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Estimation of population trend of Odisha by using least square method

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Abstract

The least square method enables us to compare the trend values for all the given time period in the series. The least squares method is a form of mathematical regression analysis that find the line of best fit for a database and visual demonstration of the relationships between the data point. Each point of data is representative of the relationship between a known independent variable and unknown dependent variable. The objective of this research work is to estimate population trend by using last square method taking 7 years growth of population in Odisha that is from 2011 to 2017 using census data where population given in crores. The least square method enable us to estimate the trend values for all the given time periods in series. The fund equation can be used to estimate or predict the values of the variable for any period in future.

Keywords: estimation, fund equation, least square method, predict, regression analysis, trend

Introduction

The least square method is the process of estimating the best-fitting curve or line of best fit for a set of data by minimising the sum of the squares. During the process of finding the relation between two variables, the trend of outcomes are estimated quantitatively. This process is termed as regression analysis. The method of curve fitting is an approach to regression analysis. This method of fitting equations which approximates the curves to given raw data is the method of least square. It is quite obvious that the fitting of curves for a particular data set are not always unique. Thus, it is required to find a curve having a minimal deviation from all the measured data points. This is known as the best-fitting curve and is found by using the least-squares method.

The least-squares method is a crucial statistical method to find a regression line or a best-fit line for the given set of data. This method is described by an equation with specific parameters. The method of least squares is generously used in evaluation and regression. In regression analysis, this method is said to be a standard approach for the approximation of sets of equations having more equations than the number of unknowns. The method of least squares actually defines the solution for the minimization of the sum of squares of deviations or the errors in the result of each equation. The least-squares method is often applied in data fitting. The best fit result is assumed to reduce the sum of squared errors or residuals which are stated to be the differences between the observed or experimental value and corresponding fitted value given in the model.

- The least squares method is a form of mathematical regression analysis that find the line of best fit for a database, providing a visual demonstration of the relationships between the data point.
- Each point of data is representative of the relationship between a known independent variable and unknown dependent variable
- The method yield very correct results if sufficiently good appraisal of the form of the function to the fitted data is obtained either by a security of the graphical plot of the values over time or by a theoretical understanding of the mechanism of the variable change.

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Objective of the study

The objective of this research work is to estimate population trend by using last square method taking 7 years growth of population in Odisha that is from 2011 to 2017 using census data where population given in crores. The least square method enable us to estimate the trend values for all the given time periods in series. The fund equation can be used to estimate or predict the values of the variable for any period in future.

Significance of the study

- This method is completely free from personal bias of the analyst as it is very objective in nature. Anybody using this method is bound to fit the same type of straight line and find the same trend values fir the series.
- The least square method enables us to compare the trend values for all the given time period in the series.
- The trend equation can be used to estimate or predict the values of the variable for any period ‘t’ in future.
- This method is the most popular and widely used for fitting mathematical function to a given set of observations.

Methodology

- The formula used for calculating method of least square.
- Statistical tabulation used for data.

Sources of data

- The secondary data obtained from census 2011 to 2017 (growth of population in Odisha) sources with internet.

Overview of the study

Data

Census year (X)	Population (In crore)
2011	41
2012	42
2013	43
2014	43
2015	44
2016	44
2017	45

Formula

The straight line trend is represented by the equation $Y_t = a + bt$, where Y_t are the trend values, a is the Y intercept on the value of Y when $x = a$, b represents the slope of line or the amount by which Y variable will change if x is increased or decreased by one unit, and x variable is the time period. In order to determine the value of the constant ‘a’ and ‘b’ following two equations called normal equations are to be solved.

$$\sum Y = n a + b \sum x$$

$$\sum XY = a \sum x + b \sum x^2$$

Where ‘n’ is the number of time periods.

For calculation, generally the mid-point of the given time series is taken as origin so that negative values of the first half of the series balance out the positive values of the second half and we get $\sum x = 0$. When $\sum x = 0$ the two normal equations will be reduced to $a = \frac{\sum Y}{n}$ and $b = \frac{\sum XY}{\sum x^2}$.

Table 1: Population trend value

Years	Population (In crore)	X	X ²	XY	Trend value (YT)
2011	41	-3	9	-123	41.34
2012	42	-2	4	-84	41.94
2013	43	-1	1	-43	42.54
2014	43	0	0	0	43.14
2015	44	1	1	44	43.74
2016	44	2	4	88	44.34
2017	45	3	9	135	44.94

Total $\sum Y = 302$ $\sum X = 0$ $\sum X^2 = 28$ $\sum XY = 17$

Calculation

$$\sum Y = n a + b \sum X$$

$$\Rightarrow 302 = 7a + b \times 0$$

$$\Rightarrow 7a = 302$$

$$\Rightarrow a = 43.14$$

$$\sum XY = a \sum x + b \sum x^2$$

$$\Rightarrow 17 = a \times 0 + b \times 28$$

$$\Rightarrow 28b = 17 \Rightarrow b = \frac{17}{28}$$

$$\Rightarrow b = 0.60$$

Straight line trend is $Y_t = a + b x$
 Since, $\sum x = 0$, $a = 43.14$, $b = 0.60$
 The required trend line is $Y_t = 43.14 + 0.60 x$
 The trend values of different years will be obtained by putting the corresponding value of x in the above questions e.g.

For 2011, $X = -3$
 $Y_t = 43.14 + 0.60(-3) = 41.34$

For 2015, $X = 1$
 $Y_t = 43.14 + 0.60(1) = 43.74$ similarly for all the given year the trend value can be calculated.

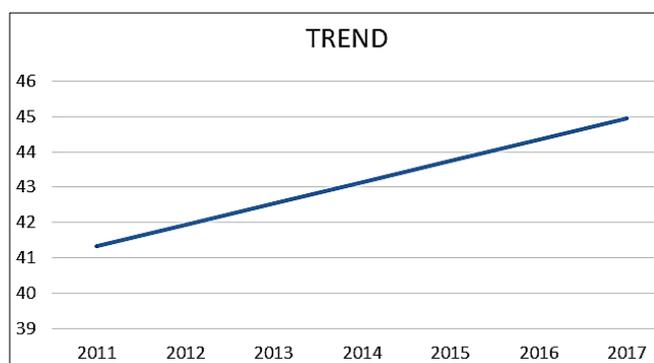


Fig 1: Trend line for estimated trend value

Concluding remarks

Here, after that the estimated and mathematical calculation we conclude that from the above table estimation of population

trend value from the year 2011 to 2017 are 41.34, 41.94, 42.54, 43.74, 44.34, and 44.94 respectively & estimated trend value of 2018 is 45.

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