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Determination of Tendency of Rainfall at Delhi and Mumbai

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ABSTRACT: Recently, one formulation/method has been developed for determining the tendency of integral valued numerical data. This article is based on the application of this formulation/method in determining the tendency of rainfall (number of rainy days) at Delhi as well as at Mumbai in the twelve months separately.

KEYWORDS: Integral valued numerical data, Tendency of Rainfall, Formulation of Determination, Rainfall at Delhi and Mumbai

I. INTRODUCTION

There had already been a lot of research on searching for suitable measure of average [9 , 79]. The first attempt had been made by Pythagoras [12] who developed three measures of average namely Arithmetic Mean (*AM*), Geometric Mean (*GM*) & Harmonic Mean (*HM*) which were later named as Pythagorean means [13 , 38 , 47 , 48 , 58] as a mark of honour to him for his ever-significant discovery. A number of measures of average had been developed consequently in continuation to the three Pythagorean means [36 , 37 , 47 , 48 , 50 , 58]. In the next step of development of measure of average, Kolmogorov [80] formulated one generalized definition of average namely Generalized f - Mean. [75 , 76*] from which* the existing measures of average can be derived as special cases [36 , 37]. In other studies, Chakrabarty developed two generalized definitions of measure of average namely Generalized f_H – Mean [39*]* and Generalized f_G – Mean [40 , 42] along with one general method of defining measure of average [47, 48 , 62] as well as the different formulations of average from the first principles [50].

In statistics, the three Pythagorean means are treated/ accepted as three basic measures of central tendency [66 , 65 , **67** , 81 , 82] of numerical data. In fact, if μ is the central tendency of

$$X_1 \ , \ X_2 \ , \ldots\ldots\ldots\ldots \ , \ X_N$$

then they can be described/explained by the model

$$X_i = \mu + \varepsilon_i \quad , \quad (i = 1 \ , 2 \ , \ldots\ldots\ldots\ldots \ , N) \tag{1.1}$$

where

$$\varepsilon_1 \ , \varepsilon_2 \ , \ \ldots\ldots\ldots\ldots \ , \varepsilon_N$$

errors (random in nature) associated to

$$X_1 \ , \ X_2 \ , \ldots\ldots\ldots \ , \ X_N$$

respectively [17 – 22 , 27 , 55 , 56 , 63 , 64, 65].

The available statistical methods of estimation of the parameter [1 – 8 , 10, 11 , 15 , 16 , 30, 31 , 32 , 71 , 73 , 74 , 77 , 78 ,80], cannot yield value of the parameter μ accurately [20 , 26 , 28 , 29]. Recently some attempts have been made on developing method(s) of determining the value of parameter μ accurately [18 , 21 , 24 , 25 , 33 , 34 , 38, 43 , 45 , 46 , 51 – 56, 59 , 60]. In these attempts, some methods have been developed for determining such value of parameter and consequently the central tendency [22 , 23 , 55 , 81 , 82] of $X_1 \ , \ X_2 \ , \ldots\ldots \ , \ X_N$. These methods are based on Arithmetic-Geometric Mean (*AGM*) [14 , 49, 51 , 57 , 61 , 72], Arithmetic-Harmonic Mean (*AHM*) [52 , 53 , 57 , 59 , 60 , 61], Geometric-Harmonic Mean (*GHM*) [54 , 57, 61], Arithmetic-Geometric-Harmonic Mean (*AGHM*) [56 , 57, 61] and *GM* of *AM* & *HM* [69].

Each measure of central tendency results in value which lies in the middle part or central part of the associated data. However, tendency of data may not always be towards the central portion of the data in reality. There are situations in reality where the tendency of data is not towards the central / middle portion of the data but towards one end point of the data set. Thus there is necessity of some formulation/method of determining tendency of data in such situation. For

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this reason, one formulation/method has recently been developed for determining the tendency of integral valued numerical data [68 , 70]. This formulation/method has here been applied in determining the tendency of rainfall (number of rainy days) at Delhi as well as at Mumbai in the twelve months separately.

II. METHOD OF DETERMINING TENDENCY OF INTEGRALVAUED NUMERICAL DATA

Suppose,

$$x_1 , x_2 , \ldots\ldots\ldots\ldots , x_N$$

are $\boldsymbol{N}$ observations which are non-negative integral values, observed on a non-negative integral valued random variable X , so that its central tendency is also a non-negative integral value.

Arithmetic Mean (AM) of the N observations is defined by

$$AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N) = \frac{1}{N} \sum_{i=1}^{N} x_i \qquad (2.1)$$

Possible Situations and determination of Central Tendency

(1) If either of the integer just below $AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ or the integer just above $AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ is identical with the $Mode\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ of the data set then that common value is the value of central tendency of $\boldsymbol{x}$.

(2) If none of the integer just below $AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ and the integer just above $AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ is identical with the mode of the data set then identify the outlier(s) in the data set and repeat the process to obtain the common value of $Mode\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ and either of the integer just below $AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ or the integer just above $AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ which is the value of central tendency of $\boldsymbol{x}$.

(3) If $Mode\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$ is found not to be unique and/or if found not to be identifiable, then

the integer just below $AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$

or

the integer just above $AM\,(x_1 , x_2 , \ldots\ldots\ldots , x_N)$

is the value of central tendency of $\boldsymbol{x}$

depending upon

the set of possible positive errors associated to $\boldsymbol{x_1 , x_2 , \ldots\ldots , x_N}$ is bigger than the set of possible negative errors associated to them

or

the set of possible positive errors is smaller than the set of possible negative errors.

Note

(1) The above formulation/method is for non-negative integral valued observations.

(2) If the observations are all non-positive integral valued then by changing the origin, the observations can be transformed to all non-negative integral valued so that the method can be applied to determine the tendency of the transformed data.

If c is an arbitrary number which transforms all the original observations to non-negative integral valued numbers then

Tendency of original data = Tendency of transformed data - c

(3) If the observations are mixture of non-negative and non-positive integral valued then the technique mentioned in (2) can be applied.

III. TENDENCY OF RAINFALL AT DELHI AND MUMBAI

Data on number of rainy days (month-wise) at Delhi and Mumbai corresponding to the twelve months during the period from 1969 to 2001 have been collected from Indian Meteorological Department, which have been shown in **Table - 3.1** and **Table - 3.2** respectively. The values of tendency of number of rainy days at these two places, obtained by the formulation/method outlined above, have been shown in **Table - 3.3** and **Table - 3.4** respectively.

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Table - 3.1
(Number of Rainy Days at Delhi)

Year	Month											
	Jan	Feb	Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec
1969	0	1	2	0	3	5	11	6	6	0	0	0
1970	3	4	2	0	1	5	5	11	9	1	0	0
1971	1	1	0	1	3	4	6	13	6	1	0	0
1972	1	1	0	2	0	2	10	13	3	1	2	0
1973	2	1	0	0	2	2	8	18	3	2	0	1
1974	0	0	1	0	0	4	14	5	1	3	0	1
1975	2	1	1	0	0	6	11	14	11	3	0	0
1976	0	2	2	1	3	6	11	17	2	0	0	0
1977	4	0	0	5	3	8	21	4	11	2	0	2
1978	0	2	3	1	0	5	17	14	5	0	0	1
1979	4	4	2	1	2	4	11	7	3	1	0	2
1980	1	1	3	0	2	3	18	7	4	2	0	1
1981	2	3	3	0	0	2	12	4	2	0	4	0
1982	2	2	5	4	4	4	7	13	0	4	1	2
1983	3	2	2	6	3	3	9	10	10	1	0	2
1984	0	1	0	1	1	4	11	12	4	0	0	0
1985	0	0	0	3	0	5	17	10	5	5	0	6
1986	1	2	2	1	2	3	4	7	4	0	0	2
1987	1	2	1	1	5	3	5	5	3	0	0	1
1988	0	3	4	1	1	8	14	13	5	0	0	1
1989	2	1	3	0	0	4	6	6	4	1	1	1
1990	0	5	1	1	0	4	11	8	9	0	2	1
1991	0	2	1	0	0	1	5	11	3	0	2	3
1992	2	M	M	M	0	1	11	M	M	M	M	M
1993	2	1	1	1	1	5	9	5	10	0	0	0
1994	2	1	0	2	3	6	18	10	0	0	0	0
1995	2	4	3	0	0	3	4	18	5	0	0	0
1996	1	2	0	1	2	6	13	14	9	1	0	0
1997	2	0	2	2	4	6	8	11	3	4	1	4
1998	0	2	3	1	2	5	10	12	7	3	1	0
1999	3	0	0	0	2	5	7	3	4	2	0	0
2000	3	2	2	0	2	7	11	9	2	0	0	0
2001	1	1	1	2	6	9	8	6	2	1	0	0

(M means Missing)

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Table - 3.2
(Number of Rainy Days at Mumbai)

Year	Month											
	Jan	Feb	Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec
1969	0	0	0	0	0	14	28	20	15	1	2	0
1970	0	0	0	1	1	18	19	27	17	5	0	0
1971	0	0	0	0	2	17	19	18	11	2	0	0
1972	0	1	0	0	0	0	22	12	6	0	1	0
1973	0	0	0	0	0	12	26	26	25	2	0	0
1974	0	0	0	1	3	10	24	26	18	10	0	0
1975	0	0	0	0	0	15	20	27	16	9	0	0
1976	0	0	0	0	0	15	24	22	16	0	2	0
1977	0	0	0	0	0	13	27	16	11	3	5	0
1978	0	0	0	0	0	19	24	23	13	2	3	1
1979	0	0	0	0	0	12	17	17	10	1	7	0
1980	0	0	0	0	0	15	17	25	10	2	2	2
1981	0	0	0	0	0	0	24	21	18	6	1	0
1982	0	0	0	0	0	0	20	24	15	0	2	0
1983	0	0	0	1	0	12	27	25	23	5	0	0
1984	0	1	0	0	0	14	24	19	9	3	0	0
1985	0	0	0	0	1	18	22	20	8	6	0	0
1986	0	0	0	0	0	16	16	15	6	0	2	1
1987	0	0	0	0	0	14	26	21	5	3	0	2
1988	0	0	0	0	0	17	27	24	25	3	0	0
1989	0	0	0	0	0	18	24	23	13	3	0	0
1990	0	1	1	0	5	13	23	27	21	6	0	0
1991	1	0	0	0	0	10	26	26	6	0	0	1
1992	0	0	0	0	0	9	22	22	11	3	0	0
1993	0	0	0	0	0	9	26	23	22	7	0	0
1994	1	0	0	0	1	13	28	21	16	2	0	0
1995	0	0	0	0	0	5	24	17	13	5	0	0
1996	0	0	0	0	0	12	29	25	15	6	0	0
1997	0	0	0	0	0	16	16	24	12	0	4	2
1998	0	0	0	0	0	16	22	19	14	12	2	0
1999	0	0	0	0	4	18	18	16	16	6	0	0
2000	0	0	0	0	7	4	19	19	7	4	0	1

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Table - 3.3
(Tendency of Number of Rainy Days at Delhi)

Month	Integral value just below AM	Integral value just above AM	Mode	Value of Tendency
January	1	2	2	2
February	1	2	2	2
March	1	2	2	2
April	1 (1 *)	2 (1 *)	0 & 1	1
May	1 (1 *)	2 (1 *)	0	1
June	4	5	4 , 5	4
July	10	11	11	11
August	9	10	NI	9
September	4	5	4	4
October	1 (0 *)	2 (1 *)	0	0
November	0	1	0	0
December	0	1	0	0

(* means the value obtained after excluding outliers & NI means Not Identifiable)

Table - 3.4
(Tendency of Number of Rainy Days at Mumbai)

Month	Integral value just below AM	Integral value just above AM	Mode	Value of Tendency
January	0	1	0	0
February	0	1	0	0
March	0	1	0	0
April	0	1	0	0
May	0	1	0	0
June	12	13	12	12
July	22	23	22	22
August	21	22	21	21
September	13	13	16	13
October	3	4	3	3
November	0	1	0	0
December	0	1	0	0

IV. RESULTS AND DISCUSSIONS

From the results, shown in **Table - 3.3**, it is found that no tendency of rainfall is experienced in the three months namely October, November and December at Delhi while Mumbai is experienced as having no tendency of rainfall in the seven months namely January, February, March, April, May, November and December. Maximum rainfall is experienced at Delhi in July while maximum rainfall is experienced at Mumbai in July and August (see **Table - 3.4**).

Each existing measure of central tendency results in value which lies in the middle part or central part of the associated data. However, tendency of data may not always be towards the central portion of the data in reality. There are situations in reality where the tendency of data is not towards the central / middle portion of the data but towards one end point of the data set. Findings of this study provide information that the value of central tendency of data may

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not always lie in the central part of the data set. It may lie at one end point of the data set. Thus, it is more appropriate to say "**measure of tendency of data**" than to say "**measure of central tendency of data**".

Finally, from the meaning of research [35 , 41 , 44], it can be concluded that the development of the formulation/method of determining tendency of integral valued numerical data as mentioned above can be regarded as research findings carrying fundamental importance and high significance in the theory of analysis of data specially in measuring tendency of data.

REFERENCES

[1] Atwar Rahman, Dhritikesh Chakrabarty (2009): "Linear Curve: A Simpler Method of Obtaining Least squares Estimates of Parameters', *Int. J. Agricult. Stat. Sci*., 5(2, 415 – 424.
[2] Atwar Rahman, Dhritikesh Chakrabarty.(2011): "General Linear Curve: A Simpler Method of Obtaining Least squares Estimates of Parameters", *Int. J. Agricult. Stat. Sci.*, 7(2), 429 – 440.
[3] Atwar Rahman, Dhritikesh Chakrabarty (2015): "Elimination of Parameters and Principle of Least Squares: Fitting of Linear Curve to Average Minimum Temperature Data in the Context of Assam", *IJESRT*, 4(2), 255 – 259. www.IJESRT.com .
[4] Atwar Rahman, Dhritikesh Chakrabarty (2015): "Elimination of Parameters and Principle of Least Squares: Fitting of Linear Curve to Average Maximum Temperature Data in the Context of Assam"' *AryaBhatta J. Math. & Info.*,7(1), 23 – 28. www.abjni.com .
[5] Atwar Rahman, Dhritikesh Chakrabarty (2015): "Basian-Markovian Principle in Fitting of Linear Curve", *THEIJES*, 4(6), 31 – 43. www.theijes.com .
[6] Atwar Rahman, Dhritikesh Chakrabarty (2015): "Basian-Markovian Principle in Fitting of Quadratic Curve", *IRJNAS*; 2(6), 186 – 210. www.aarf.asia .
[7] Atwar Rahman, Dhritikesh Chakrabarty (2015): "Method of Least Squares in Reverse Order: Fitting of Linear Curve to Average Maximum Temperature Data at Guwahati and Tezpur", *IJPAS*; 2(9), 24 – 38. www.ijmr.net.in .
[8] Atwar Rahman, Dhritikesh Chakrabarty (2015): "Method of Least Squares in Reverse Order: Fitting of Linear Curve to Average Minimum Temperature Data at Guwahati and Tezpur", *AryaBhatta J. Math. & Info*., 7(2), 305 – 312. www.abjni.com .
[9] Bakker Arthur (2003): 'The early history of average values and implications for education", *Journal of Statistics Education*, 11(1), 17 – 26.
[10] Barnard G. A. (1949): "Statistical Inference", *JRSS Series B*, 11, 115 – 149.
[11] Birnbaum Allan (1962): "On the Foundations of Statistical Inference", *JASA*, 57, 269 – 306.
[12] Christoph Riedweg (2005): "*Pythagoras: his life, teaching, and influence* (translated by Steven Rendall in collaboration with Christoph Riedweg and Andreas Schatzmann, Ithaca), ISBN 0-8014-4240-0, Cornell University Press.
[13] David W. Cantrell (---): "*Pythagorean Means*", Math World .
*[14] David A. Cox (*1984): "*The Arithmetic-Geometric Mean of Gauss", L'Enseignement Mathématique*, 30, 275 – 330.
[15] Dhritikesh Chakrabarty, Atwar Rahman. Exponential Curve (2007): "Estimation Using the Just Preceding Observation in Fitted Curve", *Int. J. Agricult. Stat. Sci*., 3(2), 381 – 386.
[16] Dhritikesh Chakrabarty & Atwar Rahman (2008): "Gompartz Curve: Estimation Using the Just Preceding Observation in Fitted Curve", *Int. J. Agricult. Stat. Sci*., 4(2), 421 – 424.
[17] Dhritikesh Chakrabarty (2014): "Temperature in Assam: Natural Extreme Value, *J. Chem. Bio. Phy. Sci. Sec. C*, 4(2), 1479 –1488. www.jcbsc.org .
[18] Dhritikesh Chakrabarty (2014): "Determination of Parameter from Observations Composed of Itself and Errors", *IJESIT*, 3(2), 304 – 311. www.ijesit.com .
[19] Dhritikesh Chakrabarty (2014): "Natural Interval of Monthly Extreme Temperature in the Context of Assam", *J. Chem. Bio. Phy. Sci. Sec. C*, 4(3), 2424 –2433. www.jcbsc.org .
[20] Dhritikesh Chakrabarty (2014): "Analysis of Errors Associated to Observations of Measurement Type", *IJEAR*, 1(1), 15 – 28. http://eses.net.in/online_journal.html .
[21] Dhritikesh Chakrabarty (2014): "Observation Composed of a Parameter and Chance Error: An Analytical Method of Determining the Parameter", *IJEAR*, 1(2), 20 – 38. http://eses.net.in/online_journal.html .
[22] Dhritikesh Chakrabarty (2015): "Central Tendency of Annual Extremum of Ambient Air Temperature at Guwahati", *JCBPS Sec. C*, 5(3), 2863 – 2877. www.jcbsc.org .
[23] Dhritikesh Chakrabarty {2015}: "Central Tendency of Annual Extremum of Ambient Air Temperature at Guwahati Based on Midrange and Median", *JCBPS Sec. D*, 5(3), 3193 – 3204. www.jcbsc.org .
[24] Dhritikesh Chakrabarty (2015): "Observation Composed of a Parameter and Chance Error: Determining the Parameter as Stable Mid Range", *IJEAR*, 2(1), 35 – 47. http://eses.net.in/online_journal.html .
[25] Dhritikesh Chakrabarty (2015): "A Method of Finding True Value of Parameter from Observation Containing Itself and Chance Error", *INDSRT*, 3(4), 14 – 21. http://www.indjsrt.com .
[26] Dhritikesh Chakrabarty (2015): "Theoretical Model Modified For Observed Data: Error Estimation Associated To Parameter", *IJEAR*, 2(2), 29 – 45. http://eses.net.in/online_journal.html .
[27] Dhritikesh Chakrabarty (2015 – 16): "Confidence Interval of Annual Extremum of Ambient Air Temperature at Guwahati", *JCBPS Sec. C*, 6(1), 192 – 203. www.jcbsc.org .
[28] Dhritikesh Chakrabarty (2016): Impact of Error Contained in Observed Data on Theoretical Model: Study of Some Important Situations", *IJARSET*, 3(1), 1255 – 1265. www.ijarset.com.
[29] Dhritikesh Chakrabarty (2016): "Theoretical Model and Model Satisfied by Observed Data: One Pair of Related Variables", *IJARSET*, 3(2), 1527 – 1534. www.ijarset.com.
[30] Dhritikesh Chakrabarty (2016): "Elimination-Minimization Principle: Fitting of Polynomial Curve to Numerical Data", *IJARSET*, 3(5), 2067 – 2078. www.ijarset.com .

ISSN: 2350-0328

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[31] Dhritikesh Chakrabarty (2016): "Elimination-Minimization Principle: Fitting of Exponential Curve to Numerical Data", *IJARSET*, 3(6), 2256 – 2264. www.ijarset.com.
[32] Dhritikesh Chakrabarty (2017): "Elimination-Minimization Principle: Fitting of Gompertz Curve to Numerical Data", *IJARSET*, 4(1), 3180 – 3189. www.ijarset.com .
[33] Dhritikesh Chakrabarty (2017): "Observations Containing Single Parameter and Random Errors: One Method of Evaluation of the Parameter", *JECET Sec. C*, 6(4), 432 – 449. www.jecet.org .
[34] Dhritikesh Chakrabarty (2017): "Numerical Data Containing One Parameter and Chance Error: Evaluation of the Parameter by Convergence of Statistic", *IJEAR*, 4(2), 59 – 73. http://eses.net.in/online_journal.html .
[35] Dhritikesh Chakrabarty (2018): "Understanding the Space of Research", *BBOAJ*, 4(5), 001 – 017. DOI: 10.19080/BBOAJ.2018.04.555642.
[36] Dhritikesh Chakrabarty (2018): "Derivation of Some Formulations of Average from One Technique of Construction of Mean", *American Journal of Mathematical and Computational Sciences*, 3(3), 62 – 68. http://www.aascit.org/journal/ajmcs .
[37] Dhritikesh Chakrabarty (2018): "One Generalized Definition of Average: Derivation of Formulations of Various Means", *JECET Sec. C*, 7(3), 212 – 225. www.jecet.org .
[38] Dhritikesh Chakrabarty (2018): "Observed Data Containing One Parameter and Chance Error: Evaluation of the Parameter Applying Pythagorean Mean", *IJEAR*, 5(1), 32 – 45. http://eses.net.in/online_journal.html .
[39] Dhritikesh Chakrabarty (2018): "f_H - Mean: One Generalized Definition of Average", *JECET Sec. C*, 7(4), 301 – 314. www.jecet.org .
[40] Dhritikesh Chakrabarty (2018): "Generalized f_G - Mean: Derivation of Various Formulations of Average", *American Journal of Computation, Communication and Control*, 5(3), 101 – 108. http://www.aascit.org/journal/ajmcs .
[41] Dhritikesh Chakrabarty (2018): "Statistics and Bioscience: Association in Research", *Significances of Bioengineering & Biosciences*, 2(5), 001–007. DOI: 10.31031/SBB.2018.02.000546.
[42] Dhritikesh Chakrabarty (2019): "One Definition of Generalized f_G - Mean: Derivation of Various Formulations of Average", *JECET Sec. C*, 8(2), 051– 066. www.jecet.org . DOI: 10.24214/jecet.C.8.2.05166.
[43] Dhritikesh Chakrabarty (2019): "Significance of Change of Rainfall: Confidence Interval of Annual Total Rainfall", *JCBPS Sec. C*, 9(3), 151–166. www.jcbsc.org . [DOI: 10.24214/jcbps.C.9.
[44] Dhritikesh Chakrabarty (2019): "Association of Statistics with Biostatistics Research", *BBIJ*, 8(3), 104–109. DOI: 10.15406/bbij.2019.08.00279 .
[45] Dhritikesh Chakrabarty (2019): "Observed Data Containing One Parameter and Chance Error: Probabilistic Evaluation of Parameter by Pythagorean Mean", *IJEAR*, 6(1), 24 – 40. http://eses.net.in/online_journal.html .
[46] Dhritikesh Chakrabarty (2019): "Significance of Change in Ambient Air Temperature in the Context of India", *JCBPS Sec. C*, 9(4), 251 – 261. www.jcbsc.org . DOI: 10.24214/jcbps.C.9.4.25161.
[47] Dhritikesh Chakrabarty. One General Method of Defining Average: Derivation of Definitions/Formulations of Various Means. JECET Sec. C 2019;8(4):32–338. www.jecet.org . DOI: 10.24214/jecet.C.8.4.32738.
[48] Dhritikesh Chakrabarty (2019): "A General Method of Defining Average of Function of a Set of Values", . *Aryabhatta Journal of Mathematics & Informatics*, 11(2), 269 – 284. www.abjni.com .
[49] Dhritikesh Chakrabarty (2019): "Arithmetic-Geometric Mean: Evaluation of Parameter from Observed Data Containing Itself and Random Error", *IJEAR*, 6(2), 98 – 111. http://eses.net.in/online_journal.html .
[50] Dhritikesh Chakrabarty (2020): "Definition / Formulation of Average from First Principle", *JECET Sec. C*, 9(2), 151 – 163. www.jecet.org . DOI: 10.24214/jecet.C.9.2.15163.
[51] Dhritikesh Chakrabarty (2020): "AGM: A Technique of Determining the Value of Parameter from Observed Data Containing Itself and Random Error", *JECET*, 9(3), 473 – 486. www.jecet.org . DOI: 10.24214/jecet.C.9.3.47386.
[52] Dhritikesh Chakrabarty (2020): "AHM: A Measure of the Value of Parameter μ of the Model $X = \mu + \varepsilon$ ", *IJARSET*, 7(10), 15268 – 15276. www.ijarset.com .
[53] Dhritikesh Chakrabarty (2020): "Arithmetic-Harmonic Mean: Evaluation of Parameter from Observed Data Containing Itself and Random Error", *IJEAR*, 7(1), 29 – 45. http://eses.net.in/online_journal.html .
[54] Dhritikesh Chakrabarty (2020): "Determination of the Value of Parameter μ of the Model $X = \mu + \varepsilon$ by GHM", *IJARSET*, 7(11), 15801 – 15810. www.ijarset.com .
[55] Dhritikesh Chakrabarty (2020): "Central Tendency of Annual Extremum of Surface Air Temperature at Guwahati by AGHM", *IJARSET*, 7(12), 16088 – 16098. www.ijarset.com .
[56] Dhritikesh Chakrabarty (2020): "AGHM as A Tool of Evaluating the Parameter from Observed Data Containing Itself and Random Error", *IJEAR*, 7(2), 05 – 23. http://eses.net.in/online_journal.html .
[57] Dhritikesh Chakrabarty. AGM, AHM, GHM & AGHM: Evaluation of Parameter μ of the Model $X = \mu + \varepsilon$. IJARSET 2021;8(2):16691–16699. www.ijarset.com .
[58] Dhritikesh Chakrabarty(2021): "Comparison of Measures of Parameter of the Model $X = \mu + \varepsilon$ Based On Pythagorean Means", *IJARSET*, 8(3), 16948 – 16956. www.ijarset.com .
[59] Dhritikesh Chakrabarty (2021): "AHM as A Measure of Central Tendency of Sex Ratio", *BBIJ*, 10(2), 50 – 57. http://medcraveonline.com . DOI: 10.15406/bbij.2021.10.00330 .
[60] Dhritikesh Chakrabarty (2021): "Arithmetic-Harmonic Mean: A Measure of Central Tendency of Ratio-Type Data", *IJARSET*, 8(5), 17324 – 17333. www.ijarset.com .
[61] Dhritikesh Chakrabarty (2021): "Four Formulations of Average Derived from Pythagorean Means", *IJMTT*, 67(6), 97 – 118. http://www.ijmttjournal.org . Doi:10.14445/22315373/IJMTT-V67I6P512 .
[62] Dhritikesh Chakrabarty (2021): "Recent Development on General Method of Defining Average: A Brief Outline", *IJARSET*, 8(8), 17947 – 17955. www.ijarset.com .
[63] Dhritikesh Chakrabarty (2021): "Model Describing Central Tendency of Data", *IJARSET*, 8(9), 18193 – 18201. www.ijarset.com .
[64] Dhritikesh Chakrabarty (2021): "Annual Total Rainfall in India: Confidence Interval and Significance of Change", *IJARSET*, 8(11), 18540 – 18550. www.ijarset.com .

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[65] Dhritikesh Chakrabarty (2021): "Measuremental Data: Seven Measures of Central Tendency", *IJEAR*, 8(1), 15 – 24. http://eses.net.in/online_journal.html .
[66] Dhritikesh Chakrabarty (2021): "Sex Ratio and Seven Measures of Central Tendency", *International Journal of Electronics and Applied Research* (ISSN : 2395 – 0064), 8(2), 31 – 50. http://eses.net.in/online_journal.html .
[67] Dhritikesh Chakrabarty (2022): "AGM, AHM, GHM & AGH: Measures of Central Tendency of Data", *International Journal of Electronics and Applied Research* (ISSN : 2395 – 0064), 9(1). http://eses.net.in/online_journal.html .
[68] Dhritikesh Chakrabarty (2022): "Integral Valued Numerical Data: Measure of Central Tendency", *Partners Universal International Research Journal* (*PUIRJ*), 01(03), 74 – 82. www.puirj.com . DOI:10.5281/zenodo.7123662 .
[69] Dhritikesh Chakrabarty (2022): "GM of AM and HM: A Measure of Central Tendency of Sex Ratio", *International Journal of Advanced Research in Science, Engineering and Technology*, (ISSN : 2350 – 0328), 9(11), 20125 – 20133. www.ijarset.com .
[70] Dhritikesh Chakrabarty (2022): "Integral Valued Numerical Data: Measure of Tendency", NaSAEAST-2022, *Abstract ID: CMAST_NaSAEAST-22-01 (I)*. https://www.researchgate.net/profile/Dhritikesh_Chakrabarty/stats .
[71] Hald Anders (1999): "On the History of Maximum Likelihood in Relation to Inverse Probability and Least Squares", Statistical Science , 14, 214 – 222.
[72] Hazewinkel, Michiel *ed (2001): "*Arithmetic–Geometric Mean Process", *Encyclopedia of Mathematics, Springer Science+Business Media B.V. / Kluwer Academic Publishers*, ISBN 978-1-55608-010-4 .
[73] Ivory (1825): "On the Method of Least Squares", *Phil. Mag*, LXV, 3 – 10.
[74] Kendall M. G. and Stuart A (1977): "*Advanced Theory of Statistics* Vol. 1 & 2", 4th Edition. New York. Hafner Press.
[75] Kolmogorov Andrey (1930): "On the Notion of Mean", *Mathematics and Mechanics* (Kluwer 1991), 44 – 146.
[76] Kolmogorov Andrey (1933): "Grundbegriffe der Wahrscheinlichkeitsrechnung", Berlin: Julius Springer
[77] Lehmann Erich L. & Casella George (1998): "*Theory of Point Estimation*", Springer.. ISBN 0 – 387 – 98502 – 6.
[78] Lucien Le Cam (1990): "Maximum likelihood — An introduction", *ISI Review*, 8(2), 153 – 171.
[79] Miguel de Carvalho (2016): "Mean, what do you Mean?", *The American Statistician*, 70, 764 – 776.
[80] Walker Helen M. & Lev J. (1965): "*Statistical Inference*", Oxford & IBH Publishing Company.
[81] Williams R. (1984): "Measures of central tendency", *In Introduction to Statistics for Geographers and Earth Scientists*, Springer; 51 – 60.
[82] Youschkevitch A. P. & Kolmogorov A. N. (1983): "Historian and philosopher of mathematics on the occasion of his 80th birfhday", *Historia Mathematica*, 10(4), 383 – 395.

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Dr. Dhritikesh Chakrabarty passed B.Sc. (with Honours in Statistics) Examination from Darrang College, Gauhati University, in 1981 securing 1st class &1st position. He passed M.Sc. Examination (in Statistics) from the same university in the year 1983 securing 1st class & 1st position and successively passed M.Sc. Examination (in Mathematics) from the same university in 1987 securing 1st class (5th position). He obtained the degree of Ph.D. (in Statistics) in the year 1993 from Gauhati University. Later on, he obtained the degree of Sangeet Visharad (inVocal Music) in the year 2000 from Bhatkhande Sangeet vidyapith securing 1st class, the degree of Sangeet Visharad (in Tabla) from Pracheen Kala Kendra in 2010 securing 2nd class, the degree of Sangeet Pravakar (in Tabla) from Prayag Sangeet Samiti in 2012 securing 1st class, the degree of Sangeet Bhaskar (in Tabla) from Pracheen Kala Kendra in 2014 securing 1st class and Sangeet Pravakar (in Guitar) from Prayag Sangeet Samiti in 2021 securing 1st class. He obtained Jawaharlal Nehru Award for securing 1st position in Degree Examination in the year 1981. He also obtained Academic Gold Medal of Gauhati University and Prof. V. D. Thawani Academic Award for securing 1st position in Post Graduate Examination in the year 1983.

Dr. Dhritikesh Chakrabarty also did post doctoral research under the Post Doctoral Research Award by the University Grants Commission for the period 2002 – 05.

He attended five of orientation/refresher course held in Gauhati University, Indian Statistical Institute, University of Calicut and Cochin University of Science & Technology sponsored/organized by University Grants Commission/Indian Academy of Science. He also attended/participated eleven workshops/training programmes of different fields at various institutes.

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(Dr. Dhritikesh Chakrabarty with his students in his last official working day (December 31, 2021) at Handique Girls' College)

Dr. Dhritikesh Chakrabarty served Handique Girls' College, Gauhati University, during the period of 34 years from December 09, 1987 to December 31, 2021, as Professor (first Assistant and then Associate) in the Department of Statistics along with Head of the Department for 9 years and also as Vice Principal of the college. He also served the National Institute of Pharmaceutical Education & Research (NIPER) Guwahati, as guest faculty (teacher cum research guide), during the period from May, 2010 to December, 2016. Moreover, he is a Research Guide (Ph.D. Guide) in the Department of Statistics of Gauhati University and also a Research Guide (Ph.D. Guide) in the Department of Statistics of Assam Down Town University. He has been guiding a number of Ph.D. students in the two universities. He acted as Guest Faculty in the Department of Statistics and also in the Department of Physics of Gauhati University. He also acted as Guest Faculty cum Resource Person in the Ph.D. Course work Programme in the Department of Computer Science and also in the Department of Biotechnology of the same University for the last six years. Dr. Chakrabarty has been working as an independent researcher for the last more than thirty years. He has already been an author of 250 published research items namely research papers, chapter in books / conference proceedings, books etc. He visited U.S.A. in 2007, Canada in 2011, U.K. in 2014 and Taiwan in 2017. He has already completed one post doctoral research project (2002 – 05) and one minor research project (2010 – 11). He is an active life member of the academic

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cum research organizations namely (1) Assam Science Society (ASS), (2) Assam Statistical Review (ASR), (3) Indian Statistical Association (ISA), (4) Indian Society for Probability & Statistics (ISPS), (5) Forum for Interdisciplinary Mathematics (FIM), (6) Electronics Scientists & Engineers Society (ESES) and (7) International Association of Engineers (IAENG). Moreover, he is a Reviewer/Referee of (1) Journal of Assam Science Society (JASS) & (2) Biometrics & Biostatistics International Journal (BBIJ); a member of the executive committee of Electronic Scientists and Engineers Society (ESES); and a Member of the Editorial Board of (1) Journal of Environmental Science, Computer Science and Engineering & Technology (JECET), (2) Journal of Mathematics and System Science (JMSS) & (3) Partners Universal International Research Journal (PUIRJ). Dr. Chakrabarty acted as members (at various capacities) of the organizing committees of a number of conferences/seminars already held.

Dr. Chakrabarty was awarded with the prestigious SAS Eminent Fellow Membership (SEFM) with membership ID No. SAS/SEFM/132/2022 by Scholars Academic and Scientific Society (SAS Society) on March 27, 2022.