CHAPTER - 1

BACKGROUND AND OVERVIEW OF THE THESIS

1.1. INTRODUCTION :

A study was made on the determination of the central tendency, variation and confidence interval of surface air temperature, which can also be regarded as ambient air temperature, in the context of Assam. This thesis has been prepared based on the findings of the study. The work done in this study is based on application of the theory of statistics (Specially the theory of probability, the theory of statistical inference) in the field of analysis of meteorological data specially data on temperature. The background and the motivation of the study have been discussed in the following sections namely section 1.2 and section 1.3 with a brief overview of the work done in the next section namely section 1.4.

1.2. BACKGROUND OF THE STUDY :

Temperature is one of the major factors that determine the weather and the climate of location. Temperature at a location on the earth surface is a variable, which changes over time. Data on temperature at a location forms a time series where the period of the smallest periodic component is a day and the period of the highest periodic component is, naturally, a year. It may or may not have cyclical component. Of course, the random component always effects upon it.

The component of the climate (for example temperature, rainfall, humidity etc.) at a location/region has been changing continuously over time. The change in a component occurs basically due to two broad causes namely,

1. Assignable or controllable cause (or causes),

2. Chance cause.

The change in a component will be significant or equivalently effective or equivalently countable if and only if it occurs due to both of the causes. On the other hand, the change in the component will be significant or equivalently ineffective or equivalently negligible if and only if it occurs due to chance cause only. There is necessity of determining whether the change occurs due to both the causes or due to the chance cause only because, the task of controlling the change arises only when the change occurs due to assignable cause (as causes).

It has already been mentioned that temperature is one of the major factors that determine the weather/climate of a location/region. The usual behavior of temperature is that at a location/region it attains some maximum value and also some minimum value in a year that ought to be constants if the weather/climate of the location/region is not influenced by some unnatural factor/factors. Thus, there is necessity of a study on the natural maximum and of the natural minimum of temperature.

Chakrabarty (2005*a*) made a study on mean maximum temperature and mean minimum temperature in respect of forecasting. In this study, attempt has also been made on the determination of the natural maximum temperature and the natural minimum temperature in the context of Assam.

1.3. MOTIVATION OF RESEARCH :

There exist several statistical methods of point estimation of parameters namely maximum likelihood method [Allan (1962); Andersen (1970); Aldrich (1997); Hald (1999); Barnard (1949); Basu (1988); Le Cam (1990); Pratt (1976) et al], minimum variance unbiased method [Bart (2007); Buehler (2004); Chen, Gupta & Huang (2017); Douglas and Herbert (1951); Drygas (1970); Hsu (1938); Harville (1969); Keener; Lamotte (1971); Peter (1987)**;** Rao(1952); (1971*a*); Robert (2006); Voinov & Nikulin (1993) et al], method of moments [Bowman & Shenton (1998); Munkhammar; Mattsson & Rydén (2017); Gelman (1995); Hansen (1982); Hazelton (2011) et all] , least squares method [Aldrich (1998); Björck (1996); Boyd (2017); Graybill (1954) (1954); Kariya, Kurata (2004); Luenberger (1997); Nocedal & Wright (1999) ; Plackett (1972); Rao, Toutenburg (2008); Wolberg (2005) et al] , minimum chi-square method [Alessandro (2017); Berkson (1980) et al] minimum inverse probability method [Fienberg & Stephen

(2006); Fisher (1922); Jeffrey & Harold (1939); Kotz (1992) et al] etc. which are available in many literatures [Aldrich (1997) ; Bernoulli (1713); De Moivre (1711); Federer (1955); Fisher(1922); Graybill, (1954) ; Grant E. L (1972) ; Ivory (1825); Jeffreys, Harold (1939) ; Kendall & Stuart (1977); Kotz (1992), Kelley (1994), Millar (2011), Rao (1965), Shewhart (1931), Spring (2014 ; Walker , Helen and Lev (1965) et al]. Similarly, there exist several statistical methods of interval estimation of parameters [Neyman (1937); Severini (1991); Kendall & Stuart (1973); Meeker, Hahn & Escobar (2017)].

The methods of estimation (as mentioned above) of central tendency, variation and confidence interval yield estimates which suffer from error though may be small in some situations which, in other words, means that these methods cannot provide error free estimate(s) of parameter(s) [Allan (1962); Andersen (1970); Aldrich (1997); Hald (1999); Barnard (1949); Basu (1988); Le Cam (1990); Pratt (1976); Bart (2007); Buehler (2004 **);** Chen, Gupta & Huang (2017); Douglas and Herbert (1951); Drygas (1970); Hsu (1938); Harville (1969); Keener, Lamotte (1971); Peter (1987); Rao (1952); (1971*a*); Robert (2006); Voinov, Nikulin (1993); Bowman & Shenton (1998); Munkhammar, Mattsson & Rydén (2017); Gelman (1995); Hansen (1982); Hazelton (2011); Aldrich(1998); Björck (1996); Boyd (2017); Graybill (1954); Kariya, Kurata (2004); Luenberger (1997) (1969); Nocedal & Wright (1999); Plackett (1972); Rao, Toutenburg (2008); Wolberg (2005); Alessandro (2017); Berkson (1980); Fienberg &Stephen (2006); Fisher (1922); Jeffrey & Harold (1939); Kotz (1992); Aldrich (1997); Bernoulli (1713); De Moivre (1711); Federer (1955); Fisher (1922); Graybill (1954); Grant E. L (1972) ; Ivory (1825); Jeffreys, Harold (1939); Kendall & Stuart (1977); Kotz (1992); Kelley (1994); Millar (2011); Rao (1965); Shewhart (1931); Spring (2014); Walker , Helen and Lev(1965) et all].

On the other hand, the recently developed methods namely mid range method (Chakrabarty , 2011), shortest interval method (Chakrabarty , 2014*e*) and analytical method (Chakrabarty , 2014*b*) can suitably be applied in determining the value, with more accurately than that by the available statistical methods, of parameter in respect of central tendency, variation and confidence interval of ambient air temperature at a location .

There had been no research on determining central tendency, variation and confidence interval of temperature (more specifically of ambient air temperature), neither in the context of Assam nor in the context of India nor in the global context, though study on these carries high significance/greater importance.

Accordingly, attempt has been made on the determination of these three characteristics of ambient air temperature.

Attempt has been made confined in the context of ambient air temperature in Assam.

The attempt has been made not by applying the existing statistical methods but by the methods that have been searched for recently [Chakrabarty (2014*a*, 2014*b*, 2015*a*, 2015*b*).

1.4. OVERVIEW OF THE STUDY :

In view of the points, mentioned above, the following three objectives have been fixed in the current study regarding the annual maximum and the annual minimum of surface air temperature in the context of Assam based on five stations namely Guwahati , Dhubri, Silchar, Dibrugarh & Tezpur :

(1) To determine the central tendency of the annual maximum and the annual minimum of surface air temperature.

(2) To determine the standard deviation of the annual maximum and the annual minimum of surface air temperature.

(3) To determine confidence interval of the annual maximum and the annual minimum of surface air temperature.

In the current study, attempt has been made on searching for some method of determining the natural maximum and the natural minimum of temperature at a location/region. Attempt has also been made on determining the natural maximum and the natural minimum of temperature in the context of Assam. The natural maximum and the natural minimum have been determined in terms of confidence interval.

At the first step, data have been collected on annual maximum & annual minimum of ambient air temperature at the five meteorological centers in Assam namely Dhubri, Dibrugarh, Guwahati, Silchar & Tezpur. The data have been collected from Indian Meteorological centre at Guwahati (Borjhar).

At the second step, the values of central tendency of the annual maximum and the annual minimum of surface air temperature have been computed for the five meteorological centers.

The three methods namely

(1) Midrange Method (Chakrabarty, 2011),

(2) Shortest Interval method (Chakrabarty, 2014*e*)

&   (3) Analytical method (Chakrabarty, 2014*b*)

Described in Chapter–2 have been applied in computing the values of central tendency.

At the third step, the values of standard deviation of the annual maximum and the annual minimum of surface air temperature at the five stations have been computed from the respective data using the values of the respective central tendency.

At the fourth step, after obtaining the values of central tendency and standard deviation, the values of confidence interval (with 95%, 99% & 99.73% confidences respectively) have been computed for the annual maximum and the annual minimum of surface air temperature at the five stations.

The values of 95%, 99% & 99.73% confidence interval have been computed using the respective values of central tendency and standard deviation obtained in the earlier steps.

The findings on central tendency, standard deviation and confidence interval of annual maximum and annual minimum of ambient air temperature have been presented in Chapter-3, Chapter-4, Chapter-5, Chapter-6 & Chapter-7 for the five stations Dhubri, Dibrugarh, Guwahati, Silchar & Tezpur respectively.