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Smoothed 1961 Census Age Distribution

Age distribution is important in demographic analysis. Unfortunately, the distributions produced by Indian Census are greatly distorted due to misreporting of age, arising mainly from ignorance of correct age and, to some extent, also from preference of the respondents for certain ages. In recognition of the problem, smoothed age data, aimed at producing distributions nearer to the true ones, were prepared for 1941, 1951 and 1961 by the writer as Census Actuary; these are published in two of the Census Papers.[1] In essence, the method adopted here is the removal of a major part of the distortions by applying, after a careful study of their nature, smoothing techniques. Recently, Coale has given a method of constructing the age distribution of a population subject to declining mortality in the recent past, and has illustrated the method by working out the age distribution of India for 1961[s]. Table 1 gives the relevant sets of age distributions; it will be seen from these sets that the distributions obtained by Coale closely agree with those of the present writer, ft may be noted that Coale's method does not directly use the distributions as recorded by the census. In his method, a first estimate of the birth rate is obtained from the median value of the series given by the recorded proportionate female population below age x for x = 5, 10, 15,.. 40, as seen from the 'West' female stable age distributions for different rates of population growth and mortality levels. The first estimate is adjusted for quasi-stability. Again, a first approximation to the age distribution is obtained by referring to 'West' female age distribution corresponding to the adjusted birth rate and the observed rate of population growth. This approximation is adjusted for quasi-stability by referring to a set of empirical tabulations of correction factors. Thus, the method attempts to estimate birth rate by identifying the recorded age distribution in the family of stable age distributions on the strength of a median value and by tracing back the stable age distribution corresponding to the estimated birth rate, given the observed rate of growth. The efficacy of the method hinges on the power of the median, based on some 7 to 9 values, to reflect the population characteristics.

Comparison of columns 3 and 4, or columns 7 and 8, of Table 1 shows trivial differences. Taking note of the differences, whatever they are, it is seen that the male figures in column 3 below age 25 and above age 50 are a wee bit smaller than the corresponding ones in col. 4 and that the reverse is true for age groups between 25 and 49. On the female side, figures in column 7 for age groups up to age 40, excepting the 15-19 group, are a wee bit higher, and for the 45-49 and higher age groups, a wee bit smaller than the corresponding values in column 8. However, both sets of smoothed age distributions go against the common belief that decennial age grouping minimises distortion due to age misreporting. A comparison of

Table 1 : Smoothed age-distributions, 1961 and 1951

	MALES				FEMALES			
		Smoothed, 1961		Smoothed, 1951		Smoothed, 1961		Smoothed, 1951
Age	Census	Writer	Coale	Coale	Census	Writer	Coale	Coale
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—4	.1469	.1624	.1625	.1532	.1548	.1685	.1647	.1527
5—9	.1463	.1305	.1318	.1226	.1486	.1340	.1320	.1240
10—14	.1162	.1129	.1142	.1114	.1083	.1138	.1137	.1121
15—19	.0823	.0980	.1002	.1014	.0813	.0981	.0991	.1014
20—24	.0805	.0863	.0874	.0914	.0900	.0870	.0860	.0903
25—29	.0820	.0779	.0762	.0808	.0849	.0785	.0747	.0795
30—34	.0707	.0697	.0661	.0713	.0698	.0687	.0645	.0693
35—39	.0602	.0602	.0566	.0618	.0558	.0570	.0551	.0597
40—44	.0535	.0511	.0485	.0525	.0506	.0474	.0474	.0515
45—49	.0431	.0428	.0416	.0440	.0391	.0394	.0412	.0436
50—54	.0404	.0346	.0349	.0354	.0375	.0320	.0353	.0361
55—59	.0234	.0267	.0281	.0275	.0214	.0253	.0291	.0287
60—64	.0252	.0194	.0214	.0201	.0260	.0193	.0228	.0216
65—69	.0109	.0129	.0148	.0134	.0112	.0132	.0162	.0149
70	.0184	.0146	.0155	.0130	.0207	.0178	.0182	.0146
	1.0000	1.0000	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000

columns 2 and 4 (or 3), or 6 and 8 (or 7) shows that the recorded group totals are not alternately in excess or deficit of the true figures as reflected by the smoothed series. There is a run of excess or deficit totals. Table 2 shows the group totals in the decennial age groupings.

Table 2 : Smoothed and Unsmoothed Age **Distributions**

Age	MALES		FEMALES	
	Unsmoothed	Smoothed	Unsmoothed	Smoothed
(1)	(2)	(3)	(4)	(5)
0-4	.1469	.1625	.1548	.1647
5-14	.2625	.2420	.2569	.2457
15-24	.1628	.1876	.1713	.1851
25-34	.1527	.1423	.1547	.1392
35-44	.1137	.1051	.1064	.1025
45-54	.0835	.0765	.0766	.0765
55-64	.0486	.0495	.0474	.0579

It is seen that the collapsing of the quinquennial into decennial age groups leads to an accentuation of the differences between recorded and true values. This is particularly significant in the case of females. The recorded (unsmoothed) figure is deficient particularly in the 15-24 age group, but it is in excess in the 25-34, and also in the 35-44 age group. Could it be that younger women have a marked tendency to overstate their age to appear elderly?

There is room for improvement in Coale's calculation of the pace of mortality decline, which is reflected in the rate of acceleration of growth rate. He takes 1921 as marking the beginning of mortality decline; and obtains the acceleration in the growth rate on this account "by substracting from 1951-61 rate of increase (which may be thought of as referring to the year 1956), the level of growth that prevailed on the average up to 1921. The latter may be estimated from the ratio of 1921 all-India population to the same population in 1881".[3] The expedient of adopting the average growth rate between 1881-1921 seems to have been necessitated by the fact that the total growth rate during 1911-20 was small and negative. Per cent decadal increase was-1.1 in 1891-1900, 5.8 in 1901-10, and-0.3 in 1911-20. Truly, growth rates during 1881-1920 showed a sequence of 'ups and downs' due undoubtedly to marked fluctations in mortality caused by recurring outbreaks of epidemics, pestilence, famine and scarcity. Heavy mortality entailed high infant and childhood mortality, which tended to raise fertility. In India, breast-feeding is universal, and this leads to a check on fertility. If lactation is stopped early due to the death of the infant, or the child, conception follows early. Hence, in conditions of high infant and child mortality, the schedule of age-specific fertility should be modified to an appreciable extent and the birth rate should be raised. Conditions of the period 1881-1920 throw doubt on the validity of the assumption of constancy of fertility and mortality necessary for the suitability of stable population model, on the basis of which Indian "population is taken to follow a, quasi-stable population course. It would make better sense if the 1921 age distribution had been identified with a

stable population distribution corresponding to a defined level of mortality and growth rate. In effect, this would mean a reorientation of the argument.

On the question of suitability of stable population model, Manual IV of the United Nations observes, "Ideally, stable estimation should be employed only for a closed population with constant mortality during the preceding 25-30 years and constant fertility for some two generations. A useful practical test is the absence of substantial change in age composition and of inter-censal rate of increase in three consecutive quinquennial or decennial censuses". Queerly enough, it holds that "Stable analysis is appropriate for India in 1911",[4] since age distribution from 1891 to 1911 is much the same in form, the observed regularities being due to age misreporting. Even granting that "the underlying age composition was essentially constant", the intercensal growth rate was not constant. The Manual gets over the point by saying that "the series of intercensal growth rates preceding 1911 lack any detectable trend away from the horizontal; rather ups are followed by downs in regular succession".

Constancy of age distribution and fluctuating growth rates are consistent with indirect or qualitative knowledge on the main features of the Indian demographic situation of the period preceding 1911. These features are frequent short term changes in mortality conditions coupled with the absence of lasting improvement, or deterioration, in the chance of dying; a sustained high level of fertility explained by the lack of contraceptive practices and quasi-universal and early marriage ; and finally, the essential closedness of the population with respect to external migration.

Stable conditions notwithstanding, no high precision can be expected from estimates derived by stable analaysis in the Indian case, primarily because of the defects in age reporting mentioned earlier.[5]

However, the logic takes a different turn, when it is stated that "Few populations for which estimation is necessary have been enumerated in an extended series of censuses of comparable quality, and it is often impossible to apply the suggested criterion of an essentially unchanging age distribution and rate of increase. The assumption of stability must often be made without much direct evidence in its support".[8]

Even as it is, the rate of acceleration of population growth during 1921-60 can be calculated from the equation:

$$\frac{dP}{dt} = c + at$$

where P=population at time t, c=growth rate before quasi-stability starts in = .0043 as taken by Coale, and a= acceleration in the growth rate. The equation is appropriate for a quasi-stable population. It gives:

$$\log_e \frac{P_1}{P_o} = \cdot 0043 \times 40 + \frac{1}{2} a (40)^2$$

Taking P_1=female population in 1961=212.94 millions, and P_0=female population in 1921= 121.24 millions, we get a = .00049 in place of .000417 as calculated by Coale. The

value of k, which is empirically taken as 17.8 *a,* would then be .0087 instead of .0074, which is taken as the constant change in fertility equivalent to the annual change in mortality. The difference is sufficient to affect the age distribution obtained.

Coale seems to attach some sort of finality to the age distribution obtained by his method, when he says that it is "less affected by massive age misreporting than a smoothed version of the recorded distribution".[7] His method is based on so many approximations, empirical relationships, and limitations, that it is difficult to accept this claim. He has clearly recorded the limitations and added that "The procedure is not applicable to all populations with constant fertility and recent declines in mortality".[8] His method assumes a major restriction on the the time pattern of decline in mortality, namely, "the decline in mortality must approximate a form such that the annual increase in the proportion surviving, from O to 5 exceeds the annual increase in the proportion surviving from 25 to 30 by a fixed factor ek".[9] This, he states, ensures "an approximately constant acceleration in the rate of increase in the population, if fertility remains constant". But where is the evidence that this condition is satisfied?

As regards other limitations, he says, "It cannot be applied unless the duration and pace of mortality decline is known, and it would provide a poorer approximation, if the mean age of fertility schedule were far removed from the 29 years of the schedule underlying the projection shown in Table 1, or if the age pattern of mortality deviated greatly from the West model. Even without violation of any assumptions, the calculations are only approximate".[10] There is no attempt to show how far the conditions for applicability are satisfied in the Indian case. On the other hand, in the illustrative example of calculating vital rates for India for 1911, it is pointed out that 'These statements qualified by the fact that there is no direct evidence confirming the validity of the 'West' pattern of mortality in the Indian case".[11] The decadal percentage variation in the population of India was 11.0 in 1921-30, 14.2 in 1931-40, 13.3 in 1941-50, and 21.6 in 1951-60. The growth was, more or less, steady in the first three decades and was accelerated in 1951-60. The acceleration was sustained in 1961-70, when decadal increase was 24.8%. The recorded growth rates do not support the assumption of a steady decline in mortality during 1921-60. It would be more appropriate to the case, if 1951 smoothed age distribution is adjusted for the accelerated growth during 1951-60 and the age distribution after 10 years of declining mortality is obtained by Coale's method to show 1961 age distribution. At any rate, it is an interesting exercise. The corrected age distribution for 1951 given by Coale and Hoover[11] is shown in columns 5 and 9 of the Table 1. It is seen that the percentages in 0-14 are higher and in the remaining ages lower in 1961 than the corresponding percentages in 1951 both for males and females.

Undoubtedly, application of stable and quasi-stable models opens a way for estimating demographic situation for developing countries, which do not have the necessary data with the requisite accuracy. When the situation is obscure, any reasonable estimate—nay, even guesstimates, may have to be accepted as working guides, but some discrimination is necessary. It is, of course, improper to clothe them with unwarranted authenticity.

References

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