INTRODUCTION

Fertility is determined by a complex set of biological, socio-economic, political, legal and psychological factors. Therefore social scientists belonging to different disciplines have developed calibrate theories of fertility suited to their disciplinary approaches. Crude birth rate (CBR) is an important measure of fertility, for it directly points to the fertility to the growth rate of the population. It is defined as the ratio of the total registered live births in a calendar year in a particular area to the mid-year population of that area in the given year. But this measure is greatly affected by the age-sex composition of the population. Any comparison of two populations with this measure may be misleading, if they vary widely in their age-sex composition.

A better picture of fertility can be obtained by examining the total fertility rate (TFR), because it is not affected by the age structure of the population. The total fertility rate is interpreted as the number of children a woman would bear during her reproductive period experiencing the current fertility.

However, in the majority of developing nation’s vital registration system are not good in coverage and quality. Moreover, any survey data from these countries, however, carefully planned and executed, are subject to large errors of omission of events, errors in the identification of the appropriate time period in which the events have occurred, and serious errors in the reporting of the age of the mothers like recall lapse, heaping etc.

For the estimation of total fertility rate generally used indirect methods are the birth history method and own-children method. Another indirect technique is...
proximate determinants model given by Bongaart\textsuperscript{1} and Bongaart and Potter.\textsuperscript{2} They have proposed a simple but ingenious method of quantifying the relative effects of the proximate determinants on fertility in a given population. Mauldin and Ross,\textsuperscript{3} Jain\textsuperscript{4} have used CPR to predict TFR of any population. In this context, demographers have also used the data of birth order for the estimation of total fertility rate. In this paper we have suggested a similar indirect estimation procedure for estimating total fertility rate through birth order statistics.

**THE DATA**

In the present study the data has been taken from National Family Health Survey (NFHS)\textsuperscript{5} and Sample Registration System (SRS).\textsuperscript{6} A brief description of these sources of data has given below.

Since the mid – 1990s, the Ministry of Health and Family Welfare, Government of India, has been relying increasingly on the country’s National Family Health Surveys (NFHS) to monitor and evaluate the success of its family planning and reproductive and child health programmes, both national wide and in individual states. The first such survey (NFHS-1) was conducted in 1992-93. NFHS-1 has published data on proportion of different orders of births for births occurring during last three years from the survey date.

In the absence of a complete and reliable civil registration system in India, the Office of the Registrar General established a sample Registration System (SRS) in 1964-65 on a pilot basis. India’s Sample Registration System also provides national and state-level estimates of fertility. The SRS is based on a nationally representative sample of villages and urban blocks. In the SRS sample, the sampling unit in rural areas is an entire village or segment of the village with a population of 1,500 or more. In urban areas the sampling unit is a census enumeration block with a population ranging from about 750 to 1,000. SRS has also published data on proportion of different orders of births.

**THE CHOICE OF A PREDICTOR**

In this type of estimation, the choice of predictor variable(s) is very critical and important. An inappropriate choice may result in not useful and sometimes misleading conclusions. The basic requirement in the choice is that the independent and dependent variable(s) should be highly correlated and data on independent variable(s) should be easily obtainable.

A married woman having no live born child is said to be of parity zero and if she has given live birth to one child then she is considered as parity one and so on. Birth order analysis is important in understanding trends and differentials in fertility and its indirect implications to population growth also. Thus, birth order data may be a good choice for predictor for the prediction of total fertility rate.

Recently demographers have used proportion of 3+ order births for estimation total fertility rate. Here, we have also used 5+ order births. Here another predictor is proposed, which is weighted average of proportions of different birth orders. Mathematically this predictor is

\[ X = p_1 + 2p_2 + 3p_3 + \ldots \]

Where \( p_i \) is the proportion of \( i \)th order births in the given period.

**METHODOLOGY**

The method is essentially based on the technique of regression line. Using regression line concept, the relationship between total fertility rate and birth order statistics is established.

When line of regression between TFR (Y) and proportion of 3+ order births (X) is drawn taking major states of India considering NFHS – 1 data, its equation is found to be
Y = 0.079 X – 0.3376 \quad (1)
\text{with } R^2 = 0.78

When the data of Sample Registration System (SRS) for different states for the year 1993 are used then the equation of the regression line is found to be.

Y = 0.0914 X – 0.2357 \quad (2)
\text{with } R^2 = 0.82

However, when a similar line is drawn taking X as the proportion of 5+ order births, the equation is found to be

(For NFHS – 1)
Y = 0.1041 X + 1.5435 \quad (3)
\text{with } R^2 = 0.83

(For SRS)
Y = 0.1629 X + 1.5423 \quad (4)
\text{with } R^2 = 0.80

Thus, the predictor here gives slightly better value of R^2 than the previous one. However, when a regression line is drawn taking X as weighted average of proportions of different birth orders the equation is found to be

(For NFHS – 1)
Y = 1.8385 X – 1.9119 \quad (5)
\text{with } R^2 = 0.86

(For SRS)
Y = 2.7486 X – 3.4449 \quad (6)
\text{with } R^2 = 0.83

When propose predictor which seems to further improve the value of R^2 is used.

RESULTS AND DISCUSSION

The observed TFR and those estimated with help of above lines are presented in Table-1and Table-2. These values are based on NFHS and SRS data, respectively.

Out of 15 major states under study, 5, 5 and 7 states have difference less than or equal to 5 percent, if using three predictors (viz. 3+, 5+ birth orders and weighted mean of birth orders). If the difference range has been taken upto 10 percent but above to 5 percent, the number of states 3, 7 and 2 respectively in this category. The no. of states, under three predictors are 7, 3 and 6 respectively, if the difference limit is above to 10 percent.

A similar pattern has been observed in SRS data also, for example, the number of states 6, 5 and 6 respectively, for the difference limit upto 5 percent , 1, 2 and 3 for 5-10 percent and for above to 10 percent the 8, 8 and 6 respectively.

On the above basis it is reasonable to conclude that all the above suggested predictors seem to be capable of providing good estimates of TFRs requiring less data.

\begin{table}[h!]
\centering
\caption{Estimated total fertility rate using the three predictors for major states: (NFHS – 1 data)}
\begin{tabular}{|c|c|c|c|c|}
\hline
\textbf{States} & \textbf{3 + order births} & \textbf{5 + order births} & \textbf{Weighted mean} & \textbf{Observed TFR} \\
\hline
India & 3.50 (3.2\%) & 3.55 (4.7\%) & 3.51 (3.5\%) & 3.39 \\
Haryana & 3.41 (-14.5\%) & 3.28 (-17.8\%) & 3.35 (-16.0\%) & 3.99 \\
Punjab & 3.04 (4.1\%) & 2.72 (-6.8\%) & 2.87 (-1.7\%) & 2.92 \\
Rajasthan & 3.67 (1.1\%) & 3.74 (3.0\%) & 3.67 (1.1\%) & 3.63 \\
Madhya Pradesh & 3.60 (7.7\%) & 3.72 (4.6\%) & 3.37 (-13.6\%) & 3.9 \\
Uttar Pradesh & 4.20 (-12.9\%) & 4.52 (-6.2\%) & 4.38 (-9.1\%) & 4.82 \\
Bihar & 4.12 (3.0\%) & 4.23 (5.0\%) & 4.20 (5.0\%) & 4 \\
Orissa & 3.45 (18.2\%) & 3.15 (7.9\%) & 3.30 (13.0\%) & 2.92 \\
\hline
\end{tabular}
\end{table}
<table>
<thead>
<tr>
<th>States</th>
<th>Estimated TFR from 3 + order births</th>
<th>Estimated TFR from 5 + order births</th>
<th>Weighted mean</th>
<th>Observed TFR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.31 (13.4%)</td>
<td>3.41 (16.8%)</td>
<td>3.33 (14.0%)</td>
<td>2.92</td>
</tr>
<tr>
<td>Gujarath</td>
<td>2.98 (0.0%)</td>
<td>2.92 (-2.3%)</td>
<td>2.88 (-3.7%)</td>
<td>2.99</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>3.04 (5.2%)</td>
<td>2.71 (-5.2%)</td>
<td>2.89 (1.0%)</td>
<td>2.86</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>2.99 (15.4%)</td>
<td>2.67 (-3.1%)</td>
<td>3.07 (18.5%)</td>
<td>2.59</td>
</tr>
<tr>
<td>Karnataka</td>
<td>3.01 (5.6%)</td>
<td>3.17 (11.2%)</td>
<td>3.05 (7.0%)</td>
<td>2.85</td>
</tr>
<tr>
<td>Kerala</td>
<td>1.72 (-4.0%)</td>
<td>2.20 (10.0%)</td>
<td>1.90 (-5.0%)</td>
<td>2</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>2.21 (-10.9%)</td>
<td>2.29 (-7.7%)</td>
<td>2.19 (-11.7%)</td>
<td>2.48</td>
</tr>
</tbody>
</table>

Figure in parenthesis shows the percentage difference between the estimated and the corresponding observed values for each state.

### Table 2

**Estimated total fertility rate using the three predictors for major states SRS (1993)**

<table>
<thead>
<tr>
<th>States</th>
<th>Estimated TFR from 3 + order births</th>
<th>Estimated TFR from 5 + order births</th>
<th>Weighted Mean</th>
<th>Observed TFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>3.6 (2.9%)</td>
<td>3.6 (2.9%)</td>
<td>3.6 (2.9%)</td>
<td>3.5</td>
</tr>
<tr>
<td>Haryana</td>
<td>3.5 (-5.4%)</td>
<td>3.4 (-8.1%)</td>
<td>3.5 (-5.4%)</td>
<td>3.7</td>
</tr>
<tr>
<td>Punjab</td>
<td>3.1 (3.3%)</td>
<td>2.7 (-10.3%)</td>
<td>3.0 (0.0%)</td>
<td>3</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>3.9 (13.3%)</td>
<td>3.9 (-13.3%)</td>
<td>3.9 (-13.3%)</td>
<td>4.5</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>4.0 (-4.8%)</td>
<td>3.6 (-14.3%)</td>
<td>3.8 (-9.5%)</td>
<td>4.2</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>4.6 (-11.5%)</td>
<td>5.0 (-13.8%)</td>
<td>4.8 (-5.8%)</td>
<td>5.2</td>
</tr>
<tr>
<td>Bihar</td>
<td>4.5 (-2.2%)</td>
<td>4.7 (-2.2%)</td>
<td>4.6 (0.0%)</td>
<td>4.6</td>
</tr>
<tr>
<td>Orissa</td>
<td>3.9 (25.8%)</td>
<td>3.5 (12.9%)</td>
<td>3.8 (22.6%)</td>
<td>3.1</td>
</tr>
<tr>
<td>Gujarat</td>
<td>3.2 (0.0%)</td>
<td>3.0 (-6.3%)</td>
<td>3.1 (-3.1%)</td>
<td>3.2</td>
</tr>
<tr>
<td>West Bengal</td>
<td>3.5 (16.7%)</td>
<td>3.9 (10.0%)</td>
<td>3.7 (23.3%)</td>
<td>3</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>3.4 (17.2%)</td>
<td>3.4 (17.2%)</td>
<td>3.2 (10.3%)</td>
<td>2.9</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>2.4 (-11.1%)</td>
<td>2.4 (-11.1%)</td>
<td>2.3 (-14.8%)</td>
<td>2.7</td>
</tr>
<tr>
<td>Karnataka</td>
<td>3.2 (10.3%)</td>
<td>3.2 (10.3%)</td>
<td>3.3 (13.8%)</td>
<td>2.9</td>
</tr>
<tr>
<td>Kerala</td>
<td>1.4 (-17.6%)</td>
<td>1.7 (0.0%)</td>
<td>1.7 (0.0%)</td>
<td>1.7</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>2.1 (0.0%)</td>
<td>2.2 (10.0%)</td>
<td>2.0 (-4.8%)</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Figure in parenthesis shows the percentage difference between the estimated and the corresponding observed values for each state.

### References


