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Determination of Parameter from Observation Containing Itself and Chance Error: Central Tendency of Annual Extremum of Ambient air Temperature at Silchar

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ABSTRACT: An analytical method has been developed, by Chakrabarty in 2014, for determining the true value of the parameter from observed data in the situation where the observations consist of a single parameter chance error but any assignable error. The method has already been successfully applied in determining the central tendency of each of annual maximum and annual minimum of the ambient air temperature at Guwahati. This paper deals with the determination of the central tendency of each of annual maximum and annual minimum of the ambient air temperature at Silchar by the same method. The study has carried out using the data since 1969 onwards.

KEYWORDS: Ambient air temperature at Silchar, central tendency, data with chance error, analytical method of determination

I. INTRODUCTION

Observations or data collected from experiments or survey suffer from chance error (which is unavoidable or uncontrollable) even if all the assignable (or intentional) causes or the sources of errors are controlled or eliminated and consequently the findings obtained by analyzing the observations or data which are free from the assignable errors are also subject to errors due to the presence of chance error in the observations [7]. Determination of parameters, in different situations, based on the observations is also subject to error due to the same reason. Searching for mathematical models describing the association of chance error with the observations is necessary for analyzing the errors. There are innumerable situations/forms corresponding to the scientific experiments. The simplest one is that where observations are composed of some parameter and chance errors ([7], [8] & [9]). The existing methods of estimation namely least squares method, maximum likelihood method, minimum variance unbiased method, method of moment and method of minimum chi-square ([1], [2], [3], [4], [5] &, [6]) provide the estimator of the parameter which suffers from some error. In other words, none of these methods can provide the true value of the parameter. However, An analytical method has been developed, by Chakrabarty [8] for determining the true value of the parameter from observed data in the situation where the observations consist of a single parameter chance error but any assignable error. The method has already been successfully applied in determining the central tendency of each of annual maximum and annual minimum of the ambient air temperature at Guwahati ([8] & [9]). This paper deals with the determination of the central tendency of each of annual maximum and annual minimum of the ambient air temperature at Silchar by the same method. The study has carried out using the data since 1969 onwards.

II. THE METHOD

Let

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

be n observations on the annual maximum (or minimum) of the ambient air temperature at a location with central tendency μ.

In this situation, each observation X_i is composed of μ and chance error ε_i [10].

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The method determining the value of the central tendency μ, developed by Chakrabarty [8] consists of the following steps:

Step-1:

Arranged the observations in ascending order of magnitude as

$$X_{(1)} < X_{(2)} < \ldots\ldots\ldots\ldots < X_{(n)} \qquad (2.1)$$

Step-2:

Construct the averages

$$\bar{X}_{(i)}(1) = (n-1)^{-1} \sum_{j=1,\, j \neq i}^{n} X_{(j)} \qquad (2.2)$$

$$(i = 1, 2, \ldots\ldots\ldots, n)$$

Step-3:

Take the interval

$$\bar{X}_{(n)}(1) < \mu < \bar{X}_{(1)}(1) \qquad (2.3)$$

as the first interval of μ.

Step-4:

Exclude the two extreme values namely $X_{(1)}$ & $X_{(n)}$ and construct

$$\bar{X}_{(i)}(2) = (n-3)^{-1} \sum_{j=2,\, j \neq i}^{n-1} X_{(j)} \qquad (2.4)$$

$$(i = 2, \ldots\ldots\ldots, n-1).$$

Step-5:

Take the interval

$$\bar{X}_{(n-1)}(2) < \mu < \bar{X}_{(2)}(2) \qquad (2.5)$$

as the second interval of μ.

Step-6:

Exclude the four extreme values namely $X_{(1)}, X_{(2)}, X_{(n-1)}$ & $X_{(n)}$ and construct

$$\bar{X}_{(i)}(3) = (n-5)^{-1} \sum_{j=3,\, j \neq i}^{n-2} X_{(j)} \qquad (2.6)$$

$$(i = 3, \ldots\ldots\ldots, n-2),$$

Step-7:

Take the interval

$$\bar{X}_{(n-2)}(3) < \mu < \bar{X}_{(3)}(3) \qquad (2.7)$$

as the third interval of μ.

Step-8:

Exclude the six extreme values namely $X_{(1)}$, $X_{(2)}$, $X_{(3)}$, $X_{(n-2)}$, $X_{(n-1)}$ & $X_{(n)}$ and construct

$$\bar{X}_{(i)}(4) = (n-5)^{-1} \sum_{j=4,\, j \neq i}^{n-3} X_{(j)} \qquad (2.8)$$

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$(i = 4 , \ldots\ldots\ldots , n - 3)$

Step-9:

Take the interval

$$\bar{X}_{(n-3)}(4) < \mu < \bar{X}_{(4)}(4) \qquad (2.9)$$

as the fourth interval of μ.

The process can be continued further if necessary.

From the intervals obtained, one can detect the point value of μ.

III. ANNUAL EXTREMUM OF AMBIENT AIR TEMPERATURE AT SILCHAR:

A. ANNUAL MAXIMUM

Data on annual maximum of the ambient air temperature at Silchar, collected from the meteorological department of India, for the period from 1969 to 2013 have been presented in **Table – 1**. These have been arranged in ascending order of magnitude and presented in **Table – 2**.

TABLE – 1

Observed value of Annual Maximum Temperature at Silchar (in Degree Celsius)

Year	Observed value	Year	Observed value	Year	Observed value	Year	Observed value
1969	35.1	1988	37.7	1996	37.9	2007	37.9
1970	36	1989	36.4	2000	37.3	2008	39.1
1971	34.9	1990	37.1	2001	37.5	2009	38.5
1972	34.5	1991	37.9	2002	37.5	2010	37.2
1973	35.5	1992	38.2	2003	37.3	2011	37.6
1974	34.4	1993	36.5	2004	36.9	2012	38.1
1986	38.0	1994	36.9	2005	37.9	2013	38.6
1987	38.4	1995	36.9	2006	39.1		

TABLE – 2

Observed values of Annual Maximum Temperature at Silchar in ascending order (in Degree Celsius)

Serial No	Observed value	Serial No	Observed value	Serial No	Observed value	Serial No	Observed value
1	34.4	7	36.4	13	37.5	19	38.2
2	34.5	8	36.5	14	37.6	20	38.4

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3	34.9	9	36.9	15	37.7	21	38.5
4	35.1	10	37.1	16	37.9	22	38.6
5	35.5	11	37.2	17	38.0	23	39.1
6	36.0	12	37.3	18	38.1		

Determination of the Central Tendency

1. INTERVAL VALUE BASED ON ALL DISTINCT OBSERVED VALUES

TABLE – 3

Mean of all observed values excluding the corresponding one (in Degree Celsius)

Serial No	Observed value	Mean	Serial No	Observed value	Mean
1	34.4	37.1364	12	37.3	37.0045
2	34.5	37.1318	13	37.5	36.9955
3	34.9	37.1136	14	37.6	36.9910
4	35.1	37.1045	15	37.7	36.9864
5	35.5	37.0864	16	37.9	36.9773
6	36.0	37.0636	17	38.0	36.9727
7	36.4	37.0455	18	38.1	36.9681
8	36.5	37.0409	19	38.2	36.9636
9	36.9	37.0227	20	38.4	36.9545
10	37.1	37.0136	21	38.5	36.95
11	37.2	37.0091	22	38.6	36.9455
			23	39.1	36.9227

From this table the interval value of the central tendency is found to be

(36. 9227 Degree Celsius , 37.1364 Degree Celsius) (3.1)

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2. INTERVAL VALUE BASED ON ALL DISTINCT OBSERVED VALUES EXCLUDING THE TWO EXTREME OBSERVATIONS NAMELY THE 1ST & THE 23rd ONES

TABLE – 4

Mean of all observed values excluding the corresponding one (in Degree Celsius)

Serial No	Observed value	Mean	Serial No	Observed value	Mean
1	34.4		12	37.3	37.03
2	34.5	37.17	13	37.5	37.02
3	34.9	37.15	14	37.6	37.015
4	35.1	37.14	15	37.7	37.01
5	35.5	37.12	16	37.9	37.0000
6	36.0	37.095	17	38.0	36.995
7	36.4	37.075	18	38.1	36.99
8	36.5	37.07	19	38.2	36.985
9	36.9	37.05	20	38.4	36.975
10	37.1	37.04	21	38.5	36.97
11	37.2	37.035	22	38.6	36.95
			23	39.1	

From this table the interval value of the central tendency is found to be

(36.965 Degree Celsius , 37.1 Degree Celsius) (3.2)

3. INTERVAL VALUE BASED ON ALL DISTINCT OBSERVED VALUES EXCLUDING THE FOUR EXTREME OBSERVATIONS NAMELY THE 1ST, 2ND, 22TH & THE 23rd ONES

TABLE – 5

Mean of all observed values excluding the corresponding one (in Degree Celsius)

Serial No	Observed value	Mean	Serial No	Observed value	Mean
1	34.4		12	37.3	37.0833
2	34.5		13	37.5	37.0722
3	34.9	37.2167	14	37.6	37.0667
4	35.1	37.2056	15	37.7	37.0611

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5	35.5	37.1833	16	37.9	37.05
6	36.0	37.1556	17	38.0	37.0444
7	36.4	37.1333	18	38.1	37.0389
8	36.5	37.1278	19	38.2	37.0333
9	36.9	37.1056	20	38.4	37.0222
10	37.1	37.0944	21	38.5	37.0167
11	37.2	37.0889	22	38.6	
			23	39.1	

From this table the interval value of the central tendency is found to be

(37.0167 Degree Celsius , 37.2167 Degree Celsius) (3.3)

4. INTERVAL VALUE BASED ON ALL DISTINCT OBSERVED VALUES EXCLUDING THE SIX EXTREME OBSERVATIONS NAMELY THE FIRST THREE & THE LAST THREE

TABLE – 6

Mean of all observed values excluding the corresponding one (in Degree Celsius)

Serial No	Observed value	Mean	Serial No	Observed value	Mean
1	34.4		12	37.3	37.1313
2	34.5		13	37.5	37.1188
3	34.9		14	37.6	37.1125
4	35.1	37.2688	15	37.7	37.1063
5	35.5	37.2438	16	37.9	37.0938
6	36.0	37.2125	17	38.0	37.0875
7	36.4	37.1875	18	38.1	37.0813
8	36.5	37.1813	19	38.2	37.075
9	36.9	37.1563	20	38.4	37.0625
10	37.1	37.1438	21	38.5	

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11	37.2	37.1375	22	38.6	
			23	39.1	

From this table the interval value of the central tendency is found to be

(37.0625 Degree Celsius , 37.2688 Degree Celsius) (3.4)

POINT VALUE : The above four intervals yields the shortest interval as

(37.0625 Degree Celsius , 37.17 Degree Celsius) (3.5)

which further implies that the value of the central tendency 37.1 Degree Celsius.

Thus the central tendency of annual maximum of the ambient air temperature at Silchar, as the available data yield, is 37.1 Degree Celsius.

B. ANNUAL MINIMUM

Data on annual minimum of the ambient air temperature at Silchar, collected from the meteorological department of India, for the period from 1969 to 2013 have been presented in **Table – 1** from {[6] & [7]}. These have been arranged in ascending order of magnitude and presented in **Table – 2**

TABLE – 1

Observed value of Annual Minimum Temperature at Silchar (in Degree Celsius)

Year no	Observed value	Calendar year, Month & Date of occurrence	Year no	Observed value	Calendar year ,Month & Date of occurrence
1	8.9	1970, January 30	15	9.7	2000, January 05
2	9.2	1971, February 02	16	8.5	2001, January 12
3	9.3	1972, February 10	17	9.9	2002, February 01
4	9.5	1973, January 18	18	9.1	2003, January 24
5	9.0	1974, February 08	19	9.0	2004, january 29
6	7.0	1988, January 28	20	8.9	2004, December 28
7	6.4	1989, January 15	21	9.4	2006, January 22
8	6.8	1990, January 03	22	7.6	2007, January 16
9	9.0	1991, January 26	23	8.5	2008, February 15
10	9.4	1991, December 31	24	9.6	2009, January 03
11	8.5	1993, january 22	25	7.4	2010, February 04

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12	9.0	1994, January 22	26	7.6	2011, January 21
13	7.9	1995, January 26	27	8.6	2012, January 28
14	9.1	1996, January 22	28	7.6	2013, January 12

TABLE – 2

Observed value of Annual Minimum Temperature at Silchar in ascending order (in Degree Celsius)

Serial No	Observed value	Serial No	Observed value	Serial No	Observed value	Serial No	Observed value
1	6.4	6	7.9	11	9.1	16	9.6
2	6.8	7	8.5	12	9.2	17	9.7
3	7.0	8	8.6	13	9.3	18	9.9
4	7.4	9	8.9	14	9.4		
5	7.6	10	9.0	15	9.5		

Determination of the Central Tendency

1. INTERVAL VALUE BASED ON ALL DISTINCT OBSERVED VALUES

TABLE – 3

Mean of all observed values excluding the corresponding one (in Degree Celsius)

Serial No	Observed value	Mean	Serial No	Observed value	Mean	Serial No	Observed value	Mean
1	6.4	8.6706	7	8.5	8.5471	13	9.3	8.5
2	6.8	8.6471	8	8.6	8.5412	14	9.4	8.4941
3	7.0	8.6353	9	8.9	8.5235	15	9.5	8.4882
4	7.4	8.6118	10	9.0	8.5176	16	9.6	8.4824
5	7.6	8.6	11	9.1	8.51176	17	9.7	8.4765
6	7.9	8.5824	12	9.2	8.5059	18	9.9	8.4647

From this table the interval value of the central tendency is found to be

(8.4647 Degree Celsius , 8.6706 Degree Celsius) (3.6)

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1. INTERVAL VALUE BASED ON ALL DISTINCT OBSERVED VALUES EXCLUDING THE TWO EXTREME OBSERVATIONS NAMELY THE 1ST & THE 18TH ONES

TABLE – 4

Mean of all observed values excluding the corresponding one (in Degree Celsius)

Serial No	Observed value	Mean	Serial No	Observed value	Mean	Serial No	Observed value	Mean
1	6.4		7	8.5	8.6	13	9.3	8.5467
2	6.8	8.7133	8	8.6	8.5933	14	9.4	8.54
3	7.0	8.7	9	8.9	8.5733	15	9.5	8.5333
4	7.4	8.6733	10	9.0	8.5667	16	9.6	8.5267
5	7.6	8.66	11	9.1	8.56	17	9.7	8.52
6	7.9	8.64	12	9.2	8.5533	18	9.9	

From this table the interval value of the central tendency is found to be

(8.52 Degree Celsius , 8.7133 Degree Celsius) (3.7)

2. INTERVAL VALUE BASED ON ALL DISTINCT OBSERVED VALUES EXCLUDING THE FOUR EXTREME OBSERVATIONS NAMELY THE 1ST, 2ND, 17TH & THE 18TH ONES

TABLE – 5

Mean of all observed values excluding the corresponding one (in Degree Celsius)

Serial No	Observed value	Mean	Serial No	Observed value	Mean	Serial No	Observed value	Mean
1	6.4		7	8.5	8.6538	13	9.3	8.5923
2	6.8		8	8.6	8.6462	14	9.4	8.5846
3	7.0	8.7692	9	8.9	8.6231	15	9.5	8.5769
4	7.4	8.7385	10	9.0	8.6154	16	9.6	8.5692
5	7.6	8.7231	11	9.1	8.6077	17	9.7	
6	7.9	8.7	12	9.2	8.6	18	9.9	

From this table the interval value of the central tendency is found to be

(8.5692 Degree Celsius , 8.7692 Degree Celsius) (3.8)

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2. INTERVAL VALUE BASED ON ALL DISTINCT OBSERVED VALUES EXCLUDING THE FOUR EXTREME OBSERVATIONS NAMELY THE FIRST THREE & THE LAST THREE

TABLE – 6

Mean of all observed values excluding the corresponding one (in Degree Celsius)

Serial No	Observed value	Mean	Serial No	Observed value	Mean	Serial No	Observed value	Mean
1	6.4		7	8.5	8.7182	13	9.3	8.6455
2	6.8		8	8.6	8.7091	14	9.4	8.6454
3	7.0		9	8.9	8.6818	15	9.5	8.6273
4	7.4	8.8182	10	9.0	8.6727	16	9.6	
5	7.6	8.8	11	9.1	8.6636	17	9.7	
6	7.9	8.7364	12	9.2	8.6545	18	9.9	

From this table the interval value of the central tendency is found to be

(8.6273 Degree Celsius , 8.7692 Degree Celsius) (3.9)

POINT VALUE : The above four intervals yields the shortest interval as

(8.6273 Degree Celsius , 8.6706 Degree Celsius) (3.10)

which further implies that the value of the central tendency 8.63 to 8.66 Degree Celsius.

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IV. CONCLUSION

The existing statistical methods of estimation yield estimates which are not free from error.
However, the method developed by Chakrabarty [8] can yield the estimate which is free from error (i.e. exactly equal to the true value of the parameter). Thus the central tendency of annual maximum as well as annual minimum of the ambient air temperature at Silchar, as the available data yield, can be taken as 37.1 Degree Celsius and 8.63 to 8.66 Degree Celsius respectively.
The determination of these two is based on the assumption that the data recorded by the Indian Meteorological Department have been recorded correctly. If there is any error in recording the data, the determined value(s) will not be accurate.
The determination of these two is based on another assumption that the change in temperature at Silchar during the period whose data have been used in computation has not been influenced by any assignable cause(s). If in this period, some assignable cause has influenced significantly on the change in temperature at this location, the findings are bound to be inaccurate.

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