THINK INDIA JOURNAL

ISSN:0971-1260

Vol-22-Issue-10-November-2019

A Statistical Analysis of Time Series to Analysis based on the production of Rice for the period of 1990 to 2010, Assam, India

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Abstract

This paper attempt to estimate the trend values for the production of Rice in Assam (India) for period 1990 to 2010. A time series analysis has been made to estimate the trend values for the production of Rice for the period of 19990 to 2010, Assam, India. The data have been collected from the official record of the office of the Extension coordinator Agricultural Technology Management Agency (ATMA) Dhemaji District of Assam (India) with personal investigation. The natures of the data are secondary.

Keywords: Agriculture, Rice, Trend, Moving Average, Least Square, Parabola, Production.

Introduction

The institutional mechanism in the form of the Agricultural Technology Management Agency (ATMA) at the district level was first pilot tested under the innovations in Technology dissemination (IID) component of the National Agricultural technology project (NATP) in 28 Districts of seven states from 1998 to 2005 based on it positive outcome.

The extension reforms (ATMA) Programme was introduced during 2005-06 by the ministry of Agriculture, as a major intervention is addressing the constraints as observed the in the T and V and the post T and V system by introducing an extension system that is farmer derive and former accountable, based on an institutional reforms mechanism.

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Rice production Assam:

At present, rice occupies about two-third of the total cropped area in the state. Being the single major source of agricultural GOP, rice plays a significant role in the state economy. Further, its importance basket (the average monthly consumption per capita is about 13 kg) also speaks volumes on the rice orientation of the state. Another specially is that rice orientation of the state. Another specialty is that rice is traditionally growth through the year viz. winter, autumn and summer seasons, with winter (kharif) rice as the main crop. Assam occupies a special place in the rainted rice production system in the Eastern India (being a major rainted rice growing area) by covering about 9 percent of the total rice area and contributes 8 percent to the production. At the national level, the state contributes over 5 percent of rice area and 4 percent of rice production. Though Assam produced about 3.4 million tons of rice in 1997-98 the state is deficient to the tune of a million tones making state a net importer of rice.

Aim of the Field work

The study of almost all branches of science remains incomplete without any practical Knowledge. By means of field work we will be able to utilize our theoretical knowledge in practical life. Thus field works makes our mind research oriented and give confidence to take any in independent study in our future career.

The result of an experiment depend much more the representation of data collected for a particular experiment so we have to look for the data which are the most appropriate and suitable for the particular experiment. And this the main criteria of field work. In field work several factors are to be taken into account which is in some way or other may affect the study. Only by choosing some of the necessary information one cannot arrive at a correct result other one will arrive at an erroneous and absurd result so without practical experience of collection of data in the field complete knowledge in statistics can be claimed. The field works that which gives the student a chance to train up and to any carryout any work of statistical nature independently so that he would be able to solve statistical problems in the future.

Objectives of the study

The following are the objectives of time series analysis:

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(1) To study the part behavior of the series, past experience is guides in future, time series analysis only bring to light the salient feature of this part experience.

(2) To study the trend values for the production of Rice in Assam for the period 1990 to 2010.

(3) To forecast the future trend.

Materials and Methods

Research methodology is a way to systematically solve a research problem research as an art of scientific investigation research comprises defining and redefining problems, formulae, organizing and evaluation data, making deduction and reach and reaching conclusions and at lost carefully testing the conclusion to determine whether they fit the formulating hypothesis here we describe the various steps that are generally adopted by a research in studying his research problems along with the logic be behind them.

Copy of the raw data on the field work is enclosed here with "office of the Extension coordinator Agriculture Technology Management Agency" (ATMA), Dhemaji, Assam.

Table 1: Copy of the raw data collected

Year	**Production ('000' tons)**
1990-91	**3270.2**
1991-92	**3270.2**
1992-93	**3197.2**
1993-94	**3299.7**
1994-95	**3361.1**
1995-96	**3309.1**
1996-97	**3390.0**
1997-98	**3328.2**
1998-99	**3382.9**
1999-20	**3254.8**
2000-01	**3860.7**
2002-02	**3998.4**
2002-03	**3854.0**
2003-04	**3738.0**
2004-05	**3880.0**
2005-06	**3470.0**

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2006-07	**3552.0**
2007-08	**2916.0**
2008-09	**3319.0**
2009-10	**4008.0**

Statistical Modeling

Time series is an arrangement of the statistical data in chronological order i.e. in accordance with occurrence of time, is known as "Time series in other words a set of data depending on the time is called a 'time series' according to p. mast or, time series is show that change of phenomenon over a period of time i.e. change in the magnitude of quantity due to chronological variations. According to Spiegel, "A time series is a set of observations taken at specified time usually at equal intervals".

Mathematically, a time series is defined by the values u_1, u_2,…,u_n of a variable U (Temperature ,rainfall, population etc) at time t_1, t_2,...,t_n this is a function of t symbolized by u=f(t)

So, the series of values of a variable at difference points of time can be termed at of time series and is given as

t: t_1,t_2,…,t_n

U: u_1, u_2,…,u_n

Thus, a time series invariably gives a bivariate distribution, one of the two being time (t) and the other being the value (U_t) of the phenomenon at different points of time. The value of t may be given yearly , monthly, weekly, daily, or even hourly, usually but not always at equal intervals at time.

Mathematical models for time series:

The following are the two models commonly used for the decomposition of a time series is to its components.

(1) Decomposition by additive hypothesis: According to the additive model, a time series can be expressed as $U_t= T_t+S_t+C_t+R_t$……(1.1)

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Where U_t is the time series value at time t.T_t, S_t, C_t and R_t represents the Trend, seasonal, cyclic and random fluctuation respectively at time t.

Obviously, the term S_t will not appear in series of annual data. The additive model (1.1) implies that seasonal forces (in different years), cyclical forces (in different cycles) and irregular forces (in different long term periods) operate with equal absolute effect irrespective of the trend value.

Analysis of the data

Calculation of Trend by Moving Average

Table 2: computation of 5 yearly moving averages

Year	Production ('000' tons)	5 yearly moving total	5 yearly moving average
1990-91	3270.2		
1991-92	3197.2		
1992-93	3299.7	16437.3	3287.46
1993-94	3361.1	16557.1	3311.42
1994-95	3309.1	16688.1	3337.62
1995-96	3390.0	16771.3	3354.26
1996-97	3328.2	16665	3333
1997-98	3382.9	17216.6	3443.32
1998-99	3254.8	17825	3565
1999-20	3860.7	18350.8	3670.16
2000-01	3998.4	18705.9	3741.18
2001-02	3854.0	19331.1	3866.22
2002-03	3738.0	18940.4	3788.08
2003-04	3880.0	18494	3698.8
2004-05	3470.0	17556	3511.2
2005-06	3552.0	17137	3427.4
2006-07	2916.0	17265	3453
2007-08	3319.0	18203	3640.6
2008-09	4008.0		
2009-10	4408.0		

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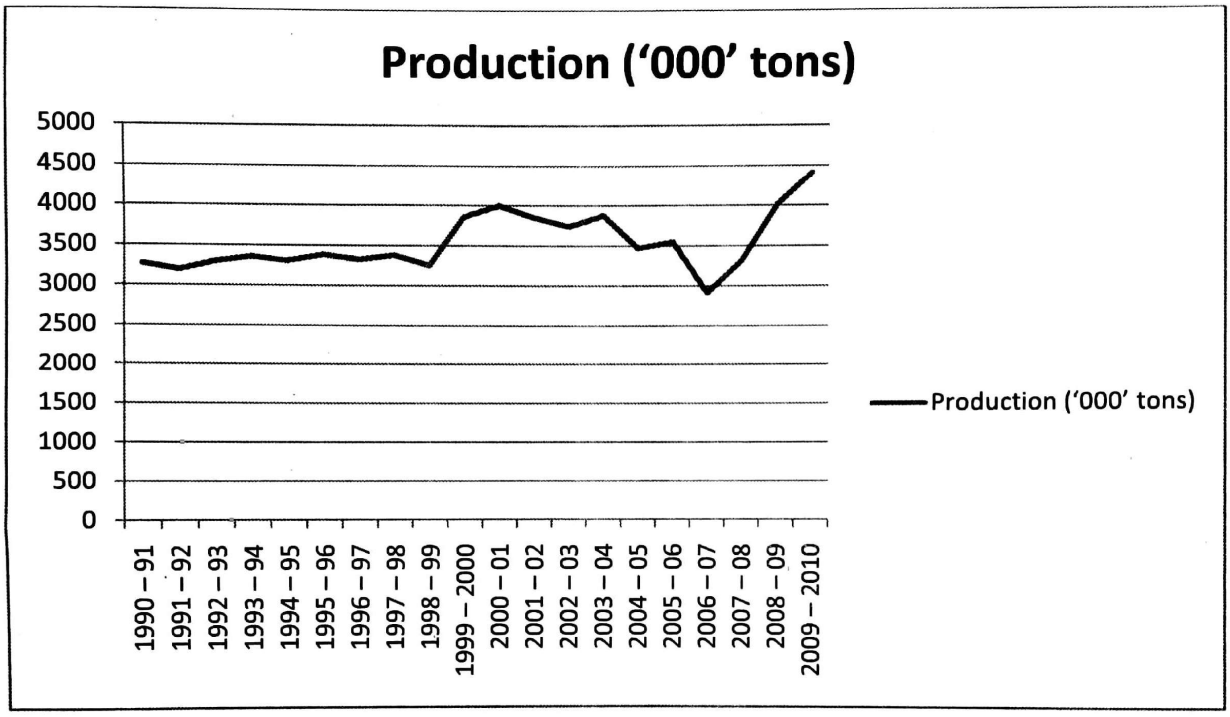
Graph-1



Method of least squares

Model

$Y_t = ab^t$ …… (i)

Taking logarithm of both side of (i), we have

$LogY_t = loga + t\ logb$

⇨ $Y = A + Bt + E$……(ii)

The normal equation are-

⇨ $NA + B\Sigma = \Sigma Y$ ……(iii)

⇨ $A\Sigma t + B\Sigma t^2 = \Sigma tY_1$ ……..(iv)

Table 3: Method of Least Squares

Year X	**Production total in ('000' tons) Y_t**	**X= t- 2000**	**XY_t**	**X^2**	**Trend values ('000' tons) Y_t= 2807.3+28.81X**

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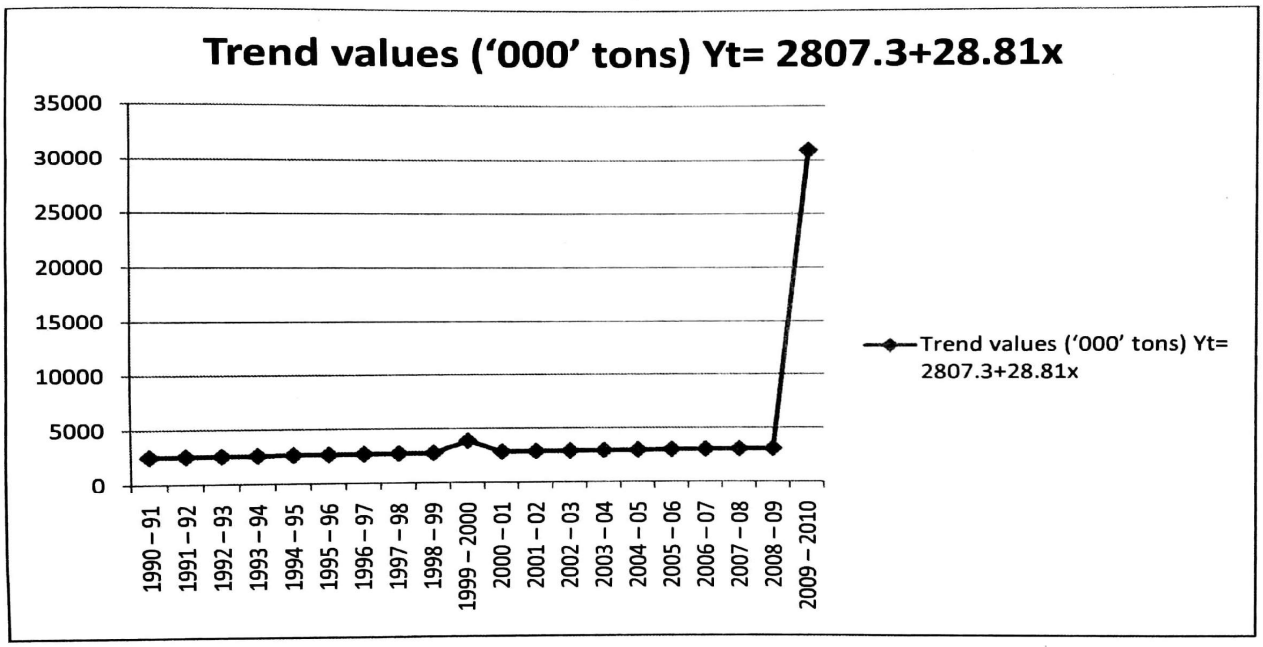
1990-91	**3270.2**	**-10**	**-32702**	**100**	**2519.2**
1991-92	**3197.2**	**-9**	**-28774.8**	**81**	**2548.01**
1992-93	**3299.7**	**-8**	**-26397.7**	**64**	**2576.82**
1993-94	**3361.1**	**-7**	**-26397.7**	**49**	**2605.63**
1994-95	**3309.1**	**-6**	**-19854.6**	**36**	**2634.44**
1995-96	**3390.0**	**-5**	**-16950**	**25**	**2663.25**
1996-97	**3328.2**	**-4**	**-13312.8**	**16**	**2692.06**
1997-98	**3382.9**	**-3**	**-10148.7**	**9**	**2720.87**
1998-99	**3254.7**	**-2**	**-6509.6**	**4**	**2749.68**
1999-20	**3860.7**	**-1**	**-3860.7**	**1**	**3860.7**
2000-01	**3998.4**	**1**	**39984**	**1**	**2836.11**
2001-02	**3854.0**	**2**	**7708**	**4**	**2836.92**
2002-03	**3738.0**	**3**	**11214**	**9**	**2893.73**
2003-04	**3880.0**	**4**	**15520**	**16**	**2922.54**
2004-05	**3470.0**	**5**	**17350**	**25**	**2951.35**
2005-06	**3552.0**	**6**	**21312**	**36**	**2980.16**
2006-07	**2916.0**	**7**	**20412**	**49**	**3008.97**
2007-08	**3319.0**	**8**	**26552**	**64**	**3037.78**
2008-09	**4008.0**	**9**	**36072**	**81**	**3066.59**
2009-10	**4408.0**	**10**	**44080**	**100**	**30954**
	ΣY_t=56146.3	**ΣX=0**	**ΣXY_t=22179.9**	**ΣX^2=770**	

Graph-2



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Let the trend equation between Y_t and x be

$Y_t = a + bx$, $x = (t - 2000)$ …… (v)

Since $\Sigma X = 0$, the normal equation for estimation a and b are

$$a = \frac{\Sigma Y_t}{n} = \frac{56146.3}{20} = 2807.3$$

$$b = \frac{\Sigma XY_t}{\Sigma X^2} = \frac{22179.9}{770} = 28.81$$

Hence the least square trend line be comes

$Y_t = 2807.3 + 28.81$ …… (vi)

Where b = 28.81 unit represent yearly increase in the production.

The trend vales of the year 1990-2010 can now be obtained from (vi) on putting it x = 10, -9, …,9, 10 respectively, as show in the column at the above table.

Estimate for 2011: when t = 2011, we get from x = (t – 2000), we get

X = (2011 – 2000) = 11

Hence the predicted production for 2011

$Y_t = 2807.3 + 28.81 \times 11 = 3124.21$ (‘000’ tones)

Table 4: Fitting of Second Degree parabola

Year(t)	**Production (‘000’ tones) Y_t**	**X= t - 2000**	**X^2**	**X^3**	**X^4**	**XY**	**X^2Y**	**Trend values $Y_t = 4033.56 + 51.34 + (00.31x^2)$**
1990-91	**3270.2**	**-10**	**100**	**-1000**	**10000**	**-32702**	**327020**	**3551.16**
1991-92	**3197.2**	**-9**	**81**	**-729**	**6561**	**-28774.8**	**258973.2**	**3596.61**
1992-93	**3299.7**	**-8**	**64**	**-512**	**4096**	**-26397.6**	**211180.8**	**3642.62**
1993-94	**3361.1**	**-7**	**49**	**-273**	**1911**	**-23527.7**	**1646939**	**3689.37**
1994-95	**3309.1**	**-6**	**36**	**-216**	**1296**	**-19854.7**	**111127.6**	**3736.68**
1995-96	**3390.0**	**-5**	**25**	**-125**	**625**	**-16950**	**84750**	**3784.61**
1996-97	**3328.2**	**-4**	**16**	**-64**	**256**	**-13312.8**	**53251.2**	**3833.16**
1997-98	**3382.9**	**-3**	**9**	**-27**	**81**	**-10148.7**	**30446.1**	**3882.33**

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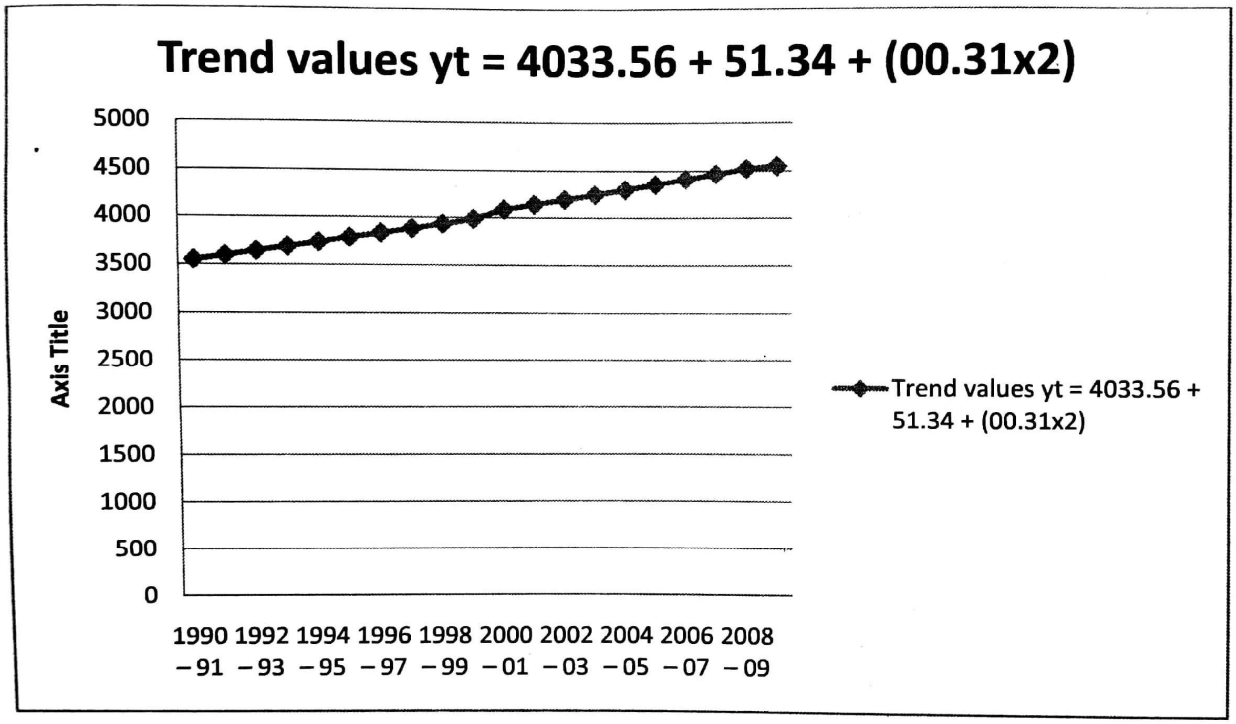
1998-99	**3254.7**	**-2**	**4**	**-8**	**16**	**-6509.6**	**13019.2**	**3932.12**
1999-20	**3860.7**	**-1**	**1**	**-1**	**1**	**-3860.7**	**3860.8**	**3982.53**
2000-01	**3998.4**	**1**	**1**	**1**	**1**	**3998.4**	**3998.5**	**4085.21**
2001-02	**3854.0**	**2**	**4**	**8**	**16**	**7708.0**	**15416**	**4137.48**
2002-03	**3738.0**	**3**	**9**	**27**	**81**	**11214**	**33642**	**4190.37**
2003-04	**3880.0**	**4**	**16**	**64**	**256**	**15520**	**62080**	**4243.88**
2004-05	**3470.0**	**5**	**25**	**125**	**625**	**17350**	**86750**	**4298.01**
2005-06	**3552.0**	**6**	**36**	**216**	**1296**	**21312**	**127872**	**4352.76**
2006-07	**2916.0**	**7**	**49**	**273**	**1911**	**20412**	**142884**	**4408.13**
2007-08	**3319.0**	**8**	**64**	**512**	**4096**	**26552**	**212416**	**4464.12**
2008-09	**4008.0**	**9**	**81**	**729**	**6561**	**36072**	**324648**	**4520.73**
2009-10	**4408.0**	**10**	**100**	**1000**	**10000**	**44080**	**440800**	**4550.06**
	ΣY_t=56146.3	**ΣX =0**	**ΣX^2= 770**	**ΣX^3 = 0**	**ΣX^4 =49686**	**XY=39529.9**	**X^2Y=2716829.8**	

Graph-3



3. Fitting of Second Degree Parabola

The normal equation for estimating a, b and c in $Y_t = a + bx + x^2$, where x = t – 2000 …… (1)

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$\Sigma Y_t = na + b\Sigma x + c\Sigma X^2$ $\Rightarrow 561463 = 20a + 770c$ ……. (a)

$\sum XY_t = a\Sigma x + b\Sigma X^2 + c\Sigma X^3$ $\Rightarrow 395299 = 770b$ ……. (b)

$\Sigma x^2 Y_t = a\Sigma x^2 + b\Sigma x^3 + c\Sigma x^4$ $\Rightarrow 27168298 = 770a + 49686c$ ……(c)

From (b), $b = \frac{\sum xy}{\sum x^2} = \frac{39529.9}{770} = 51.33$

From (a) and (c), we get

c = 31.85

Substituting in (a) we get

a = 4033.54

Substituting the values of a, b, and c in (1) we get the required trend equation as

$Y_t = 4033.56 + 51.33x + 31.85x^2$…….. (*)

The trend values Y_t can be computed on putting x= -10, -9… 9, 10 in (*) and are given in the last column of the table -4.

Summary and Conclusion

In this dissertation, a time series analysis has been made to estimate the trend values for the production of Assam rice for period 1990 to 2010. The data have been collected from the official record of the office of the Extension coordinator Agricultural technology management agency (ATMA) Dhemaji with personal investigation. The natures of the data are secondary.

Conclusion:

1. We observe from tables 2, 3, 4 and graphs 1, 2, 3 that all these method applied here leads to the same conclusion that there a gradual increase in trend. Although there is slight fall in production in the years 2006-07, 1991-92, 1998-99 even shows upward trend. The downfall in the production may be the due to the following reasons.
   (a) Insufficient rainfall
   (b) Rise in temperature

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(c) Weather condition

(d) Pests etc.

2. The calculated trend values by least squares method and second degree parabola for the data collected on the production of Assam rice for the period 1990-2010.

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