus.com/authid/detail.uri?authorId=54974181600

[f] https://www.mendeley.com/search/?authorFullName=Ilija%20Baruk%C4%8Di%C4%87&page=1&query=Barukcic&sortBy=relevance

[g] https://www.researchgate.net/profile/Ilija-Barukcic-2

[h] https://zenodo.org/search?page=1&size=20&q=keywords:%22Baruk%C4%8Di%C4%87%22&sort=mostviewed

[i] https://zenodo.org/search?page=1&size=20&q=keywords:%22Baruk%C4%8Di%C4%87,%20Conference%22

[j] https://twitter.com/ilijabarukcic?lang=de

[k] https://twitter.com/Causation_Journ

[l] https://vixra.org/author/ilija_barukcic

[m] https://www.youtube.com/channel/UCwf3w1IngcukIOOjpw8HTwg

[n] https://portal.dnb.de/opac/showNextResultSite?currentResultId=%22Barukcic%22%26any&currentPosition=30