JCBPS: Section D: May 2015-July 2015, Vol. 5, No. 3; 3193-3204. E- ISSN: 2249 –1929

Journal of Chemical, Biological and Physical Sciences

An International Peer Review E-3 Journal of Sciences

Available online atwww.jcbsc.org

Section D: Environmental Sciences

CODEN (USA): JCBPAT Research Article

Central Tendency of Annual Extremum of Ambient Air Temperature at Guwahati Based on Midrange and Median

Dhritikesh Chakrabarty

Department of Statistics, Handique Girls' College, Guwahati, Assam, India

Received: 8 July 2015**; Revised:** 21 July 2015; **Accepted:** 29 July 2015

Abstract: An analytical method, based on the stability property of the midrange and symmetry property of normal distribution has been developed for determining the true value of the central tendency of annual extremum of ambient air temperature at a location. The method has been applied to determine the value of the central tendency of each of annual maximum and annual minimum of ambient air temperature at Guwahati based on the data since the year 1969 onwards. Determination of these two values is based on the assumption that change in temperature over years during the period for which data are available occurs due to chance cause only but not due to any assignable cause. The values of these two have been found to be 37.2 Degree Celsius and 7.4 Degree Celsius respectively.

Keyword: Annual maximum, annual minimum, ambient air temperature, Guwahati, midrange, median, analytical method of determination.

INTRODUCTION

There are many situations where observations are composed of some parameter and chance errors[1]. Change in temperature at a location over temperature periodic year (abbreviated, in this article, as TPY) corresponds to such a situation.

Temperature at a location attains at a maximum and at a minimum during a TPY [2, 9, 13 & 14]. The extremum occurred during a TPY is termed, in this paper, as the annual extremum. The annual extremum of temperature at a location is to remain the same provided there is no cause(s) influencing upon the change in temperature at the location other than the chance error which is universal [1, 2, 6 & 13].

For this reason, variation occurs among the observations on annual maximum as well as an annual minimum. Though variation exists, each of annual maximum and of annual minimum temperature has a central tendency. Thus, if

$$X_1 , X_2 , \ldots\ldots\ldots , X_n$$

are observations on the annual maximum (or annual minimum) of the ambient air temperature at the location with μ as its central tendency and if the variation among the observations occurs due to chance cause only,

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

where $\varepsilon_1 , \varepsilon_2 , \ldots\ldots\ldots , \varepsilon_n$ are the values of the chance error associated to $X_1 , X_2 , \ldots\ldots\ldots\ldots , X_n$ respectively.

The existing statistical methods of estimation namely least squares method, maximum likelihood method, minimum variance unbiased method, method of moment and method of minimum chi-square etc. provide

$$\bar{X} = n^{-1} \sum_{i=1}^{n} X_i \tag{1.2}$$

as an estimator of the central tendency μ [1 , 6 , 10 , 13 , 14 & 21].

This estimator, however, suffers from an error $e = e\,(\varepsilon_1 , \varepsilon_2 , \ldots\ldots\ldots\ldots , \varepsilon_n)$ given by

$$e = e\,(\varepsilon_1 , \varepsilon_2 , \ldots\ldots\ldots\ldots , \varepsilon_n) = \bar{\varepsilon}_i = n^{-1} \sum_{i=1}^{n} \varepsilon_i \tag{1.3}$$

which may not be zero [1 , 6 , 13 & 15].

In other words, none of these methods can provide the true value of the parameter μ. A method has been developed by Chakrabarty [1 , 2 & 9] for determining almost certain interval for the parameter μ. The method is based on the area property of normal probability distribution [9-14]. In another study, Chakrabarty [1 & 6] has developed an analytical method for determining the true value of the parameter μ in the situation where the observations are composed of the parameter itself and chance errors. This method is based on the idea of finding the sufficient shortest interval value for the parameter μ using order statistics. In this method, it is required to exclude two extreme observations in a cumulative manner for computing interval value at every stage in order to obtain the sufficient shortest interval. This method, however, fails in the situation where insufficient observations are remained after exclusion of the extreme observations at some stage before obtaining the sufficient shortest interval. A method for the same has therefore been developed in order to overcome this inconvenience which is also based on the same idea of finding the sufficient shortest interval value for the parameter μ using order statistics, but free from the exclusion of two extreme observations in a cumulative manner for computing interval value at every stage in order to obtain the sufficient shortest interval[1 & 6]. This paper is based on the development of this method and on one numerical application of the method in determining the value of the central tendency of each of the annual maximum and the annual minimum of the ambient air temperature at Guwahati. The determination of these two values is based on the assumption that the variation among the observations used in determination occurs due to chance cause only.

The method developed is based on the theory of normal probability distribution discovered by a German mathematician Carl Friedrich Gauss [17] in the year 1809, the credit for which discovery is also given by some authors to a French mathematician Abraham[16 & 20] who published a paper in 1738 that showed the normal distribution as an approximation to the binomial distribution discovered by James Bernoulli [5, 8 & 19] in the year 1713. The normal distribution [3, 4, 7, 12 & 18] is described by the probability density function

$$f(x : \mu , \sigma) = \{ \sigma (2\pi)^{½} \}^{-1} \; exp [- ½\{(x - \mu)/\sigma\}^2] , \tag{1.4}$$

$$- \infty < x < \infty , \; - \infty < \mu < \infty , \; 0 < \sigma < \infty .$$

where (i) X is the associated normal variable,

(ii) μ & σ are the two parameters of the distribution and

(iii) Mean of X = μ & Standard Deviation of $X = \sigma$.

For a normal distribution mean, median and mode are equal. Moreover, the midrange of the distribution coincides with each of them.

DEVELOPMENT OF THE METHOD

Let

$$X_1 , X_2 , \ldots\ldots\ldots\ldots , X_n$$

be the observations on the annual extremum (maximum or minimum) of the ambient air temperature at a location in the years

$$1 , 2 , 3 , \ldots\ldots\ldots\ldots\ldots , n$$

respectively.

(If the available observations are not distinct, one can extract the distinct observations from them.)

If μ is the central tendency of the annual extremum of the ambient air temperature at the location and if the variation among the observations occurs due to chance cause only,

$$X_i = \mu + \varepsilon_i \quad , \quad (i = 1 , 2 , \ldots\ldots\ldots\ldots , n) \tag{2.1}$$

where $\varepsilon_1 , \varepsilon_2 , \ldots\ldots\ldots\ldots , \varepsilon_n$ are the values of the chance error variable ε associated to $X_1 , X_2 , \ldots\ldots\ldots\ldots , X_n$ respectively.

It is to be noted that

(1) $X_1 , X_2 , \ldots\ldots\ldots\ldots , X_n$ are known,

(2) $\mu , \varepsilon_1 , \varepsilon_2 , \ldots\ldots\ldots\ldots , \varepsilon_n$ are unknown

& (3) the number of linear equations in (2.1) is n with $(n + 1)$ unknowns implying that the equations are not solvable mathematically.

Reasonable facts /Assumptions regarding ε_i:

(1) $\varepsilon_1 , \varepsilon_2 , \ldots\ldots\ldots\ldots , \varepsilon_n$ are unknown values of the variables ε.

(2) The values $\varepsilon_1 , \varepsilon_2 , \ldots\ldots\ldots , \varepsilon_n$ are very small relative to the respective values $X_1 , X_2 , \ldots\ldots\ldots X_n$.

(3) The variable ε assumes both positive and negative values.

(4) $P(- a - da < \varepsilon < - a) = P(a < \varepsilon < a + da)$ for every real a.

(5) $P(a < \varepsilon < a + da) > P(b < \varepsilon < b + db)$

& $P(- a - da < \varepsilon < - a) < P(- b - db < \varepsilon < - b)$

for every real positive $a < b$.

(6) The facts (3), (4) & (5) together imply that ε obeys the normal probability law.

(7) The sum of all possible values of each ε is 0 (zero) which together with the fact (6) implies that

$E(\varepsilon) = 0$.

(8) Standard deviation of ε is unknown and small, say σ_ε.

(9) The facts (6), (7) & (8) together imply that ε obeys the normal probability law with *a* mean (expectation) 0 & standard deviation σ_ε. Thus

$$\varepsilon \sim N(0 , \sigma_\varepsilon) \tag{2.2}$$

Note (2.1): Since

$$\varepsilon_1 , \varepsilon_2 , \ldots\ldots\ldots\ldots , \varepsilon_n$$

are independently and identically distributed $N(0 , \sigma_\varepsilon)$ varieties,

their mean defined by

$$\bar{\varepsilon}_i = n^{-1} \sum_{i=1}^{n} \varepsilon_i$$

is a $N(0 , \sigma_\varepsilon/\sqrt{n})$ variate.

The method:

Assumptions (3) & (4) imply that if the chance error ε can assume the positive value 'a' then it can also assume the value '$-a$'.

This implies that the midrange of ε is 0 (zero).

However, the midrange of a few observations on ε may not be 0.

But since the distribution of ε is normal with central tendency 0, the distribution of large numbers (more than 30) of observations on ε will be approximated by the normal distribution with central tendency 0 and/or the distribution of n observations of the chance error ε will more and more closer to the normal distribution with the same central tendency as n becomes more and more large.

This implies that the midrange of n observations on ε will be more and more close to 0 as n becomes more and more large. Moreover, if the value of the midrange attains 0, it will be stable.

Thus the stable value of the midrange of the observations on ε will be the true value of the central tendency of ε.

Consequently, the stable value of the midrange of the observations on X will be the true value of the central tendency of X.

If the k observations

$$X_1 , X_2 , \ldots\ldots\ldots\ldots , X_k$$

are arranged in ascending order of magnitude as

$$X_{(1)} < X_{(2)} < \ldots\ldots\ldots\ldots < X_{(k)} \quad , \tag{2.3}$$

then the midrange of the observations is given by

$$½ \{X_{(1)} + X_{(k)}\}$$

Ambient air Temperature at Guwahati:

Observations on annual maximum and annual minimum of the ambient air temperature at Guwahati, which have been collected from the meteorological department of India, are available from the year 1969 to the year 2013. These have been presented in Table–1 and Table–4 respectively.

Central Tendency of the Annual Maximum:

Observed values of the annual maximum of the ambient air Temperature at Guwahati observed during the period from 1969 to 2013 have been collected from the meteorological department of India. These have been presented in Table–1.

Computation of the values of the midrange of the cumulative observations has been shown in Table–2.

It has been observed in Table –2, that since the temperature, periodic year number 30 onwards the value of the midrange has become stable with the stabilized value 37.5.

One can observe that 29 observations lie below 37.5 and 12 observations lie above 37.5.

Thus, 37.5 cannot be the median.

Therefore, by the symmetric property of normal distribution, the central tendency of the annual maximum of the ambient air temperature in Guwahati cannot be 37.5 degree Celsius.

However, if the most extreme (highest) observation "39.9" is excluded, then the values of the midrange obtained have been shown in the in Table –3.

Tables of Annual Maximum of Ambient Air Temperature at Guwahati:

Table–1: Observed Value on Highest Maximum Temperature (in Degree Celsius) occurred during the Temperature Periodic Year

Year No	Observed Value	Calendar Year, Month & Date of occurrence	Year No	Observed Value	Calendar Year, Month & Date of occurrence
1	37.1	1969, May, 20	23	37.4	1991, July, 20
2	36.6	1970, April,01	24	39.4	1992, April, 16
3	36.0	1971, March, 27	25	36.4	1993, September, 08
4	35.7	1972, July, 14	26	38.1	1994, May, 07
5	39.0	1973, April,10	27	36.3	1995, May, 14
6	36.1	1974, August, 14	28	39.9	1996, April, 19
7	39.2	1975, April, 10	29	37.4	1998, May 21
8	39.0	1976, April,17	30	37.5	2000, May, 13
9	35.3	1977, August, 14	31	36.7	2001, April,07
10	36.8	1978, May, 19	32	35.5	2002, May, 17
11	38.6	1979, March, 27	33	37.4	2003, July, 26
12	35.1	1980, July, 01	34	38.0	2004, March, 28
13	35.8	1981, June, 21	35	36.6	2005, July, 30
14	36.5	1982, May, 26	36	38.0	2006, August, 11
15	36.7	1983, April, 06	37	37.3	2007, May, 06
16	37.2	1984, April, 06	38	37.3	2008, August, 08
17	36.5	1985, April,26	39	38.0	2009, May, 23
18	38.4	1986, April,03	40	37.2	2010, July, 03
19	37.2	1987, May, 19	41	37.3	2011, August, 30
20	36.4	1988, August, 03	42	**37.4**	2012, April,03
21	36.7	1989, July, 23	43	38.8	2013, June, 12
22	36.0	1990, September, 02			

Table– 2: Value of Midrange of the Observed Values on Highest Maximum Temperature (in Degree Celsius) occurred during the Temperature Periodic Year

Year No	Observed Value	Extreme values of the observations up to the period Min. , Max.	Mid-Range	Year No	Observed Value	Extreme values of the observations up to the period Min. , Max.	Mid-Range
1	37.1			23	37.4	35.1 , 39.2	37.15
2	36.6	36.6 , 37.1	36.85	24	39.4	35.1 , 39.4	37.25
3	36.0	36.0 , 37.1	36.85	25	36.4	35.1 , 39.4	37.25
4	35.7	35.7 , 37.1	36.4	26	38.1	35.1 , 39.4	37.25
5	39.0	35.7 , 39.0	37.35	27	36.3	35.1 , 39.4	37.25
6	36.1	35.7 , 39.0	37.35	28	39.9	35.1 , 39.9	37.5
7	39.2	35.7 , 39.2	37.45	29	37.4	35.1 , 39.9	37.5
8	39.0	35.7 , 39.2	37.45	30	37.5	35.1 , 39.9	37.5
9	35.3	35.3 , 39.2	37.25	31	36.7	35.1 , 39.9	37.5
10	36.8	35.3 , 39.2	37.25	32	35.5	35.1 , 39.9	37.5
11	38.6	35.3 , 39.2	37.25	33	37.4	35.1 , 39.9	37.5
12	35.1	35.1 , 39.2	37.15	34	38.0	35.1 , 39.9	37.5
13	35.8	35.1 , 39.2	37.15	35	36.6	35.1 , 39.9	37.5
14	36.5	35.1 , 39.2	37.15	36	38.0	35.1 , 39.9	37.5
15	36.7	35.1 , 39.2	37.15	37	37.3	35.1 , 39.9	37.5
16	37.2	35.1 , 39.2	37.15	38	37.3	35.1 , 39.9	37.5
17	36.5	35.1 , 39.2	37.15	39	38.0	35.1 , 39.9	37.5
18	38.4	35.1 , 39.2	37.15	40	37.2	35.1 , 39.9	37.5
19	37.2	35.1 , 39.2	37.15	41	37.3	35.1 , 39.9	37.5
20	36.4	35.1 , 39.2	37.15	42	37.4	35.1 , 39.9	37.5
21	36.7	35.1 , 39.2	37.15	43	38.8	35.1 , 39.9	37.5
22	36.0	35.1 , 39.2	37.15				

In this case, it is found (in Table –3) that 20 observations lie below 37.2 and 20 observations above the observation “37.2”.

Also, the observation “37.2” has appeared thrice.

Thus “37.2” is the median of the observations.

Moreover, in this case, the stable value of the midrange from the periodic year number 30 onwards is 37.25.

Therefore, by the symmetric property of normal distribution, the central tendency of the annual maximum of the ambient air temperature in Guwahati can be regarded as 37.2 degree Celsius.

Table–3: Value of Midrange of the Observed Values on Highest Maximum Temperature (in Degree Celsius) occurred during the Temperature Periodic Year

Year No	Observed Value	Extreme values of the observations up to the period Min. , Max.	Mid-Range	Year No	Observed Value	Extreme values of the observations up to the period Min. , Max.	Mid-Range
1	37.1			23	37.4	35.1 , 39.2	37.15
2	36.6	36.6 , 37.1	36.85	24	39.4	35.1 , 39.4	37.25
3	36.0	36.0 , 37.1	36.85	25	36.4	35.1 , 39.4	37.25
4	35.7	35.7 , 37.1	36.4	26	38.1	35.1 , 39.4	37.25
5	39.0	35.7 , 39.0	37.35	27	36.3	35.1 , 39.4	37.25
6	36.1	35.7 , 39.0	37.35	28	-	-	-
7	39.2	35.7 , 39.2	37.45	29	37.4	35.1 , 39.4	37.25
8	39.0	35.7 , 39.2	37.45	30	37.5	35.1 , 39.4	37.25
9	35.3	35.3 , 39.2	37.25	31	36.7	35.1 , 39.4	37.25
10	36.8	35.3 , 39.2	37.25	32	35.5	35.1 , 39.4	37.25
11	38.6	35.3 , 39.2	37.25	33	37.4	35.1 , 39.4	37.25
12	35.1	35.1 , 39.2	37.15	34	38.0	35.1 , 39.4	37.25
13	35.8	35.1 , 39.2	37.15	35	36.6	35.1 , 39.4	37.25
14	36.5	35.1 , 39.2	37.15	36	38.0	35.1 , 39.4	37.25
15	36.7	35.1 , 39.2	37.15	37	37.3	35.1 , 39.4	37.25
16	37.2	35.1 , 39.2	37.15	38	37.3	35.1 , 39.4	37.25
17	36.5	35.1 , 39.2	37.15	39	38.0	35.1 , 39.4	37.25
18	38.4	35.1 , 39.2	37.15	40	37.2	35.1 , 39.4	37.25
19	37.2	35.1 , 39.2	37.15	41	37.3	35.1 , 39.4	37.25
20	36.4	35.1 , 39.2	37.15	42	37.4	35.1 , 39.4	37.25
21	36.7	35.1 , 39.2	37.15	43	38.8	35.1 , 39.4	37.25
22	36.0	35.1 , 39.2	37.15				

Central Tendency of the Annual Minimum:

Observed values of the annual minimum of the ambient air Temperature at Guwahati observed during the period from 1969 to 2013 have been collected from the meteorological department of India as in[8, 1].These have been presented in Table – 4. Computation of the values of the midrange of the cumulative observations has been shown in Table – 5.

It has been observed in Table – 5, that from the temperature, periodic year number 31, the value of the midrange has become stable with the stabilized value 7.15 up to the period number 39 and then again from the year number 40 onwards the value of the midrange has become stable with the stabilized value 7.4.

One can observe that 19 observations lie below 7.4 and 19 observations lie above 7.5 whereas each of "7.4" and "75" occurs 2 times.
Thus, median of the observations lies between 7.4 and 75
i.e. 7.4 < Median < 7.5

Tables for Annual Minimum of Ambient Air Temperature at Guwahati:

Table–4: Observed Value on Lowest Minimum Temperature (in Degree Celsius) occurred during the Temperature Periodic Year

Year No	Observed Value	Calendar Year, Month & Date of occurrence	Year No	Observed Value	Calendar Year, Month & Date of occurrence
1	6.6	1969, January,16	23	7.4	1991, January, 20
2	6.6	1969, December, 27	24	5.9	1992, January, 05
3	5.9	1971, January, 31 & February, 01	25	8.4	1993, February, 23
4	8.2	1972, January, 21	26	7.8	1993, December, 27
5	5.0	1973, February, 03	27	7.5	1995, January, 22
6	6.3	1974, February, 07	28	9.4	1996, January,19
7	7.4	1975, January, 19	29	NA	Not Available
8	6.6	1976, January, 22	30	NA	Not Available
9	6.2	1977, January, 30	31	NA	Not Available
10	7.3	1978, January, 12	32	8.9	2001, January, 08
11	6.2	1979, January,09	33	8.6	2002, January, 26
12	6.4	1980, February, 08	34	8.0	2003, January, 16
13	7.5	1981, January,10	35	7.9	2004, February, 04
14	8.3	1982, February, 07	36	6.7	2004, December, 27
15	4.9	1983, January, 06	37	9.6	2006, January, 12
16	6.1	1984, January, 30	38	6.4	2007, January, 18
17	7.8	1985, January, 19	39	7.8	2008, February, 03
18	8.6	1986, January, 20	40	9.9	2009, January, 07
19	7.7	1987, January, 05	41	8.6	2010, January, 03
20	9.2	1988, January, 01	42	7.0	2011, January, 21
21	6.7	1989, January, 14	43	6.4	2012, January, 15
22	8.6	1989, December, 31	44	5.6	2013, January, 11

Table–5: Value of Midrange of the Observed Values on Lowest Minimum Temperature (in Degree Celsius) occurred during the Temperature Periodic Year

Year No	Observed Value	Extreme values of the observations up to the period Min. , Max.	Mid-Range	Year No	Observed Value	Extreme values of the observations up to the period Min. , Max.	Mid-Range
1	6.6			23	7.4	4.9 , 9.2	7.05
2	6.6			24	5.9	4.9 , 9.2	7.05
3	5.9	5.9 , 6.6	6.25	25	8.4	4.9 , 9.2	7.05
4	8.2	5.9 , 6.6	6.25	26	7.8	4.9 , 9.2	7.05
5	5.0	5.0 , 6.6	5.8	27	7.5	4.9 , 9.2	7.05
6	6.3	5.0 , 6.6	5.8	28	9.4	4.9 , 9.4	7.15
7	7.4	5.0 , 7.4	6.2	29	8.3	4.9 , 9.4	7.15
8	6.6	5.0 , 7.4	6.2	30	8.9	4.9 , 9.4	7.15
9	6.2	5.0 , 7.4	6.2	31	8.6	4.9 , 9.4	7.15
10	7.3	5.0 , 7.4	6.2	32	8.0	4.9 , 9.4	7.15
11	6.2	5.0 , 7.4	6.2	33	7.9	4.9 , 9.4	7.15
12	6.4	5.0 , 7.4	6.2	34	6.7	4.9 , 9.4	7.15
13	7.5	5.0 , 7.5	6.25	35	9.6	4.9 , 9.6	7.25
14	8.3	5.0 , 8.3	6.65	36	6.4	4.9 , 9.6	7.25
15	4.9	4.9 , 8.3	6.6	37	7.8	4.9 , 9.6	7.25
16	6.1	4.9 , 8.3	6.6	38	9.9	4.9 , 9.9	7.4
17	7.8	4.9 , 8.3	6.6	39	8.6	4.9 , 9.9	7.4
18	8.6	4.9 , 8.6	6,75	40	7.0	4.9 , 9.9	7.4
19	7.7	4.9 , 8.6	6,75	41	6.4	4.9 , 9.9	7.4
20	9.2	4.9 , 9.2	7.05	42	5.6	4.9 , 9.9	7.4
21	6.7	4.9 , 9.2	7.05	43			
22	8.6	4.9 , 9.2	7.05	44			

Now, since the value of the midrange for large numbers ($\geq$ 38) of observations has been found at 7.4 and the median of them as just greater than 7.4 but less than 7.5, the value of the central tendency of the observations, by the symmetric property of normal distribution, will be 7.4

Again, if the observations are arranged in order, the observation '7.4' lies at the middle position.

This also means, 7.4 is the median of the observations.

Therefore, by the symmetric property of normal distribution, the central tendency of the annual maximum of the ambient air temperature in Guwahati can be regarded as 7.4 degree Celsius.

CONCLUSION

Each of the existing statistical methods of estimation provides an estimate of the central tendency of the annual extremum of the ambient air temperature which suffers from an error though may be small. Moreover, the amount of error involved in this estimate is unknown. The method developed here provides an estimate which is free from error.

The determination of central tendency of the extremum of ambient air temperature at Guwahati is based on the assumption that change in temperature at this location over time, during the period for which data are available, occurs due to chance cause only but not due to any assignable cause.

Thus, if the assumption is true, the values of the central tendency of annual maximum and annual minimum of the ambient air temperature at Guwahati namely 37.2 Degree Celsius and 7.4 Degrees Celsius respectively, as obtained in this study, are acceptable. However, it is yet to examine whether the assumption upon which the current study is based is true. Thus one task for the researcher, at this stage, is to study whether the said assumption is valid in the instant situation.

Chakrabarty constructed an analytical method for determining the true value of the central tendency of each of annual maximum and annual minimum of ambient air temperature at a location and also computed the value of central tendency for each of annual maximum and annual minimum of ambient air temperature at Guwahati by applying the method developed here from the data for the year 1969 onwards[13]. The values of these two had been found, in that study, to be 37.2 Degree Celsius and 7.4 Degree Celsius respectively. The method developed in this study has also yielded the same findings.

For a normal distribution mean, median and median are equal. Each of them is a measure of central tendency. It seems that there exists some method of determination of central tendency in the same situation. Thus, it is a problem for the researchers at this stage to search for whether there exists method for the same based on mean, median and mode as well as to discover the hidden method if exists.

REFERENCE

1. D. Chakrabarty, “Observation Composed of a Parameter and Error: An Analytical Method of Determining the Parameter”, *International Journal of Electronics and Applied Research*, 2014, 1(2), 20–38.
2. D. Chakrabarty, “Probabilistic Forecasting of Time Series”, Report of Post-Doctoral Research Project (2002 – 2005), University Grants Commission, New Delhi. 2005.
3. M. S. Stephen, “A Modest Proposal: A New Standard for the Normal”, *The American Statistician*, 1982, 36(2), 137–138.
4. W. W. Eric, “Normal Distribution” and Math World. http:/mathworld. wolfram.Com/NormalDistribution.htma
5. D. Chakrabarty, “Bernoulli’s Definition of Probability: Special Case of Its Chakrabarty's Definition”, *Int. J. Agricult. Stat. Sci.,* 2008, 4(1), 23–27.

6. D. Chakrabarty, "Determination of Parameter from Observations Composed of Itself and Errors", *International Journal of Engineering Science and Innovative Technology*, 2014, 3(2), 304–311.
7. B. Wlodzimierz, "The Normal Distribution: Characterizations with Applications", *Springer Verlag, ISBN 0 – 387 – 97990 – 5*, 1995.
8. D. Chakrabarty, "Probability: Link between the Classical Definition and the Empirical Definition", *J. Ass. Sc. Soc.*, 2005, 45, 13–18.
9. D. Chakrabarty, "Temperature in Assam: Natural Extreme Value", *J. Chem. Bio. Phy. Sci. Sec. C*, 2014, 4(2), 1479–488.
10. M. G. Kendall and A. Stuart, "Advanced Theory of Statistics", Vol. 1 & 2, 4th Edition, New York, Hafner Press, 1977.
11. M. George, "Evaluating the Normal Distribution", *Journal of Statistical Software*, 2004, 11(4). Http: / / www.jstatsoft.org / v11 / i05 / paper, 2004.
12. M. Walker and M. Helen and D. Moivre on the Law of Normal Probability, In Smith, David Eugene. A Source Book in Mathematics, Dover, 64690-4, 1985.
13. D. Chakrabarty, "Central Tendency of Annual Extremum of Ambient Air Temperature at Guwahati", *J. Chem. Bio. Phy. Sci. Sec. C*, 2015, 5(3), 2863–2877.
14. D. Chakrabarty, "Natural Interval of Monthly Extreme Temperature in the Context of Assam", *J. Chem. Bio. Phy. Sci. Sec. C*, 2014, 4(3), 2424–2433.
15. D. Chakrabarty, "Analysis of Errors Associated to Observations of Measurement Type", *International Journal of Electronics and Applied Research*, 2014, 1(1), 15–28.
16. D. M. Abraham, "The Doctrine of Chances", 1st Edition (2nd Edition in 1738 & 3rd Edition in 1756), 1718, ISBN 0 – 8218 – 2103 – 2.
17. G. C. Friedrich, "*Britannica*" On line (web) www.britannica.com.
18. H. Michieled. "Normal Distribution", *Encyclopedia of Mathematics*, Springer, ISBN 978–1–55608–010– 4, 2001.
19. J. Bernoulli, "Arts Conjectandi", *Impensis Thurmisiorum Fratrum Basileae*, 1713.
20. D. M. Abraham, "De MensuraSortis (Latin Version)", Philosophical Transaction of the Royal Society. 1711.
21. M. Walker, M. Helen and J. Lev, "Statistical Inference", Oxford & IBH Publishing Company, 1965.

*** Corresponding author: Dhritikesh Chakrabarty;**

Department of Statistics, Handique Girls' College, Guwahati, Assam, India.