Consistency between Vital Rates from Sample Registration System and Those Based on Census Age Returns: An Assessment Using the Variable – r Method

Suryakant Yadav[1] Prof. Subrata Lahiri[2]

Introduction:

The vital rates are important demographic characteristics as death rates and birth rates are basic measure of mortality and fertility respectively. In India, these rates are given by civil registration system. However, it is not considered as good source because of inadequate coverage of birth and death registration.

Sample Registration System (SRS) is the most reliable source for these vital rates in the absence of availability of good quality of civil registration statistics. SRS involves collection of data through two different procedure (i) continuous enumerations (ii) retrospective half yearly survey followed by the process of matching of two records and subsequent field verification of unmatched and partially matched events. This methodology provides a cross-check on the correctness and completeness of events.

Even after adopting this methodology SRS is not free from errors especially completeness of births and deaths records. According to the Registrar General of India (RGI), the omission rates in 1981 SRS were 3.1 percent for births and 3.3 percent for deaths. In 1985 omission rates declined to 1.8 percent for births and 2.5 percent for deaths (India Registrar General, 1988). However, SRS does not significantly under estimate mortality levels at ages less than five years in any state (Bhat, 2000).

A very straightforward method for calculating vital rates is based on the information on birth and death records in SRS. Alternatively one make use of an indirect technique (*variable-r approach*) to estimate vital rates from census age returns alone and can check the consistency of vital rates as given by SRS. An indirect technique formulated by Preston (1983) gives a very robust estimate of birth rate and a level of mortality for intercensal period. The information on age distribution as given by census can be sufficiently utilized to know the vital rates of any developing countries. If the age distribution is not much distorted it can give a very robust estimate of vital rates. This procedure involves integration of procedures like Brass logit transformation, Brass child mortality estimation and generalization of stable population into one to obtain birth rates, level of mortality and age distribution.

In this procedure age specific growth rate has a significant role, therefore, states with minimum intercensal migration rate like Rajasthan, Andhra Pradesh, Karnataka, Himachal Pradesh and India are selected.

1 Research Scholar, IIPS, Mumbai-88

2 Prof & Head, Dept. of Public Health & Mortality Studies, IIPS, Mumbai-88

Literature Review:

Preston (1983) developed a method for estimating robust estimates of birth rate, level of mortality and age distribution based on probability of surviving to exact age five (p(5)) and two census age distribution using the concept of generalization of stable population. Since the procedure is based on fewer assumptions, it is expected to provide robust estimate. He experimented with this procedure on Indian females (1971-1981) and South Korean females (1966-1975) and found that estimated birth rates are more robust than level of mortality as it is sensitive to many factors like migration, age-misreporting and choice of model. He estimated birth rate 42.1 in case of Indian females (1971-1981) which was very close to range of 40.5 to 42.0 estimated by Adlakha and Kirk (1974) and life expectancy 51.0 years which lies between 53.2 years estimated by Tim Dyson (1979) and 50.2 years given by Registrar General of India (1977) for the intercensal period (1971-1981). He estimated birth rate 27.07 and life expectancy at age five (e_5) as 63.07 which are in good agreement of values as given by Coale (1980) in case of South Korean females (1966-1975).

Bhat (1995) examined the impact of age misreporting on adult mortality estimates. He concluded that because of age-misstatement population in older age groups are artificially inflated. He also concluded that a simple smoothing of age distribution will not be adequately correct the distortions in the data. So using age distribution with artificially inflated population at older ages produces estimates of life expectancy of male derived from popular techniques of intercensal analysis are biased upward by about four years and females by two years. Age-misstatement also effects sex differential in adult mortality.

Objectives of the study:

i) To estimate levels of CBR and CDR for the period 1991- 2000 from census age distribution using a *variable-r* approach and to examine the consistency of the vital rates from SRS.

ii) To obtain smoothed age–distribution based on the variable-r approach.

Sources of data:

(i) Census of India, 1991
(ii) Census of India, 2001
(iii) Sample Registration System 1996

Methodology:

Concept:

Preston and Coale (1982) have shown that following relation always hold in a population closed to migration

$$c(a,t) = b(t)\exp(-\int_0^a r(x,t)dx\ )^* p(a,t)$$

Where c(a ,t)=proportion of population that is aged a at time t;

b(t)= crude birth rate at time t;

r(x,t) = annual growth rate of persons aged x at time t;

p(a,t) = probability of surviving to age a according to period life table prevailing at time t.

Preston introduces q (a) in Brass logit as:

$$\ln \frac{q(a)}{p(a)} = a + b \ln \frac{q_s(a)}{p_s(a)}$$

Solving the above two equation and substituting ß=1, we get

$$\frac{\exp(-\int_0^a r(x)dx\ )}{C(a)} = \frac{1}{b} + \frac{e^a}{b}\{\frac{q_s(a)}{p_s(a)}\}$$

…….. (1)

Here setting ß=1 is a reasonable assumption in any event, since it is rare to have sufficient quality to permit accurate estimation of both a and ß. ß is more vulnerable of the two parameters to systematic age misstatement and in any event the major interest is usually attached to knowing the "level" of mortality.

The concept of the method used in this paper is based on linear equation (1) where b is birth rate and e^a (*say K) is* the “level of mortality”.

Results:

The procedure gives a level of mortality, however, which is sensitive to many factors like age-misstatement, migration and mortality pattern. After choosing Coale-Demeny South model and states with minimum net migration rate, age misstatement is found to be playing significant role in determining the death rate as the slope of regression line is mostly determined by higher age groups. Robust estimate of birth rate is obtained because intercept formed by regression line is determined by the cluster formed by the intercept values for the age group 0-30. Unless all these values are disturbed birth rate will not be affected.

Level of mortality has been obtained by applying regression technique to the model. Grouped mean procedure has been used to get the best fit as it gives lesser weight to outliers in comparison to least square method. Once the level of mortality is obtained, age specific mortality rates can be easily computed. Death rates obtained from female age returns are found to be

consistent with SRS estimates[1] than male age returns. Bhat (1995) has explained the effect of age-misstatement on pattern of adult mortality. An attempt has been made through ogive curves to capture the age misstatement. Ogive curve gives the cumulative percentage of population up to the upper limit of required age group.

Estimated birth rates from male age returns for Andhra Pradesh and estimated birth rates from female age returns for India, Andhra Pradesh, Himachal Pradesh are very close to SRS estimates. Estimated birth rates for other states differ from SRS estimates. Probable reason can be the higher cumulative percentage of population in the census age group 0-30 than the cumulative percentage of population in the age group 0-30 of SRS age distribution. It is justifiable, since *C(a)*, the proportion of population aged "a" at time t is directly proportional to birth rate. Above assertion is also justified from ogive curves. Comparatively, the estimated birth rate obtained from male age returns are higher than that obtained from female age returns. Rationale for such estimates is the higher age-specific growth rates, which is directly proportional to birth rate.

Discussion:

Any method based on intercensal procedure is most affected by variation in age-specific birth/death rates and age-misstatement. While analyzing through gender differentials it is found that age specific rates differs and therefore, has effect on the estimates as well. Age misstatement is also found to be one factor affecting the estimates especially attributable to heaping in older age group. SRS estimates are believed to be reliable; even then it is concluded that estimates are affected by non – sampling errors and to noticeable extent. SRS age distribution differs from census age distribution. True age distribution obtained, also differs from the SRS age distribution. Comparison of population distribution of census and SRS shows that census has higher count in higher age group and therefore, affecting the estimates. In addition, discrepancy in estimates also indicates the errors in both censuses may not be similar. Overall, the variable-r method seems to fit well in the Indian demographic structure and the difference in estimates indicate the possible errors in both SRS and census age returns.

[1] Bhat (2000) has given the estimates of completeness of births and deaths for period (1991-1997). Assuming it to be true and remain constant for intercensal period (1991-2001), thus omission rates obtained are used to adjust the SRS estimates. These adjusted SRS estimates are used to compare estimated vital rates from present method used in this paper. Therefore, for convenience we are using SRS estimates instead of adjusted SRS estimates.