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# Forecasting Analysing of Time Series Vital Statistics Crs Data of Delhi

KEYWORDS: Civil Registration Centre (CRS) , Infant Deaths, Estimation & Forecasting , Regression Model , Trend Analysis.

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**ABSTRACT** *The main focus of this my research work is the analysis of major vital statistics i.e. 'Live Births', 'Deaths' and 'Infant Deaths' of Delhi on the basis of secondary data collected from website of Delhi Govt by Civil Registration of Births and Deaths during the years 2003-2012 and forecasted for the next three years with usual validation . The work has tried to analyse and evaluate the trend of live births, total deaths and infant deaths. The high number of infant deaths is a major cause of concern and so is the high ratio of total deaths to infant deaths. Also, Birth order statistics are important for measuring the progress and effectiveness of family welfare activities. Data was studied on the basis of gender to analyse the figures of live births and infant deaths in greater detail. The attempted had made to derive a trend and estimate the future figures of live births, total deaths as well as infant deaths that help in the better plan and policy formation in the above mentioned fields with usual interpretations. The method of Regression analysis was the best fit forecast the data however the time series data doesn't follow any particular trend and irregular fluctuations has been observed in demographic of Delhi as recorded (CRS) key vital indicators.*

## INTRODUCTION

The secondary data is collected from the website of Delhi government on Civil Registration System (CRS) of births and deaths from the all the local bodies/Municipal Corporation (MCD, NDMC and DCB) in the form of primary data. As we aware that Delhi is the world second most populated city after **Tokyo**. It is also the largest National Capital Region (NCR) and the biggest trading centre along with largest centre of small industries in north India due to the largest attraction of migrants from the neighbouring states and other parts of the country. A per 2011 census of India, the population of Delhi is 16,753,235 and the density is 11,297 persons per $km^2$ having sex ratio of 866 female per 1000 men with literacy rate of 86.34%. The birth rate, death rate and infant mortality rate per 1000 population were 20.98, 6.65 and 21.91 respectively. In 2001, the population of Delhi increased by 285 thousands as a result of migration and by 215 thousands as a result of natural population growth and become one of the fastest growing cities in the world.

## SOURCE OF DATA

The web page of Delhi Govt is the major source of this research work collected for the year 2003-2012 for selected vital indicators i.e. Live Births, Deaths and Infant Deaths of Delhi for male and female in the form of secondary data. As we are aware that there are three sources of collection of primary data to obtain data for analysis and study namely, Civil Registration System (**CRS)** data (direct information given by the informant at the time of occurrence of event)**,** Sample Registration System **(SRS)** data (information collected for selected sample among population ), and **Census data**(Information collected for complete population at the fixed regular interval ).

## OBJECTIVE

To Forecast the Live Births, Deaths and Infant deaths (CRS) for the year 2013, 2014 and 2015 on the basis of last then year data i.e. 2003-2012 with the help of best appropriate methods and analyze the seasonal behaviour of the number of live births for the years 2008-2012 with minimize the effects.

## METHODOLOGY

On the basis of careful examination of the data the whole research work has been carry out by analysis of the data through a **Time Series Analysis**. The Regression analysis (The regression line Y= a + bX ) ,Moving Averages method and the method of Exponential smoothing has been applied for estimating the vital indicators and forecasting for next three years data .The interpretation of this indicators may also be analyses by Analysis of Variance (ANOVA). The trend analysis and variations present in the original Time Series is also analysis. The decision of best fit of data is also taken with comprising of actual live birth and death data of the year 2013. Few of the descriptive analysis have been covered for consigned presentation of analysis. The F-test is applied with 95% confidence level for testing the significance of data.

### Material Analysis

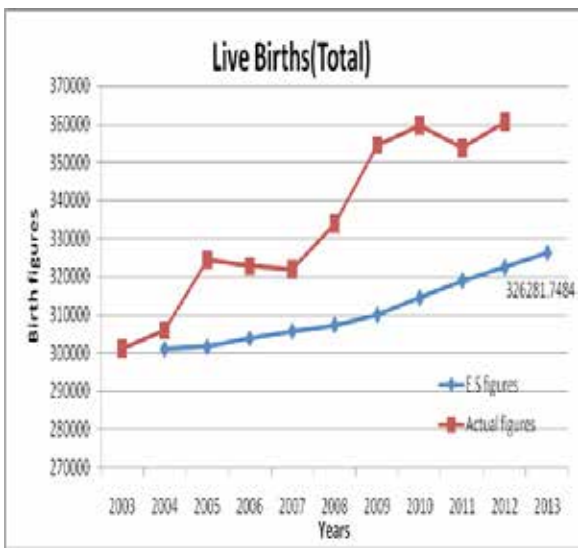
The estimated vital statistics has been calculated with the help of 'updation method' of exponential smoothing (ES) and compared by the Holt's method (Y^T+1|T = αyT + α(1−α)yT−1 + α(1−α)2yT−2 +. .).The moving Averages (MA) method is also used for analysis the vital statistics for best fit. The appropriate compatible result is presented in table and analysed by descriptive statistics.

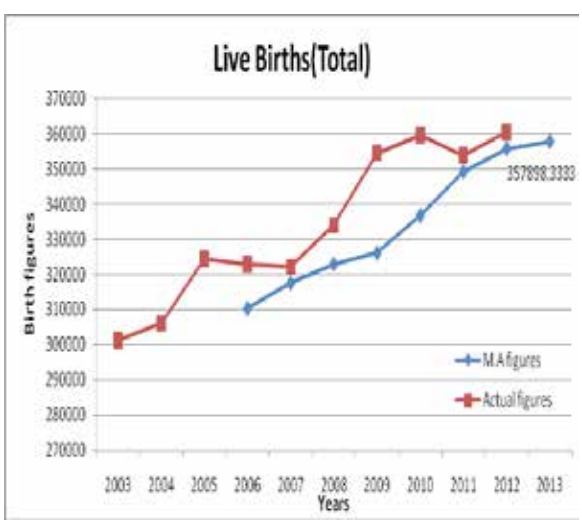
| Year | Live Births | E.S figures | M.A estimates | | Infant Deaths | E.S figures | M.A estimates | | Deaths* | M.A. estimates |
|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 301165 | - | - | | 5245 | - | - | | 87743 | - |
| 2004 | 305974 | 301165 | - | | 4003 | 5245 | - | | 85378 | - |
| 2005 | 324336 | 301646 | - | | 4182 | 5121 | - | | 94187 | - |
| 2006 | 322750 | 303915 | 310492 | | 5825 | 5027 | 4477 | | 98908 | 89103 |

Volume : 5 | Issue : 6 | June 2015 | ISSN - 2249-555X

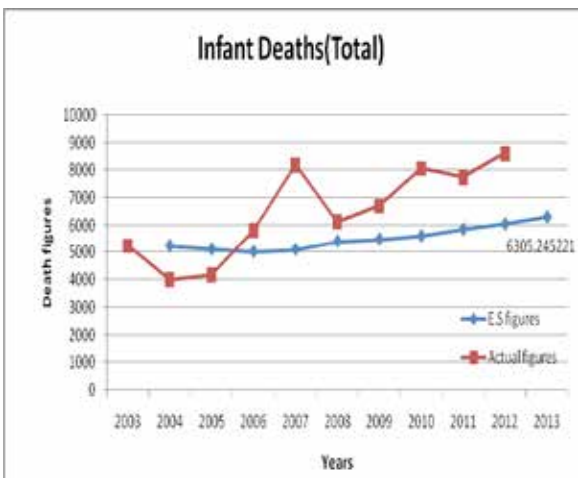
| Year | Live Births | E.S figures | M.A estimates | | Infant Deaths | E.S figures | M.A estimates | | Deaths* | M.A. estimates |
|---|---|---|---|---|---|---|---|---|---|---|
| 007 | 322044 | 305798 | 317687 | | 8194 | 5107 | 4670 | | 100974 | 92824 |
| 2008 | 333908 | 307423 | 323043 | | 6138 | 5416 | 6067 | | 107600 | 98023 |
| 2009 | 354482 | 310072 | 326234 | | 6721 | 5488 | 6719 | | 112013 | 102494 |
| 2010 | 359463 | 314513 | 336811 | | 8078 | 5611 | 7018 | | 124353 | 106862 |
| 2011 | 353759 | 319008 | 349284 | | 7752 | 5858 | 6979 | | 112142 | 114655 |
| 2012 | 360473 | 322483 | 355901 | | 8628 | 6047 | 7517 | | 104616 | 116169 |
| 2013 | - | 326282 | 357898 | | - | 6305 | 8153 | | - | 113704 |

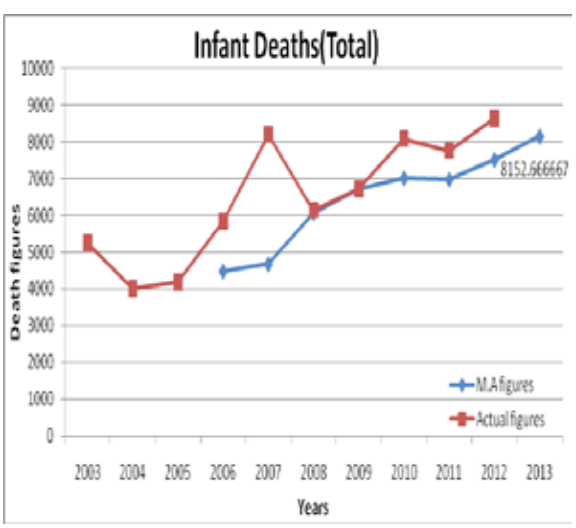
***The ES cannot be performed due to large irregular fluctuation**



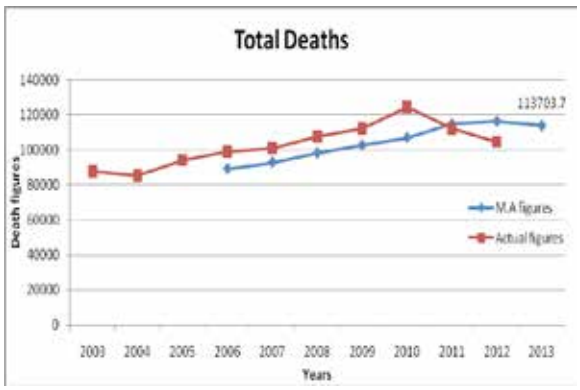

The estimated values Live Birth by the 'updation method' of exponential smoothing is as 326282 for the year 2013 and by the Holt's method ($Y^{\wedge}_{T+1|T} = \alpha y_T + \alpha(1-\alpha)y_{T-1} + \alpha(1-\alpha)^2 y_{T-2} + .$) is 3, 28,398. That means Holt's method gave better and more accurate estimates. The biggest variation was measured in the years 2005 and 2009 where the number of live births rose significantly higher than the previous year. The number of total live births estimated, by the moving average method, for the year 2013 is 3, 57,899. The data of actual live birth has been released by Delhi Govt. And found the live birth is 3, 70,000 which is near about estimated and forecasted live birth.




The estimated number of infant deaths by the updation method was calculated as 6305.The estimated figure by the Holt's method ($Y^{\wedge}_{T+1|T} = \alpha y_T + \alpha(1-\alpha)y_{T-1} + \alpha(1-\alpha)^2 y_{T-2} + .$) is 7024.35. It was observed that Holt's method gave better and more accurate estimates. In the 'M.A figures" denotes the number of total infant deaths as calculated by the moving average method. No general trend could be observed. At certain point's number of infant deaths showed an increase in one year and a decrease in the subsequent year followed by a further increase in the next year. The highest number of infant deaths was recorded in the year 2007 drastically increasing from the previous year. And then a significant drop in the year 2008 was also observed. The number of total infant deaths estimated, by the moving average method, for the year 2013 is 8,153 units. The data of actual infant deaths has been released by Delhi Govt. And found the infant deaths are 8,278 which is exactly equal to estimated and forecasted infant deaths.

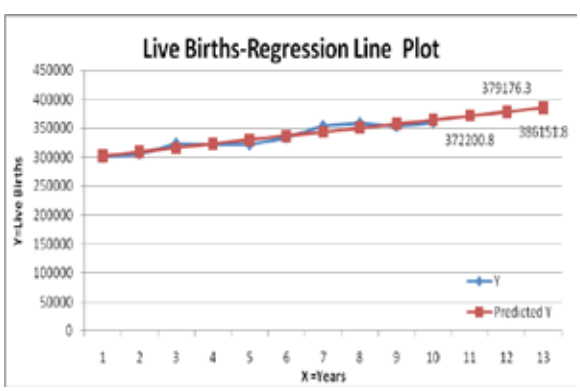
Volume : 5 | Issue : 6 | June 2015 | ISSN - 2249-555X




In the above presented graph, 'M.A figures" denotes the number of total deaths as calculated by the moving average method. No general Trend could be observed. Although number of deaths could be seen consistently rising from the year 2004 to 2010 but a sudden fall was observed thereafter. The highest variation in the observed data was seen in 2011 when the number of deaths reduced by 12211 units. The number of total deaths estimated, by the moving average method, for the year 2013 is 113704 units. The data of actual deaths has been released by Delhi Govt. And found the deaths are 97,185 which is near about estimated and forecasted infant deaths.

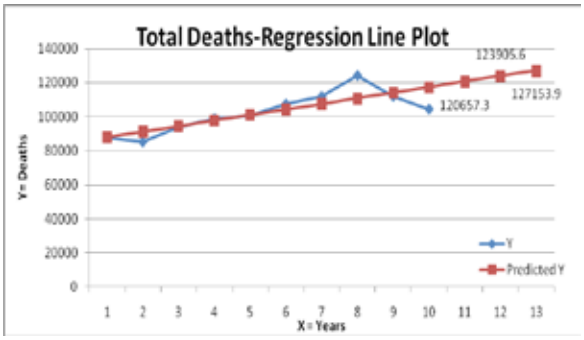
**Analysis of Regression and Variance**

The regression line fits very closely to the original value line which indicates a good fit i.e. Y = 295470 + 6975.5273(X).As per the data, an F-test at 95% confidence interval indicates that number of live births is independent of the years for which they were studied. Therefore live births are not dependent on years.



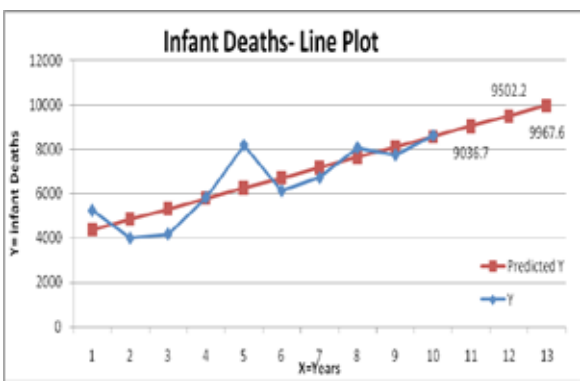

The regression line Y= a + bX was calculated as Y = 84925.53 + 3248.339(X).

The fit of the regression line is good and thus it can be said that the forecasted results can be used for study. As per the data, an F-test at 95% confidence interval indicates that number of Total deaths is independent of the years for which they were studied. Therefore Total deaths are not dependent on years.




The regression line Y= a + bX was calculated as Y =3916.5333 + 465.46667(X).

The original figures of Infant Deaths show irregular variation. Regression line doesn't fit well for the initial years but it fits well for the later years. As per the data, an F-test at 95% confidence interval indicates that number of Infant deaths is independent of the years for which they were studied. Therefore Infant deaths are not dependent on years.




**Conclusion**

Thorough examination and analysis of the data by various methods it could be concluded that the method of **Regression** analysis was the **most appropriate** to forecast the number of recorded (CRS) vital indicators (Live Births, Infant Deaths, Deaths) for the time series. However doesn't follow up any particular regular trend and also records irregular fluctuations among the data for the years 2003-2012 of Delhi-NCR. In another way method of Moving averages is applied for the, Live births and Infant deaths The ratio of infant Deaths to total deaths for the year 2013 was estimated to be 7.48% as compared to 8.25% of the year 2012.

| Summary of Forecasted Results-2013 | | | |
|---|---|---|---|
| Method Adopted | Live Births | Infant Deaths | Total Deaths |
| Regression * | 3,72,201 | 9,037 | 1,20,658 |
| Moving Average | 3,57,898 | 8,153 | 1,13,704 |
| Exponential Smoothing | 3,28,398 | 7,024 | 1,02,312 |
| * The best estimates as compared to other adopted methods and match with live birth of Delhi | | | |
| Forecasted results by Regression Method | | | |
| Vital Indicator | 2013 | 2014 | 2015 |
| Live Births | 3,72,201* | 3,79,177 | 3,86,152 |

Volume : 5 | Issue : 6 | June 2015 | ISSN - 2249-555X

| | | | |
|---|---|---|---|
| Infant Deaths | 9,037 | 9,503 | 9,968 |
| Total Deaths | 1,20,658 | 1,23,906 | 1,27,154 |

The percentage of infant deaths to total deaths at 7.48% is still very high when put in comparison to other bigger states despite of the fact that Delhi being the capital of the nation has better developed and wider reach of health amenities. It is suggested that appropriate weight be given to its study. A very disturbing fact is that number of infant deaths for the year 2013 was estimated to be higher than that of the 2012 which asks for utmost attention towards it. This study can definitely make the demographic picture clear and also shed light on the solutions to major problems. The 5%-10% variation of actual data and estimated or forecasted data may be treated as the best estimates.

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