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AGE DATA IN AFRICAN CENSUSES AND SURVEYS

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AGE DATA IN AFRICAN CENSUSES AND SURVEYS

1. After the figures of total population, the most important information which any census or demographic survey should aim to collect is that on the distribution of the population by age and sex. This information is essential for almost every aspect of development planning - for studies of employment, manpower, and the economic structure of the population, for educational planning, for the analysis of fertility, mortality and population growth and for the construction of population projections. Unfortunately in Africa the accurate estimation of ages constitutes one of the most difficult problems which face the census administration, simply because of the widespread ignorance of age in the orthodox sense of the completed number of years.

2. In recognition of the peculiar importance and difficulty of the problem, the First Working Group on Censuses of Population and Housing which met in Addis Ababa in June 1965 recommended that "the United Nations should sponsor a study of mis-statements of age in African censuses and of possible methods of improving the data." This paper has been prepared in response to this recommendation. It is divided into three main parts: the first describes the patterns of age mis-statement evident in the data obtained from African censuses and surveys; the second discusses methods of collecting the age data in the field; the third suggests methods of rectifying the figures after they have been collected and tabulated.

I. THE PATTERNS OF AGE MIS-STATEMENT IN AFRICAN CENSUSES AND SURVEYS

3. This study is not the only analysis of patterns of age mis-statement to have been made in recent years. Since the recommendation by the Working Group, similar studies have been undertaken by other agencies, notably the Office of Population Research in Princeton and the Institut National de la Statistique et des Etudes Economiques (INSEE), working in conjunction with the Institut National d'Etudes Démographiques, in Paris. The results of the Princeton study have been incorporated in the new United Nations Manual on methods of estimating population[1], and comprise analyses not only of African age distributions but also those of Asian and Latin American countries. The INSEE study[2] was confined to the former French territories in Africa south of the Sahara and covered the distributions by sex and five-year age groups obtained from censuses and demographic surveys of fifteen countries: viz. Guinea (1955); Ivory Coast (1957-59); Central African Republic (1959-60); Niger (1959-60); Senegal (1960-61); Mali (1960-61); Upper Volta (1960-61); Congo (Brazzaville)(1960-61); Gabon (1960-61); Dahomey (1961); Togo (1961); Chad (1963-64); Cameroon (1960-65); Mauritania (1964-66); and Madagascar (1957-61).

4. The data for the fifteen countries covered by the INSEE study have therefore been incorporated here, together with analyses of the age-sex data for a further fifteen African countries: United Arab Republic (1960); Morocco (1960); Libya (1964); Algeria (1966); Ghana (1960); Sierra Leone (1963); Liberia (1962); Congo (Kinshasa)(1955-57); Burundi (1965); Kenya

(1962); Angola (1960); Republic of South Africa (African population only) (1960); Botswana (1964); Swaziland (1966); and Lesotho (1966); For the remaining countries of Africa either no data have been collected (e.g. Ethiopia and Somalia); or they have been collected but not yet published (Nigeria 1963, Malawi 1966, Tunisia 1966 and Tanzania 1967); or they were collected in age groups too broad to be of use for this study (Rhodesia 1962, Zambia 1963, Uganda 1959 and Sudan 1955).

An African Population Pyramid

5. On the basis of the reported age-sex distributions for the thirty countries listed above, an attempt is made to present here a composite age-sex distribution which would reflect their principal features. It must be emphasised that this composite distribution does not purport to represent the age-sex structure of the population of the whole continent of Africa: in the first place many African countries were excluded from the study, for the reasons given above; and secondly in the construction of the composite distribution the figures for the individual countries have not been weighted in proportion to their total populations. The sole aim of the exercise is to illustrate the patterns of age mis-statement which usually afflict African census and survey data. The percentage age distribution of each sex and the sex ratios by age group of the composite population are shown in Table 1, and the figures are illustrated by the population pyramid in the accompanying figure.

Table 1

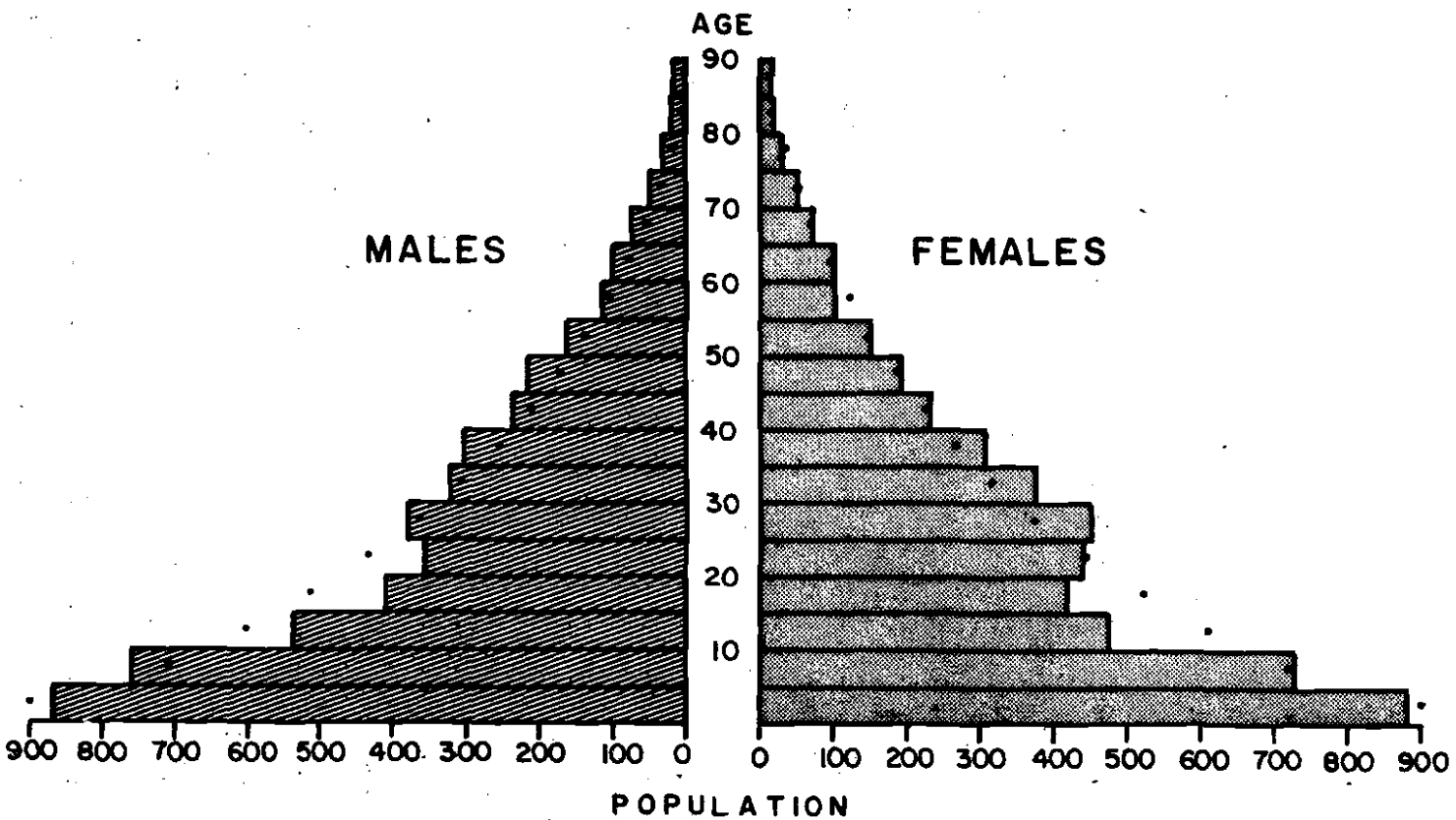
Percentage Age Distribution of Each Sex and Sex Ratios (Males per 100 Females) of a Composite African Age-Sex Distribution

Age Group	Percentage age distribution		Sex Ratios
	Males	Females	
0-4	17.5	17.5	99
5-9	15.3	14.6	103
10-14	10.8	9.4	113
15-19	8.2	8.3	97
20-24	7.2	8.7	82
25-29	7.7	8.9	85
30-34	6.5	7.4	87
35-39	6.1	6.1	99
40-44	4.8	4.6	101
45-49	4.3	3.8	113
50-54	3.3	3.0	108
55-59	2.3	2.0	114
60-64	2.0	2.0	103
65-69	1.5	1.4	106
70-74	1.1	1.0	102
75-79	0.6	0.6	103
80-84	0.4	0.4	105
85 +	0.4	0.3	106
Total	100.0	100.0	99

AN AFRICAN POPULATION PYRAMID

(BASED ON REPORTED AGE–SEX DISTRIBUTIONS OF THIRTY AFRICAN COUNTRIES)

Dots Represent Graduated Values



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6. The distribution is characterised by a broad base with relatively large numberso of children in the 0-4 and 5-9 age groups. The difference between numbers in these two age groups is frequently rather less than might be expected as a result of the known patterns of child mortality and population growth, and for some countries (e.g. Botswana and Lesotho) the numbers shown as aged 5-9 were even greater than those shown as aged 0-4.

7. The relatively large numbers under 10 are followed by a pronounced trough in the 10-14 and 15-19 age groups. This trough was a marked feature of almost all the age distributions studied, and the only countries where it was not clearly apparent were the U.A.R., Algeria, Lesotho and Swaziland. It is generally more pronounced for females than for males, and the sex ratios for the 10-14 age group showed more males than females in all the populations examined except Swaziland and Congo (Brazzaville); this excess of males was generally of the order of between 10 and 20 per cent, but in several countries it was over 30 per cent, and in Niger it was as high as 56 per cent. In the 15-19 age group no consistent bias in the sex ratios was apparent, some countries showing excesses of males and others excesses of females.

8. The trough in the 10-14 and 15-19 age groups is followed by a bulge in the 20-24 and 25-29 age groups. This bulge tends to be more pronounced for females than for males; indeed in many countries virtually no such bulge for males was apparent, while in others it was confined to the 25-29 age group, following a distinct trough at 20-24[3]. The greater prominence of the female bulge is reflected by the marked fall in the sex ratios, large excess numbers of females being reported in both the 20-24 and the 25-29 age groups. Of the thirty countries covered in this study, only three (U.A.R., Libya and Burundi) showed more males than females in the 20-24 age group, and only two (Libya and the Republic of South Africa) in the 25-29 age group.[4]

9. Above the age of thirty the numbers of both sexes show a progressive if somewhat irregular decline with age. The sex ratios, however, which in view of the normal pattern of excess male mortality might have been expected to decline with age, show instead a marked increase, and the great majority of the populations examined showed more males than females over the age of 40 years.[5]

The Directions of Age Mis-Statement

10. In order to account for these anomalies in the shape of most reported African age distributions, the composite distribution described above was graduated, using the stable population and sex ratio models described in the third section of this paper. By matching the graduated distributions against the reported ones, it has been possible to estimate the directions in which the ages of persons in the various age groups tend to be mis-stated. Several different models were used but in every case the same conclusions were reached on the directions of age mis-statement, except in two unitaries mentioned below. The values of the graduated distributions are represented by the dotes on the population pyramid.

11. It has sometimes been maintained[6] that the relatively large numbers reported as aged 0-9, followed by the sharp cut-back in the 10-14 age group may be, in part at least, a genuine feature of most African age distributions, and is attributable to drastic reductions in the levels of infant and child mortality during the decade preceding the census or survey. While it is undoubtedly true that such reductions in mortality will cause an increase in the proportion of children, we nevertheless believe that the principal cause is age mis-statement. In the first place, it appears to be a feature of almost all the reported age distributions, irrespective of the date of the census or survey; for example it is noticeable both in the data for Guinea obtained in 1955, and in those for Mauritania where the survey was conducted some ten years later. Secondly, in those countries where data from more than one census or survey are available, there seems to be no tendency for the bulge to move up into the 10-14 and 15-19 age groups (except perhaps in Madagascar where the standard of age reporting is officially higher than in most countries on the African continent). Thirdly, this type of distortion has been found, not only in African age data, but also in those of Asian countries with longer histories of census-taking; it was a prominent feature, for example, of the age distributions obtained from the Indian censuses of 1901 and 1911, when relatively little improvement in the levels of infant and child mortality had been effected.[7]

12. On the assumption, therefore, that the sharp drop in numbers between the 5-9 and 10-14 age groups is attributable chiefly to age mis-statement, the comparison with the stable population models indicated first that the 5-9 age group had been inflated by the inclusion both of children really aged 0-4[8] and of those aged 10-14. In contrast the 10-14 age group appears to have been depleted, not only by the under-statement of ages of some, causing them to be recorded in the 5-9 age group, but also in the case of females at any rate by the over-statement of ages of others, who are pushed up into the 15-19 group. In the case of males the position is somewhat obscure, the conclusions drawn being sensitive to the shape of the models used for the graduation. It has been maintained that the ages of some males in the 15-19 group tend to be under-stated, pushing them down into the 10-14 age group. The results of the present study, however, suggest that this movement may be less extensive than has sometimes been supposed, and that the high sex ratios in the 10-14 age group should be attributed primarily to the heavy two-way loss of females from this group.

13. Over the age of 15 the general over-statement of ages of females becomes increasingly pronounced. Between a quarter and a half of those really aged 15-19 are shown as aged 20-24, and a similar proportion of those really aged 20-24 are recorded as 25-29, thus creating the bulge in the latter age group noted above. Over the age of 30, however, the position as regards females is again somewhat obscure. It has been suggested that the ages of women in their late 30's tend to be under-stated,[9] but the evidence on this point is by no means conclusive. It is, however quite clear that the general tendency towards over-statement which so distorts the data for women between the ages of 15 and 30 generally eases up, and as Coale and Demeny

have pointed out,[10] the proportion of the total female population recorded as aged under 35 years tends to be one of the most reliable indices of the general shape of the age distribution. Somewhere about age 55, however, the general over-statement of female ages seems to be resumed, though the dimensions of this movement cannot be accurately estimated in view of our woeful ignorance of the patterns of African adult mortality and of past rates of growth.

14. For males the general over-statement of ages appears to begin in the 15-19 or 20-24 age group and shows no easing in the early 30's such as is evident for females. The proportions of each age group recorded in higher groups becomes progressively larger, and after the age of 60 less than a quarter of the male population seem to have been recorded in their correct quinquennial age groups.[11] The greater exaggeration of ages for males in comparison with females thus causes more pronounced heaping at older ages and the high sex ratios noted above.

Conclusions

15. The mis-statements of age which afflict the data obtained in African censuses and surveys are of a massive and deep-seated nature and are not confined to "digital preference" or rounding to the nearest numbers ending in 0, 5, 2 or 8.

16. Generally similar patterns of age mis-statement are evident throughout the continent. Indeed it may be observed that these patterns are not peculiar to Africa, and, as Coale and Demeny have shown, similar distortions are to be found in the data for Asian and Latin American countries.

17. Although the recorded age distributions for males may appear to be smoother than those for females, the inaccuracies may in fact be more serious, since the female age reporting suffers from alternating over - and under-statement, whereas that for males has a consistent and massive bias in one direction.

II. THE COLLECTION OF AGE DATA

1. The Form of the Age Question

Age or Date of Birth?

18. The censuses or surveys conducted in the majority of African countries have generally asked for the age of each individual enumerated either in completed years or in years and months. The only countries where the question on age has been replaced by one on the date of birth are Madagascar (1957-61), Rhodesia (1962), Zambia (1963) and Malawi (1966). In Rhodesia and Zambia

the questions did not require the date of birth by individual years for the whole population; persons over 16 in Rhodesia and over 21 in Zambia were merely allocated to broad groups. The data obtained are therefore insufficiently detailed to permit a critical evaluation of the procedure. No results from Malawi were available at the time of the preparation of this paper, and it is felt that conditions in Madagascar are in any case a typical of Africa as a whole.

19. When a question on date of birth has been substituted for one on age in Western countries (e.g. the U.S.A.) the information obtained is generally thought to have shown an appreciable improvement. It does not necessarily follow, however that a similar improvement would be affected in Africa. When the majority of the population do not know their date of birth its inclusion in the census or survey may simply impose on the enumerators a double task: they will first estimate the age, and then calculate the date of birth by subtracting the age from the date of the inquiry. On the other hand advocates of this approach argue that some respondents may in fact have a more accurate idea of their date of birth, which is fixed, than of their age, which changes from year to year, and that it might induce the enumerators to probe the question with the use of event calendars rather than simply to guess the person's age from his or her appearance.

20. Faced with this conundrum, some countries - notably Congo (Brazzaville) and Mauritius - have asked both for age and for date of birth, while others - notably Morocco (1960), Algeria (1966), Tunisia (1966) and Madagascar (1966) - have included both questions on an alternative basis: persons who knew their precise date of birth should record it, otherwise an estimate of the age should be entered. It is difficult to make an objective assessment of the success or failure of these procedures, and more data are needed before a final judgement can be passed. But it may be noted that the application of accuracy tests[12] has not indicated that the age data for the Congo (Brazzaville) are any more accurate than those for the neighbouring countries of the Central African Republic, Gabon and Cameroun, where only age was asked; nor were the data for Morocco and Algeria noticeably better than those for Libya and the United Arab Republic. In these circumstances it seems open to doubt whether the burdening of the questionnaire with the additional column for date of birth is justified, at least in rural areas.

Single Years or Broad Groups?

21. In many African censuses the information on age has been obtained in the form of broad groups, the enumerators being required to allocate the population to these groups rather than to estimate the ages (or dates of birth) in single years. This procedure was adopted, for example, in Nigeria in 1952-53 in Sudan in 1955, in Tanzania in 1957-58, in Uganda in 1959, in Rhodesia in 1962 and in Zambia in 1963. In its favour it may argued that it simplifies the enumerators' work, and that the data in single years are so inaccurate that all can be gleaned from them is a rough indication of the general shape of the age distribution which could be obtained equally well from broad groups. In some cases careful interpolations of these broad groups into the conventional

quinquennial groups (or any other required break-down) have been made, and it may well be that these interpolated distributions are just as close to the truth as those based on the graduation of data collected in single years.

22. There are however, valid reasons for preferring the single year approach. The age distribution obtained from a census or survey is not simply of value per se, but also because it may be cross-tabulated aginst the other characteristics under investigation; and even though the age data may be subject to considerable errors, it is nevertheless possible to establish the general relationship between age and these characteristics. When the original information on age is restricted to broad groups the value of such cross-tabulation is greatly reduced. The United Nations therefore firmly endorses the recommendation made by the two Working Groups on Censuses of Population and Housing that age data should be collected in single years, and welcomes the fact that the resort to broad age groups is now apparently becoming unfashionable.

2. Techniques of Estimating Age

Event Calendars

23. The use of calendars of notable events to assist enumerators in pin-pointing the dates of birth of their respondents is well known and need not be elaborated here.[13] There is however a mounting scepticism among persons concerned in this field of study as to the value of these event calendars. This scepticism rests on three major criteria. First, it has frequently been found that the population being enumerated is totally unfamiliar with many of the events listed in the calendars. This is particularly true of political events which may have seemed of paramount importance to the educated persons drawing up the calendars, but which in fact had had relatively little impact on the lives of the majority of the people, particularly those in remote rural areas. The second shortcoming of event calendars arises from the way in which they are used. Thus enumerators have sometimes been instructed first to estimate a person's age by looking at him, and then to refine this estimate by questioning him as to whether he remembers, or associates his birth with, the appropriate events in the calendar. But all too often a man (or woman) who appears to an enumerator to be, say, 50 years old in 1968 might readily acquiesce with the suggestion that he or she was born in the year of the influenza epidemic (1918) when in fact the respondent has not the faintest idea of what the enumerator is talking about, or even knows him to be wrong. Thirdly, the effective use of event calendars is a lengthy and laborious business, and the enumerators simply do not have the time to continue probing until a really accurate estimate of age has been reached.[14]

Conversion from a Locally-Recognised Method of Age Reckoning

24. The difficulties of obtaining accurate age statistics in Africa appear in some ways to be ironical, because although the population may be ignorant of their ages in the sense of the number of completed years, they are nevertheless acutely conscious of the general concept of age, which in Africa is

associated with status in a way unknown in western society. This awareness of age is sometimes reflected in the existence of tribal "age grades" or "age sets" - groups of individuals who have undergone circumcision or some other form of rite de passage at the same time or within a specified period and which play an important role in the hierarchy of society. If the relationship between these age grades and age in years can be established, useful indications of the latter can thus be obtained.15/

25. This method has the considerable advantage that most people when asked what age grade they belong to, can answer immediately and unequivocally, so that no probing is required. It is however of limited applicability. Many tribes and peoples have no age grade systems, and among others the age grades may be so broad as to be virtually useless for the purpose.16/ Elsewhere there may be important local variations in the system and nomenclature of the age grades even within the same tribe, and considerable care and research for small geographic areas is necessary before the conversion tables showing the relationship between the age grades and age in years can be drawn up.

Relative Ages of Persons in the Same Household or Locality

26. The relationship between age and status discussed above is sometimes also reflected in a general awareness of the relative ages of persons in the same community: although people may not know their ages in years, they may nevertheless be conscious of whether they are older or younger than other members of their household or village. This fact may be exploited: having determined the ages of one or two persons with a fair degree of precision (e.g. they may be in possession of birth or baptismal certificates), those of their relatives and neighbours can be estimated in relation to them. This method is perhaps one which has received insufficient attention to date, and its systematic use may well give valuable results. In particular attention should be paid to the relative ages of persons of opposite sex, since, as has been shown in the first section of this paper, the data for males and for females tend to suffer from different types of bias. It is, however, a technique which again requires time and probing if it is to be utilised effectively.

The Importance of Pre-Census Age Education

27. It will be seen from the foregoing that one of the great difficulties which hampers the collection of accurate age statistics in Africa is that estimation procedures are laborious and time-consuming, so that enumerators cannot reasonably be expected to exploit them efficiently. The only solution is therefore that the estimation should be done before the enumeration takes place, and an "age education campaign" should constitute an important element of the census publicity. The details of such a campaign cannot be discussed here, but two important features deserve mention. First, much can be done through the schools: if the techniques of age estimation are taught in class, the school-children can then implement them for their families and neighbours. Secondly, the establishment of informal committees for small geographical areas, comprising such persons as the chiefs, headmen, schoolmasters and priests, can be useful for the compilation of really meaningful

event calendars or age grade conversion tables, or for the pinpointing of the ages of prominent persons in the locality in relation to which those of others can be established.

III. THE RECTIFICATION OF THE REPORTED AGE DISTRIBUTIONS

28. It has been recognised by demographers for several years that the conventional methods which have been adopted for the graduation of the age distributions of western populations, and which aimed at no more than the elimination of a barely discernible digital preference, are entirely useless for the correction of the massive errors normally apparent in African data. Other more drastic methods of smoothing[17] sometimes been used successfully, but in recent years informed opinion has increasingly favoured the fitting of stable or quasi-stable population models. To take but two examples, the age distribution for the African population of Kenya obtained from the 1962 Census was corrected by the fitting of a stable population model based on the United Nations model life tables,[18] and in the recent INSEE study a quasi-stable model based on the Coale-Demeny "North" model life tables was adopted for the rectification of the age distributions of the fifteen French-speaking African countries listed in paragraph 3.[19]

The Brass-Carrier Models

29. Although the United Nations and Coale-Demeny models have often given satisfactory results, they suffer from the limitation that the underlying mortality models are essentially of the "single-parameter" variety - i.e., if the level of mortality at any age is determined the mortality rates at all other ages are also fixed.[20] This feature gives rise to a certain inflexibility in the stable population age distributions derived from them. Greater flexibility may however be achieved by the use of Brass's model life table system,[21] which is based on two parameters and thus permits variations in the relationship between adult and child mortality. It also has the advantage that it is based primarily on African mortality data, whereas in the case of the United Nations and the Coale-Demeny models no African data whatever had been incorporated in their construction.

30. A wide range of stable population models based on Brass's life table system have been constructed by Mr. N.H. Carrier of the London School of Economics. A selection of these models is reproduced in the Appendix to this paper.[22] They are arranged in groups showing the percentages under 15 (denoted by P) and over 45 (denoted by Q). They thus constitute ready-made graduated age distributions which may be taken "off the peg", and the main problem is how to select the most appropriate model. Experience shows that there is in fact no fool-proof, hard-and-fast rule for the selection of the best model; the problems vary greatly from population to population and a method which gives good results in one case may be useless in another; the element of subjective judgment can thus never be wholly eliminated.

Selection of a Model Age Distribution

31. There are basically two different approaches to the problem of selecting the best model, which we may term the "mathematical" and the "demographic" approaches. The mathematical approach is that which selects a given model on the criterion that it is a close mathematical fit to the recorded distribution - e.g. the sum of the squared deviations between the model and the recorded distribution are a minimum. With the demographic approach, on the other hand, the recorded distribution is ignored altogether and the model is selected on the basis of its underlying parameters of fertility and mortality, which should accord most closely with those estimated for the population concerned on the basis of other information. There are serious shortcomings inherent in both approaches. Thus the mathematical approach has been criticised on the grounds that "fitting by statistical methods such as least squares is not necessarily satisfactory since the assumption is that the age errors are divided fairly equally between positives and negatives over the range; the distortion may indeed be mainly in one direction.23/ On the other hand the demographic approach sometimes cannot be used at all, because no other data are available which will enable independent estimates of fertility and mortality to be made.

32. In these circumstances no precise procedure can be laid down, but we would like to suggest the following general rules:

(i) The initial selection of the model should not be made simply on the basis of the P and Q values on the recorded distribution; the percentage age distribution of the latter should be cumulated so as to show percentage aged under 5, under 10, etc., up to age 50, and these compared with the corresponding values of the cumulated models. In this way a "short list" of possible models may be compiled. The sums of the squared differences between these models and the recorded distribution should then be calculated to find which one will give the best fit on the basis of the "mathematical" approach.

(ii) The parameters of fertility, mortality and growth underlying the selected model should at least appear to be plausible for the population concerned. For this purpose three such parameters are shown in the Appendix for each of the models - the rate of population growth (per cent per annum), the infant mortality rate and the expectation of life at birth.

(iii) The corrections which the application of the selected model will make to the recorded distribution should appear to be reasonable. For example, if the model contains a higher proportion of old people than the recorded population (thus indicating that ages had been under-rather than over-stated), the use of that model should be distrusted.

(iv) In view of the fact that the general bias in the reported ages for males tends to be more serious than in those for females, and that male age distributions also tend to be more distorted by migration, it is often advisable to select the model by comparison with the female distribution only, and to graduate the male distribution by applying model sex ratios (see below) to the corrected females. If a separate fitting for males is made, the resulting pattern of sex ratios must be examined for plausibility.

(v) Despite the apparent embarras de richesses of models, improved results can sometimes be obtained by averaging two or more models, or by making small adjustments to selected models by linear regression of the recorded distribution on the models, provided that rules (ii) and (iii) above are not violated.

Sex Ratio Models

33. For the purpose outlined in (iv) above, we have constructed a set of sex ratio models for use with African data. These models are shown in Table 2, for various assumed sex ratios at birth (males live births per 100 female). These models were based on a study of sex differentials in age-specific mortality rates obtained in twelve African countries: Cameroon, Senegal, Mali, Upper Volta, Togo, Guinea, Dahomey, Chad, Central African Republic, Nigeria, Burundi and Congo (Kinshasa). Despite considerable irregularities for individual countries and age groups, the general pattern of these differentials appeared to be plausible and in general accordance with corresponding patterns derived from non-African populations.[24] Checks on the sex differentials in infant and child mortality were also obtained from figures of child-survival by sex available for nine countries: Mali, Niger, Guinea, Togo, Dahomey, Cameroon, Central African Republic, Congo (Brazzaville), and Gabon. The sex differentials in age specific rates were then combined with Brass's "African Standard Life Table" to obtain the sex ratios of the life table population.

34. There is a great shortage of reliable data on the sex ratio at birth in Africa,[25] but there is reason to suppose that it may be somewhat lower than in most European, Asian and Latin American countries. In the absence of any trustworthy indications to the contrary, it is suggested that for countries south of the Sahara the model based on the sex ratio at birth of 103 should be adopted, while for North African countries 105 or 106 may be more appropriate.

Adjustments for Migration

35. The age distribution and sex ratio models described above have of course been constructed on the assumption that there is no migration. Where such migration in fact exists, adjustments must be made for its effects on the age-sex distributions. In practice these adjustments cannot be made unless the appropriate information is obtained in the census or survey. In populations experiencing appreciable emigration, questions on members of the household outside the country by age and sex although inadequate as a means

Table 2

African Sex Ratio Models: Males Per 100 Females in Each Age Group

Age Group	Sex Ratio at Birth					
	100	102	103	104	105	106
0-4	97.6	99.5	100.5	101.5	102.4	103.4
5-9	96.8	98.8	99.7	100.7	101.7	102.6
10-14	96.7	98.6	99.6	100.6	101.5	102.5
15-19	96.8	98.7	99.7	100.6	101.6	102.6
20-24	96.8	98.7	99.7	100.7	101.7	102.6
25-29	96.8	98.7	99.7	100.6	101.6	102.6
30-34	96.6	98.5	99.5	100.5	101.4	102.4
35-39	96.2	98.1	99.1	100.1	101.0	102.0
40-44	95.2	97.3	98.3	99.2	100.2	101.2
45-49	94.1	96.0	96.9	97.8	98.8	99.7
50-54	91.9	93.7	94.7	95.6	96.5	97.4
55-59	88.8	90.6	91.5	92.4	93.3	94.2
60-64	85.3	87.0	87.9	88.7	89.6	90.4
65-69	81.7	83.4	84.2	85.0	85.8	86.6
70-74	78.0	79.5	80.3	81.1	81.9	82.7
75-79	73.3	74.8	75.5	76.3	77.0	77.7
80-84	66.6	67.9	68.6	69.3	69.9	70.6
85 +	52.9	54.0	54.5	55.0	55.5	56.1

of recording the total number of emigrants, have nevertheless been found to go a long way towards reducing the effects of such emigration on the age distribution. For countries experiencing net immigration a simple question on birthplace will enable the immigrants to be excluded, but will not wholly eliminate the effects of migration on the age structure, since the presence of local-born children of immigrants will still cause the distribution to diverge from the stable pattern. The classification of the population by "father's country of birth", such as was made in Ghana in 1960, should permit a closer approximation to stable or quasi-stable conditions.

36. In Africa, a great part of the existing migratory movements consists of temporary labour migration of unattached males. The effects of this type of movement on the age distribution are relatively easy to liminate. The problem arising from the migration of whole family units, however, is more intractable, and it must be admitted that no satisfactory solution has as yet been found. There is a great need for further research on African migration and its effects on age-sex structure; if such research results in the construction of useable migration models, a considerable advance will have been achieved.

NOTES AND REFERENCES

1. United Nations, Methods of Estimating Basic Demographic Measures from Incomplete Data (by Ansley J. Coale and Paul Demeny), New York 1967 (ST/SOA/Series A/42), pp. 17-22.

2. Afrique Noire, Madagascar, Comores: Démographie Comparée. 9-10 - Structures par âge, actuelle et future, by F. Gendreau and R. Nadot, Paris 1967.

3. The INSEE study notes that the pattern for the countries formerly constituting French Equatorial Africa (Chad, Central African Republic, Congo and Gabon) is somewhat different, the main trough for males being situated in the 15-19 age group and the main bulge in the 35-39 or 40-44 age group.

4. The sex ratios in the 20's and 30's are of course particularly liable to be affected by migration, which may well have been instrumental in producing the excess of males in the 25-29 age group in Libya and the Republic of South Africa.

5. The only exceptions were Botswana, Lesotho and Swaziland, and Togo, Congo (Brazzaville), and Gabon. Migration again may have been a factor.

6. See, for example, the INSEE study, pp. 32, 56-63.

7. For further discussion of this point, see Etienne van de Walle, "Some Characteristic Features of Census Age Distributions in Illiterate Populations", The American Journal of Sociology Vol. LXXI No. 5 (March 1956).

8. Apparent deficits of children in the 0-4 age group have frequently been attributed to under-enumeration, but there is a good case for believing that the major factor was really age mis-statement, which is itself attributable, in part at least, to the western method of reckoning age "at the last birthday". Thus according to the western definition a child aged 4 years 364 days is still only 4 and not 5 years old. But if the date of birth is not known precisely, there will be a natural tendency for the ages to be rounded up, thus leaving deficits at the youngest ages. It is often instructive to examine the distributions by single years of age, the patterns of mis-statement among children then being clearly apparent. Thus it occasionally happens that the "under 1" age group is inflated, since the attention of the enumerators may have been specially drawn to it, and there is a tendency for them to include all unweaned babies at this age. There is then a marked deficit at age 1, followed by inflated numbers at 2, 3, 4, 5 and 6.

9. See, for example, W. Brass, "Uses of Census or Survey Data for the Estimation of Vital Rates", Paper presented to the ECA Seminar on Vital Statistics, Addis Ababa, December 1964, paragraph 18. The figures shown in the INSEE study also suggest under-statement at these ages.

10. Op.cit., p. 23.

11. Confirmation of a different sort of the extreme unreliability of the ages reported for old people is available from the Ghana 1960 data. Matching of a sub-sample of records obtained from the Post-Enumeration Survey with those from the main Census showed that less than 25% of males over 65 gave ages in the same quinquennial age group in the two enumerations, which were separated by only a few months.

12. It should be noted, however, that none of the standard accuracy tests is, in our opinion, suitable for application to African data. The United Nations test based on age and sex ratios (which was in fact used in the present instance) only measures the smoothness of the data and takes no account of general bias. Indeed in some cases the results of this test may be actively misleading. The same goes for the tests of digital preference (e.g. Myer's index or Whipple's index). An ad hoc test which was also applied in the present case consisted simply in summing the divergences of the recorded sex ratios from those of the sex ratio models. This test is also clearly unsatisfactory in that the results, may be biased by migration, but it may nevertheless be more meaningful than the other types of test.

13. For an account of the use of event calendars, see, R. Blanc, Manuel de Recherche Démographique en Pays Sous-Développé.

14. Probably the most detailed and systematic use which has ever been made of event calendars was that adopted in the second round of the 1961-63 multi-purpose sample survey of Morocco, an account of which is given by Christopher Scott and Georges Sabagh in a forthcoming paper - "The Historical Calendar as a Method of Estimating Age", shortly to be published in Population Studies. Even in this case, however, it was by no means certain that the use of the calendars effected a material improvement in the quality of the data.

15. For an account of the use of age grades among the Kikuyu and Bukusu peoples in Kenya, see J.C.C. Blacker, "Use of Sample Surveys to obtain data on age structure of the population where respondents in a regular census enumeration cannot give accurate data", World Population Conference 1965 Vol. III, pp. 126-130.

16. Even fairly broad age grades, however, may help to prevent the wholesale exaggeration of ages among old people. Thus in the 1966 Census of Swaziland use was made of the Swazi "Regiments" for the estimation of ages. The results showed remarkably little evidence of over-statement of ages among old people, and there is reason to suppose that the use of the regiments may have been instrumental in preventing this bias.

17. See, for example, N.H. Carrier and A.M. Farrag, "The Reduction of Errors in Census Populations for Statistically Underdeveloped Countries", Population Studies Vol. XII No. 3 (March 1959).

18. Kenya Population Census, 1962, Vol. III, pp. 27-30, 89. For the U.N. model life tables, see Methods for Population Projections by Sex and Age (ST/SOA/Series A/25) New York 1956.

19. Gendreau and Nadot, Op.Cit., pp 58-56. For the Coale-Demeny model life tables, see Ansley J. Coale and Paul Demeny, Regional Model Life Tables and Stable Populations, Princeton 1966.

20. The Coale-Demeny tables provide a greater flexibility than the U.N. models in that they present four different "families" of model life tables and stable populations, with differing patterns of mortality.

21. See W. Brass, "Uses of Census of Survey Data .....", paragraphs 30-37.

22. Thanks are due to Mr. Carrier for permission to reproduce these models. Responsibility for the selection of the particular models shown here, and for the comments on their use, rests with the authors of this paper.

23. W. Brass, "The Use of Existing Data", in The Population of Tropical Africa (ed. J.C. Caldwell and C. Okonjo) Longmans 1968, pp. 174-5.

24. See, for example, the discussion of sex differentials in mortality in the United Nations monograph, Age and Sex Patterns of Mortality: Model Life Tables for Under-Developed Countries (ST/SOA/Series A/22) New York 1955, pp. 16-20.

25. One of the major problems in obtaining information of the sex ratio at birth is that it is subject to large random errors, so that relatively large numbers are needed. Accurate information on sex relating to about a quarter of a million births are needed before any worth-while conclusions can be drawn.

APPENDIX

Woman-Carrier Stable Population Models: Model Age Distributions Per 10,000 of All Ages

Percentage Under 15 (P)	Percentage Over 45 (Q)	Age Distribution Per 10,000																Rate of Natural Increase (Per Cent Per Annum)	Infant Mortality Rate Per 1,000	Expectation of Life (eo)
		0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+			
35	18	1331	1125	1044	964	904	820	741	664	587	506	420	331	241	157	88	57	0.2	151	31
	19	1334	1188	1038	968	885	802	723	649	575	501	423	343	260	180	110	83	0.6	163	34
	20	1333	1133	1034	954	867	782	706	632	562	493	423	351	277	203	134	120	1.0	167	38
	21	1329	1139	1032	941	850	764	686	614	546	482	413	354	289	224	159	173	1.4	153	45
36	17	1376	1157	1067	1000	913	822	737	655	574	490	402	313	224	143	79	48	0.3	145	30
	18	1380	1160	1061	983	893	802	719	640	564	486	407	326	244	166	99	72	0.7	159	33
	19	1380	1164	1056	968	874	783	700	624	551	479	407	335	262	189	122	107	1.1	166	38
	20	1377	1170	1053	955	857	765	682	606	536	469	404	339	274	210	147	156	1.5	157	44
37	17	1425	1191	1083	998	900	803	715	632	551	472	390	308	227	152	89	62	0.8	152	33
	18	1427	1195	1078	982	881	784	697	616	540	466	392	319	245	175	111	93	1.2	162	37
	19	1425	1201	1074	968	863	766	678	599	526	457	390	324	260	196	135	138	1.6	156	43
38	16	1477	1220	1103	1012	908	805	711	624	540	457	374	291	212	138	78	52	0.8	158	32
	17	1472	1227	1100	997	888	785	693	606	529	452	377	303	230	160	100	79	1.3	154	37
	18	1472	1233	1096	982	870	766	674	592	515	444	376	310	245	182	123	121	1.7	154	43
	19	1466	1240	1094	969	853	748	656	574	500	433	370	312	255	201	148	182	2.1	131	52
39	15	1527	1249	1124	1087	916	806	707	615	528	442	357	273	194	123	68	42	0.8	158	30
	16	1525	1255	1119	1010	896	786	689	601	518	439	362	286	213	146	88	67	1.3	161	35
	17	1518	1263	1118	996	877	767	671	584	505	432	362	295	230	168	111	103	1.8	147	43
	18	1523	1266	1111	981	859	749	653	568	491	422	358	298	241	186	135	160	2.1	170	47
40	14	1570	1282	1148	1044	925	808	703	606	515	426	339	255	177	110	58	34	0.9	142	31
	15	1577	1284	1139	1024	903	788	685	593	507	425	346	270	197	131	77	55	1.3	167	33
	16	1572	1292	1134	1009	883	768	667	577	495	420	348	280	214	153	99	87	1.8	162	40
	17	1570	1298	1132	994	865	749	649	561	482	411	345	285	227	173	122	137	2.2	161	46
41	14	1628	1313	1159	1039	910	789	681	585	496	411	330	253	180	117	66	44	1.3	164	32
	15	1617	1325	1159	1023	890	769	663	570	485	407	334	264	199	139	87	71	1.9	146	40
	16	1616	1330	1154	1007	871	750	645	554	472	399	333	271	213	159	110	114	2.3	148	46
42	13	1677	1342	1181	1054	918	790	677	576	484	396	313	235	164	102	55	34	1.3	156	31
	14	1669	1353	1178	1036	897	770	660	562	475	394	319	249	183	124	75	57	1.9	149	38
	15	1672	1358	1172	1020	877	751	642	547	463	388	320	257	199	145	97	94	2.3	163	43
43	12	1726	1373	1203	1070	927	792	673	568	471	381	296	217	147	88	46	26	1.3	145	30
	13	1728	1378	1195	1049	904	771	656	555	464	381	304	232	167	109	63	44	1.8	164	34
	14	1724	1386	1190	1032	883	751	[illegible]	540	454	377	307	243	184	130	84	75	2.3	169	40
44	12	1776	1408	1216	1064	912	772	652	547	453	367	286	215	150	95	52	33	1.8	153	33
	13	1776	1414	1210	1045	890	752	635	533	445	365	293	228	168	116	71	58	2.3	166	38
	14	1768	1425	1207	1029	870	733	617	518	433	359	293	235	183	136	94	101	2.8	154	47
45	11	1830	1435	1235	1079	920	774	648	539	441	358	271	198	133	80	42	24	1.7	150	31
	12	1826	1444	1230	1059	897	753	631	526	434	353	279	212	153	101	59	43	2.3	156	37
	13	1822	1453	1225	1042	876	733	613	511	424	348	281	222	169	121	80	78	2.8	158	44
46	11	1883	1470	1247	1073	904	754	627	518	424	339	264	196	136	86	48	32	2.2	158	34
	12	1874	1481	1244	1054	882	734	610	505	415	337	268	208	156	107	69	58	2.8	152	42
47	10	1936	1497	1267	1088	912	755	623	510	413	325	247	178	118	72	37	22	2.1	150	31
	11	1924	1511	1265	1068	889	735	606	488	395	313	235	163	109	62	35	41	2.8	139	40
	12	1930	1514	1256	1049	868	715	589	484	396	321	257	202	153	111	75	80	3.2	173	46
48	10	1990	1538	1279	1080	896	736	608	491	395	312	240	177	122	77	43	29	2.6	158	35
	11	1988	1544	1275	1061	874	715	585	477	387	311	245	188	139	97	62	57	3.2	158	44
49	9	2050	1555	1295	1095	904	737	598	483	384	298	224	158	105	61	32	19	2.4	158	31
	10	2041	1568	1282	1073	880	716	582	472	378	299	232	174	124	81	49	39	3.1	161	38
	11	2038	1577	1285	1055	858	696	565	457	369	295	234	182	138	101	70	80	3.6	182	48
50	9	2095	1595	1310	1087	887	717	578	463	368	287	217	158	108	68	37	25	3.0	150	36
	10	2089	1607	1305	1067	864	697	561	451	360	289	222	170	125	87	56	54	3.6	155	46