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A MODIFIED METHOD ESTIMATING AGE-SPECIFIC SURVIVAL RATIOS

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In the absence of detailed mortality data, model life tables are often used to estimate age-specific death rates when the general level of mortality of a population is given. In this estimation, it is assumed that the age patterns of mortality of the population resemble those given in the selected model life tables.

For populations with little information on deaths, this assumption has generally been accepted without questioning its validity. Even though there are data on deaths classified by age, model life tables are still preferred to actual data by many if the reliability of the data is in doubt. Furthermore, the model life tables are convenient to use when a series of consistent mortality rates over time is needed, for instance, in the case of population estimates and projections.

However, it is known that the age patterns of mortality in many populations are quite different from those given in model life tables. The death rates or survival ratios specified by age derived from model life tables for such populations are, in fact, distorted estimates. If a population has a set of reasonably reliable mortality rates classified by age, such information should be taken into account when age-specific mortality rates of a different date or a different mortality level are to be estimated.

The United Nations developed in 1956 a simple method to estimate the current levels and future trends of mortality rates with the use of the United Nations model life tables.[1/] This method first identifies, for each age group,

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1/ Methods for Population Projections by Sex and Age (United Nations Publication, Sales No.: 56.XIII.3), Chapter IV.

the level of mortality implied by the given mortality rate in accordance with the model life tables and assumes that future mortality improvement of each age follows the one suggested by the model, i.e., that mortality will improve by five levels in every five years. The projected mortality rates are then read off or interpolated from the model life tables for each age group separately.

The methods described below employ a different approach. For a given set of age-specific mortality rates, an expectation of life at birth expresses the overall mortality level of the rates. For the same $\overset{\circ}{e}_o$, another set of mortality rates can be obtained from a selected model life table. In some age groups, given mortality rates are different from the selected model life table rates. These differences, however, are used as the basis for adjusting the model life table mortality rates of an expected mortality level and for obtaining the desired age-specific mortality rates.

The present approach has an advantage of predetermining an expected overall mortality level and deriving the age-specific mortality rates accordingly while the early method may obtain the overall mortality level only after the age-specific rates are derived. Two methods, the constant method and the modified method, have been developed; the latter is a modification of the former. For the convenience of discussion, the method of obtaining mortality rates directly from the model life tables is called the model life table method. Since the development of the present methods is mainly for population projections, the following uses the estimation of survival ratios as the example for discussion.

A. Assumptions

A basic assumption adopted in the constant method and the modified method is that, for an age group, the increase or decline in the probability of surviving from one mortality level to the next follows a pattern of change provided by the model life tables for that age group. Furthermore, the highest or the lowest survival ratio that an age group can attain may not go outside of the range of survival ratios provided by the model life tables, unless the base survival ratios are already outside the range. For the latter case, the base survival ratios are kept unchanged in the estimation if the expected $\overset{\circ}{e}_o$ is higher (or lower) than the base $\overset{\circ}{e}_o$ and the base survival ratios are higher (or lower) than the highest (or lowest) survival ratios given in the model life tables.

B. Method

For every age group i, let PA_i be the survival ratio of a given population which has an overall mortality level of A, in terms of the expectation of life at birth, and let MA_i be the model life table survival ratio for mortality level A. The difference of the two survival ratios is $PA_i - MA_i$ and let it be G_i.

As the mortality level changes from A to N, N may be either higher or lower than A, a new set of survival ratios, PN_i, is sought. At the mortality level N, a set of survival ratios, MN_i, may be obtained from the model life tables. The constant method assumes that G_i remains unchanged. Thus,

$$PN_i - MN_i = PA_i - MA_i = G_i$$

or

$$PN_i = MN_i + (PA_i - MA_i)$$
$$= MN_i + G_i \qquad (1)$$

In other words, the estimated survival ratios, PN_i, is a modification of the model life table survival ratios, MN_i, according to the relationship between PA_i and MA_i.

If the age patterns of mortality of the population and of the model life tables are the same at mortality level A, or $PA_i = MA_i$, for every i, then at mortality level N,

$$PN_i = MN_i$$

That is to say, the estimated survival ratios of mortality level N is exactly the same as those obtained directly from the model life tables for the same mortality level.

Equation (1) generally gives quite satisfactory results despite its simplicity. However, it has been observed that as mortality declines, survival ratios tend to increase more slowly than when mortality is higher. If the difference between the mortality level of the base population and the estimated population (i.e. between A and N) is large, especially if the life expectancy at birth of the latter population is very high, the assumption of a constant G_i cannot be held.

An adjustment is introduced so that the factor G_i is modified as the expectation of life at birth is increased. This is the modified method.

Let H_i be the survival ratios of the lowest mortality level of the model life tables (which has the highest life expectancy at birth). The ratio K_i is defined as

$$K_i = (PA_i - MA_i)/(H_i - MA_i) = G_i/(H_i - MA_i)$$

K_i is then the relative difference between the base and the model life table survival ratios at mortality A for each i, in terms of the difference between the survival ratios of the lowest level and the level A in the model life tables. Assuming that K_i will remain unchanged, so

$$K_i = (PN_i - MN_i)/(H_i - MN_i)$$

and

$$\begin{aligned} PN_i &= MN_i + K_i\,(H_i - MN_i) \\ &= MN_i + (PA_i - MA_i).\ \frac{(H_i - MN_i)}{(H_i - MA_i)} \\ &= MN_i + G_i\ \frac{(H_i - MN_i)}{(H_i - MA_i)} \end{aligned} \qquad (2)$$

This adjustment gives assurance that as the life expectancy reaches the highest level in the model life tables, MN_i reaches H_i and $PN_i = MN_i$. As MN_i increases, the factor $(H_i - MN_i)/(H_i - MA_i)$ declines and so G_i is modified. But if MN_i is close to MA_i, $PN_i \tilde{=} MN_i + G_i$. A test of equations (1) and (2) shows that when MN_i is large, equation (2) gives better estimates than equation (1), but when MN_i is small and close to MA_i the results are not conclusive. The following, therefore, discuss only the results obtained from the modified method.

C. Resul

Tab

C. Results

Table 1 presents the indices of relative difference[2/] for 30 populations[3/] computed from a comparison of two sets of age-specific survival ratios, one taken from a national life table and the other estimated from the model life table with and without the use of the modified method; the two sets have the same overall expectation of life at birth. Population 1, Colombia, males, 1960-1964, gives the estimation of the 1964 male survival ratios on the basis of the 1960 male national life tables; Population 24, Chile, females, 1950-1930 gives the estimation of the 1930 female survival ratios on the basis of a 1950 female national life table, etc. Table 2 presents a similar comparison for only the three youngest and the three oldest age groups since the largest differences between the estimated and the national life table survival ratios tend to occur in these ages. Because of a large volume of data, detailed comparison of the survival ratios by age between the estimates and those given by the national life tables is presented only for five of the 30 populations in Table 3. In this table, the base survival

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2/ Index of relative difference is defined as:

$$IRD = \sum_{i} \left| \frac{Ai - Bi}{Bi} \right| \Big/ 2N \times 100$$

where A is the estimated ratio and B is the observed ratio and N is the number of observation or the total number of i. See Henry S. Shryock, et.al., The Methods and Materials of Demography, Vol. 1, Washington, D. C., The U. S. Government Printing Office, 1971, p. 232.

3/ See footnote 1/ in Table 1. All the national life tables are taken from Samuel H. Preston, et.al., Causes of Death, Life Tables for national populations, New York, Seminar Press, 1972.

ratios taken from a national life table are shown in Column 2. Another set of national life table survival ratios of a different mortality level, called the "actual" ratios, is shown in column 3. The estimated survival ratios which have the same overall mortality level, i.e., $\overset{\circ}{e}_o$, as the "actual" ratios, are given in columns 4 to 8, according to the model life tables used in the estimation. The upper half of columns 4-8 are the results derived with the use of the modified method (modified ratios) and the lower half indicate ratios obtained with the use of the model life table method (model ratios).

It can be seen clearly from Tables 1-3 that modified ratios give much better estimates, i.e., they are closer to the "actual" than model ratios. The indices of relative difference (IRD) given in Tables 1 and 2 are much smaller in a comparison between the "actual" and modified ratios than in that between the "actual" and model ratios for the great majority of the 30 populations.[4/] A detailed comparison by age given in Table 3 also gives the same conclusion.[4/]

As mentioned before, when the base survival ratios for a certain age group exceeds the highest survival ratios provided by the model life tables, the modified method keeps the same base ratios in the estimation if the expected overall $\overset{\circ}{e}_o$ is higher than the base $\overset{\circ}{e}_o$. This is illustrated in the examples given in Populations 1 and 4 in age group 75+/80+.

4/ The five examples for Sweden (ex. 17-22) give smaller IRDs in the comparisons between the "actual" and the model ratios than between the "actual" and the modified ratios. But since all the IRDs are so small, the above differences are, therefore, insignificant.

The modified method will fail to project a significant change in mortality in some age groups if such changes are very much different from those patterns assumed in the model life tables. This situation happens most often in the old age groups in about half of the 30 populations. However, the failure may be due to the fact that the two national life tables selected under comparison (the base and the "actual" ratios) are not comparable. Thus, the selection of the base data plays a very important role in the outcome of the estimation.

The adoption of a particular model life table in the estimation is not very important when the modified method is applied. From Table 1, the smallest IRDs are found more in the West and East model life tables than in the other three model life tables (United Nations, North and South), although the differences among various models are not significant in many of the 30 selected populations. Since the South model has only four small IRDs among the 30 populations and since the highest survival ratios in some age groups of the United Nations model life tables have already been exceeded by many low mortality populations, the use of either the North, West or the East model life tables in the application of the modified method will give a satisfactory estimate for the survival ratios.

D. Adjustment of $\overset{\circ}{e}_o$

A situation which may occur frequently in the process of estimation is that the overall level of $\overset{\circ}{e}_o$ for the derived survival ratios differs slightly from the expected or the required $\overset{\circ}{e}_o$. This is because the estimated survival ratios involve an adjustment of the model life table survival ratios of the same mortality level. If it is required that the derived $\overset{\circ}{e}_o$ is within

the range of say ± 0.05 or ± 0.1 year or some other criteria of the required $\overset{\circ}{e}_o$; an adjustment can be made in the following way.

Since the age group is classified by five-year intervals and $e = 5\ (S_1 + S_1 S_2 + S_1 S_2 S_3 + \ldots S_1 S_2 \ldots S_n)$[5/] where e is the derived expectation of life at birth and S_i is the corresponding survival ratio for age group i. If e' is the desired $\overset{\circ}{e}_o$, a factor, f, can be found such that $S'_i = S_i f$ for each i and

$$e' = 5(S'_1 + S'_1 S'_2 + S'_1 S'_2 S'_3 + \ldots S'_1 S'_2 S'_n)$$
$$= 5(S_1 f + S_1 S_2 f^2 + S_1 S_2 S_3 f^3 + \ldots S_1 S_2 \ldots S_n f^n) \qquad (5)$$

Equation (5) is a polynomial of the nth power. Since the coefficients of all terms are positive, there is only one positive real root. The needed value f can be found by solving (5).

5/ In the notations of the life table,

$$\overset{\circ}{e}_o = \sum {}_5L_X \,/\, l_0 \qquad (A)$$

where l_0 is the radix of the life table. The survival ratio of birth to aged 0-4, denoted $P(B) = {}_5L_0 \,/\, \text{Births} = {}_5L_0 \,/\, 5\, l_0$ or ${}_5L_0 = 5P(B)$. For age groups 0-4 to 5-9, 5-9 to 10-14, ...

$$P(X) = {}_5L_{X+5} \,/\, {}_5L_X \text{ or } {}_5L_{X+5} = P(X)\ {}_5L_X,\ X = 0, 5, 10, \ldots$$

Equation (A) becomes then

$$\overset{\circ}{e}_o = 5P(B) + P(0)\ {}_5L_0 + P(5)\ {}_5L_5 + P(10)\ {}_5L_{10} + \ldots$$
$$= 5P(B) + 5P(B)\ P(0) + 5P(B)\ P(0)\ P(5) + 5P(B)\ P(0)\ P(5)\ P(10) + \ldots$$

Let $e = \overset{\circ}{e}_o$

$S_1 = P(B)$

$S_2 = P(0)$

$S_3 = P(5)$

.....

and $e = 5\ (S_1 + S_1 S_2 + S_1 S_2 S_3 + S_1 S_2 S_3 S_4 + \ldots + S_1 S_2 S_3 \ldots S_n)$.

But f can also be estimated by a simplier method. Arbitarily, let $f = 1.001$. Usually, this value will give an estimated expectation of life at birth, e", greater than or equal to e' or $e \leqslant e' \leqslant e''$. But if $e'' < e'$, then increase f by 0.001, i.e., $f = 1.002$. If the estimated e" is still less than e', then increase f by another 0.001, i.e., $f = 1.003$, until $e'' \geqslant e'$ is reached. The desired correction factor, called F, is obtained by

$$F = (e' - e) \cdot (f - 1) / (e'' - e) + 1.$$

The iteration can be performed with a desk calculator, but, of course, is easier to do with a computer.

If the desired life expectancy, e', is less than the derived life expectancy, e, then the initial f value should be less than one and greater than zero. The iteration will give an F, $0 < F < 1$, even if the initial f is greater than 1.

Table 1. Indices of Relative Difference for Age-Specific Survival Ratios Estimated from the Modified Method and from Model Life Tables for Selected 30 Populations

Population[1/]	From the Modified Method					From Model Life Tables				
	UN	West	North	East	South	UN	West	North	East	South
1	0.48	0.52	0.33	0.48	0.37	0.76	1.31	0.93	1.29	1.04
2	0.39	0.37	0.30	0.27	0.23	0.77	1.05	0.80	1.14	0.99
3	0.32	0.31	0.29	0.33	0.30	1.36	1.83	1.19	1.88	1.49
4	0.32	0.26	0.22	0.24	0.20	0.82	1.19	0.82	1.23	1.01
5	0.28	0.20	0.28	0.23	0.37	0.67	0.50	0.96	0.72	1.07
6	0.67	0.37	0.39	0.33	0.35	0.65	0.56	0.82	0.79	1.11
7	0.40	0.29	0.27	0.30	0.23	0.88	0.51	1.19	0.57	1.03
8	0.58	0.40	0.44	0.36	0.27	0.58	0.36	0.71	0.48	0.89
9	0.07	0.08	0.08	0.07	0.13	0.60	0.58	1.04	0.65	1.08
10	0.26	0.14	0.18	0.12	0.15	0.33	0.38	0.28	0.49	0.57
11	0.16	0.14	0.15	0.15	0.16	0.65	0.67	1.08	0.74	1.15
12	0.35	0.23	0.25	0.21	0.19	0.41	0.46	0.30	0.56	0.57
13	0.31	0.36	0.40	0.36	0.43	0.70	1.19	0.43	1.34	1.01
14	0.40	0.47	0.51	0.55	0.56	0.50	0.87	0.47	1.15	0.90
15	0.35	0.40	0.43	0.38	0.45	0.73	1.23	0.45	1.36	0.99
16	0.35	0.42	0.44	0.48	0.48	0.46	0.81	0.43	1.08	0.84
17	0.60	0.66	0.70	0.62	0.77	0.34	0.32	0.70	0.37	0.61
18	0.58	0.62	0.65	0.68	0.76	0.56	0.30	0.77	0.37	1.02
19	0.49	0.61	0.75	0.44	0.91	0.27	0.20	0.73	0.23	0.72
20	0.43	0.62	0.59	0.74	0.89	0.33	0.24	0.65	0.29	0.98
21	0.33	0.43	0.68	0.23	0.80	0.15	0.09	0.68	0.13	0.66
22	0.20	0.30	0.35	0.41	0.57	0.17	0.08	0.36	0.07	0.69
23	1.94	1.43	1.62	0.99	1.30	2.28	2.31	1.87	1.81	1.79
24	1.20	0.84	1.02	0.88	0.93	2.00	1.99	1.87	2.09	1.89
25	1.16	1.02	1.03	0.82	0.87	1.26	1.50	1.21	1.45	1.47

Table 1 (continued)

Population[1/]	From the Modified Method					From Model Life Tables				
	UN	West	North	East	South	UN	West	North	East	South
26	0.73	0.61	0.63	0.61	0.55	1.45	1.59	1.44	1.70	1.59
27	0.77	0.68	0.81	0.77	0.83	1.10	1.06	1.63	0.98	1.35
28	0.70	0.65	0.72	0.78	0.82	0.59	0.79	0.92	0.72	0.78
29	0.50	0.50	0.49	0.67	0.51	0.98	1.00	1.40	1.07	1.25
30	0.59	0.47	0.53	0.61	0.56	0.91	1.16	1.02	1.13	1.05

1/ Population 1, Colombia, Males, 1960-1964.
" 2 " Females, 1960-1964.
" 3 Mexico, Males, 1960-1964.
" 4 " Females, 1960-1964.
" 5 U.S.A., Males, 1950-1930.
" 6 " Females, 1950-1930.
" 7 " Males, 1950-1940.
" 8 " Females, 1950-1940.
" 9 " Males, 1950-1960.
" 10 " Females, 1950-1960.
" 11 " Males, 1950-1964.
" 12 " Females, 1950-1964.
" 13 Sweden, Males, 1930-1911.
" 14 " Females, 1930-1911.
" 15 " Males, 1930-1920.
Population 16, Sweden, Females, 1930-1920.
" 17 " Males, 1930-1940.
" 18 " Females, 1930-1940.
" 19 " Males, 1930-1951.
" 20 " Females, 1930-1951.
" 21 " Males, 1930-1960.
" 22 " Females, 1930-1960.
" 23 Chile Males, 1950-1930.
" 24 " Females, 1950-1930.
" 25 " Males, 1950-1940.
" 26 " Females, 1950-1940.
" 27 " Males, 1950-1959.
" 28 " Females, 1950-1959.
" 29 " Males, 1950-1964.
" 30 " Females, 1950-1964.

Table 2. Indices of Relative Difference for Age-Specific Survival Ratios Estimated from the Modified Method and from Model Life Tables for Selected 30 Populations, for Six Age Groups 1/

Population 2/	From the Modified Method					From Model Life Tables				
	UN	West	North	East	South	UN	West	North	East	South
1	2.11	2.16	1.26	2.25	1.52	4.08	6.38	4.13	6.56	4.97
2	1.69	1.54	1.26	1.20	0.93	3.65	5.36	3.73	5.90	4.10
3	1.55	1.47	1.34	1.59	1.37	6.74	8.86	6.26	9.04	7.37
4	1.55	1.21	1.00	1.12	0.88	4.22	5.87	4.23	6.41	4.58
5	0.89	0.26	0.75	0.41	1.07	1.70	1.79	3.00	2.39	2.98
6	2.43	1.31	1.12	0.81	0.91	1.71	1.94	2.65	2.44	2.96
7	1.96	1.50	1.32	1.46	0.95	2.80	1.54	3.79	1.56	2.73
8	2.63	1.94	1.96	1.58	1.08	1.91	1.21	2.44	1.29	2.39
9	0.16	0.24	0.25	0.18	0.50	1.59	1.86	2.95	2.16	3.11
10	1.06	0.60	0.69	0.51	0.59	1.55	1.83	0.81	2.01	1.55
11	0.61	0.52	0.54	0.58	0.55	1.90	2.30	3.25	2.59	3.41
12	1.56	1.12	1.04	1.02	0.70	1.98	2.22	0.95	2.37	1.50
13	1.04	1.19	1.46	1.23	1.61	2.45	4.48	1.81	5.24	4.09
14	1.41	1.80	1.99	2.09	2.21	1.60	3.30	1.76	4.63	3.23
15	0.84	0.91	1.13	0.94	1.28	2.21	4.19	1.47	4.94	3.77
16	1.20	1.50	1.63	1.75	1.85	1.42	3.00	1.57	4.29	2.88
17	2.82	3.09	3.32	2.87	3.61	1.53	0.96	3.20	1.10	2.21
18	2.64	2.84	3.01	3.09	3.50	2.81	1.49	3.69	1.47	4.01
19	2.12	2.42	3.53	1.70	4.06	1.24	0.77	3.21	0.84	2.92
20	1.91	2.73	2.72	3.17	4.26	1.78	1.28	3.06	1.24	4.18
21	1.37	1.50	3.05	0.79	3.49	0.61	0.29	2.81	0.38	2.58
22	0.56	1.15	1.53	1.63	2.85	0.61	0.28	1.74	0.23	2.94
23	5.86	4.16	5.53	3.09	4.44	9.02	9.32	8.92	8.57	8.76
24	3.87	2.66	3.68	3.12	3.58	7.98	8.28	8.60	9.46	8.96
25	3.74	3.53	3.82	3.29	3.47	5.65	6.57	6.02	6.32	6.22
26	2.18	2.06	2.16	2.28	2.04	6.09	6.81	6.90	7.88	7.29
27	3.53	3.03	3.55	3.13	3.60	4.61	5.17	6.75	4.51	5.34
28	3.17	2.92	3.29	3.40	3.69	2.38	3.25	3.97	3.48	3.00
29	2.35	2.16	2.21	2.77	2.28	3.75	4.87	5.62	4.88	4.67
30	2.57	1.86	2.08	2.42	2.20	4.13	5.19	4.64	5.42	4.67

1/ Births to aged 0-4, aged 0-4 to 5-9, aged 5-9 to 10-14, aged 65-69 to 70-74, aged 70-74 to 75-79, aged 70 and over to 80 and over.

2/ See the note in Table 1.

Table 3

A Comparison of the Survival Ratios Derived from the Modified Method and the Model Life Tables

EXAMPLE NO. 1 - COLUMBIA MALES, 1960-1964

AGE	NATIONAL LIFE TABLE SURVIVAL RATIOS 1960 E=52.95	1964 E=58.26	DERIVED SURVIVAL RATIOS AND MODEL LIFE TABLES USED, E = 58.26 U.N.	WEST	NORTH	EAST	SOUTH
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			I - FROM THE MODIFIED METHOD				
BIRTH/ 0- 4	0.85717	0.89230	0.89356	0.89018	0.88650	0.89782	0.88927
0- 4/ 5- 9	0.94494	0.96508	0.95773	0.95815	0.96140	0.95826	0.96148
5- 9/10-14	0.98547	0.99077	0.98888	0.98896	0.99132	0.98893	0.98953
10-14/15-19	0.98955	0.99180	0.99294	0.99292	0.99330	0.99223	0.99280
15-19/20-24	0.98466	0.98588	0.98976	0.98951	0.98923	0.98865	0.98968
20-24/25-29	0.98000	0.98207	0.98626	0.98619	0.98561	0.98483	0.98608
25-29/30-34	0.97678	0.98101	0.98332	0.98392	0.98275	0.98196	0.98277
30-34/35-39	0.97401	0.97799	0.98098	0.98230	0.98060	0.98010	0.98018
35-39/40-44	0.96977	0.97453	0.97759	0.97941	0.97744	0.97711	0.97668
40-44/45-49	0.95880	0.96680	0.96753	0.96955	0.96776	0.96732	0.96658
45-49/50-54	0.94609	0.95178	0.95630	0.95812	0.95622	0.95556	0.95495
50-54/55-59	0.92050	0.93008	0.93272	0.93390	0.93251	0.93104	0.93113
55-59/60-64	0.87898	0.89515	0.89341	0.89430	0.89377	0.89137	0.89292
60-64/65-69	0.83744	0.84623	0.85456	0.85530	0.85574	0.85295	0.85622
65-69/70-74	0.76565	0.78721	0.78607	0.78553	0.78920	0.78464	0.78972
70-74/75-79	0.66289	0.71083	0.68602	0.68459	0.69173	0.68442	0.69079
75+ /80+	0.50421	0.54771	0.50421	0.50421	0.52843	0.50421	0.51961
INDEX OF RELATIVE (1) ALL AGES			0.48	0.52	0.33	0.48	0.37
DIFFERENCE (2) SIX AGES*			2.11	2.16	1.26	2.25	1.52
			II - FROM MODEL LIFE TABLES				
BIRTH/ 0- 4			0.90298	0.91283	0.91545	0.89860	0.88658
0- 4/ 5- 9			0.96955	0.97599	0.96592	0.97758	0.96836
5- 9/10-14			0.99057	0.99093	0.98541	0.99236	0.99223
10-14/15-19			0.98967	0.98992	0.98705	0.99153	0.99221
15-19/20-24			0.98430	0.98506	0.98149	0.98682	0.98830
20-24/25-29			0.98128	0.98193	0.97774	0.98430	0.98584
25-29/30-34			0.98048	0.98011	0.97649	0.98337	0.98428
30-34/35-39			0.97853	0.97649	0.97416	0.98051	0.98142
35-39/40-44			0.97387	0.97012	0.96969	0.97474	0.97662
40-44/45-49			0.96495	0.95995	0.96266	0.96470	0.96847
45-49/50-54			0.95062	0.94408	0.95056	0.94808	0.95564
50-54/55-59			0.92943	0.92021	0.93351	0.92308	0.93586
55-59/60-64			0.89713	0.88464	0.90707	0.88761	0.90576
60-64/65-69			0.84856	0.83315	0.86324	0.83561	0.85973
65-69/70-74			0.77740	0.75989	0.79743	0.75773	0.78524
70-74/75-79			0.67935	0.65797	0.70265	0.64861	0.66901
75+ /80+			0.45397	0.41673	0.44293	0.41232	0.42398
INDEX OF RELATIVE (1) ALL AGES			0.76	1.31	0.93	1.29	1.04
DIFFERENCE (2) SIX AGES*			4.08	6.38	4.13	6.56	4.97

E - EXPECTATION OF LIFE AT BIRTH

* - BIRTH/0-4,0-4/5-9,5-9/10-14,65-69/70-74,70-74/75-79,75+/80+

EXAMPLE NO. 4 - MEXICO FEMALES, 1960-1964

AGE	NATIONAL LIFE TABLE SURVIVAL RATIOS 1960 E=58.71	1964 E=62.00	DERIVED SURVIVAL RATIOS AND MODEL LIFE TABLES USED, E = 62.00 U.N.	WEST	NORTH	EAST	SOUTH
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			I - FROM THE MODIFIED METHOD				
BIRTH/ 0- 4	0.88891	0.90513	0.90885	0.90653	0.90484	0.90886	0.90581
0- 4/ 5- 9	0.95988	0.96671	0.96732	0.96759	0.96935	0.96776	0.96973
5- 9/10-14	0.99010	0.99168	0.99256	0.99266	0.99384	0.99236	0.99288
10-14/15-19	0.99240	0.99396	0.99496	0.99500	0.99501	0.99433	0.99477
15-19/20-24	0.98771	0.99020	0.99111	0.99109	0.99052	0.99026	0.99075
20-24/25-29	0.98345	0.98687	0.98746	0.98743	0.98664	0.98659	0.98691
25-29/30-34	0.98075	0.98391	0.98496	0.98517	0.98447	0.98431	0.98440
30-34/35-39	0.97614	0.97904	0.98039	0.98093	0.98043	0.98001	0.97994
35-39/40-44	0.97138	0.97438	0.97565	0.97638	0.97600	0.97542	0.97526
40-44/45-49	0.96553	0.97135	0.97003	0.97059	0.97027	0.96968	0.96944
45-49/50-54	0.95656	0.96424	0.96174	0.96219	0.96163	0.96128	0.96092
50-54/55-59	0.93971	0.94964	0.94576	0.94649	0.94589	0.94596	0.94528
55-59/60-64	0.91425	0.92274	0.92195	0.92288	0.92242	0.92302	0.92224
60-64/65-69	0.87545	0.88586	0.88536	0.88614	0.88628	0.88742	0.88701
65-69/70-74	0.81578	0.83701	0.82813	0.82818	0.82986	0.83075	0.83148
70-74/75-79	0.73833	0.76345	0.75314	0.75212	0.75516	0.75523	0.75732
75+ /80+	0.52835	0.56388	0.52835	0.53919	0.54382	0.53970	0.54514
INDEX OF RELATIVE (1) ALL AGES			0.32	0.26	0.22	0.24	0.20
DIFFERENCE (2) SIX AGES*			1.55	1.21	1.00	1.12	0.88
			II - FROM MODEL LIFE TABLES				
BIRTH/ 0- 4			0.92050	0.92761	0.92817	0.91224	0.89689
0- 4/ 5- 9			0.97299	0.97801	0.97017	0.97924	0.97099
5- 9/10-14			0.99137	0.99175	0.98727	0.99291	0.99330
10-14/15-19			0.99056	0.99104	0.98928	0.99298	0.99329
15-19/20-24			0.98645	0.98753	0.98675	0.99017	0.99060
20-24/25-29			0.98384	0.98459	0.98407	0.98773	0.98842
25-29/30-34			0.98254	0.98215	0.98175	0.98572	0.98703
30-34/35-39			0.98104	0.97919	0.97911	0.98312	0.98542
35-39/40-44			0.97824	0.97517	0.97507	0.97958	0.98255
40-44/45-49			0.97264	0.96905	0.97024	0.97404	0.97837
45-49/50-54			0.96303	0.95843	0.96217	0.96428	0.97085
50-54/55-59			0.94811	0.94186	0.94896	0.94803	0.95844
55-59/60-64			0.92369	0.91493	0.92669	0.92036	0.93613
60-64/65-69			0.88236	0.87175	0.88714	0.87325	0.89599
65-69/70-74			0.81602	0.80439	0.82471	0.79747	0.82625
70-74/75-79			0.71948	0.70536	0.73425	0.68701	0.71506
75+ /80+			0.48100	0.45148	0.46933	0.44251	0.46042
INDEX OF RELATIVE (1) ALL AGES			0.82	1.19	0.82	1.23	1.01
DIFFERENCE (2) SIX AGES*			4.22	5.87	4.23	6.41	4.58

E - EXPECTATION OF LIFE AT BIRTH

* - BIRTH/0-4,0-4/5-9,5-9/10-14,65-69/70-74,70-74/75-79,75+/80+

EXAMPLE NO. 5 - U.S.A. MALES, 1950-1930

AGE	NATIONAL LIFE TABLE SURVIVAL RATIOS 1950 E=65.46	1930 E=57.58	DERIVED SURVIVAL RATIOS AND MODEL LIFE TABLES USED, E = 57.58 U.N.	WEST	NORTH	EAST	SOUTH
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			I - FROM THE MODIFIED METHOD				
BIRTH/ 0- 4	0.96216	0.91906	0.90807	0.91793	0.92290	0.90879	0.91885
0- 4/ 5- 9	0.99425	0.97975	0.97737	0.97802	0.97349	0.97770	0.97444
5- 9/10-14	0.99663	0.99074	0.99207	0.99153	0.98822	0.99199	0.99135
10-14/15-19	0.99485	0.98884	0.99024	0.98980	0.98883	0.99077	0.99001
15-19/20-24	0.99158	0.98282	0.98450	0.98450	0.98434	0.98559	0.98442
20-24/25-29	0.99030	0.97889	0.98176	0.98151	0.98171	0.98319	0.98185
25-29/30-34	0.98945	0.97598	0.98082	0.97955	0.98036	0.98197	0.98083
30-34/35-39	0.98618	0.97152	0.97726	0.97475	0.97624	0.97754	0.97675
35-39/40-44	0.97908	0.96349	0.96941	0.96575	0.96762	0.96866	0.96838
40-44/45-49	0.96692	0.95145	0.95595	0.95175	0.95360	0.95454	0.95456
45-49/50-54	0.94841	0.93409	0.93588	0.93103	0.93322	0.93418	0.93403
50-54/55-59	0.92186	0.90990	0.90725	0.90206	0.90384	0.90553	0.90440
55-59/60-64	0.88626	0.87461	0.86878	0.86316	0.86411	0.86668	0.86322
60-64/65-69	0.84116	0.82325	0.81995	0.81392	0.81372	0.81634	0.80973
65-69/70-74	0.77857	0.75135	0.75249	0.74788	0.74326	0.74779	0.73707
70-74/75-79	0.69074	0.65473	0.66081	0.65697	0.64744	0.65529	0.64105
75+ /80+	0.48553	0.45111	0.46313	0.45290	0.44653	0.45300	0.44296
INDEX OF RELATIVE DIFFERENCE (1) ALL AGES			0.28	0.20	0.28	0.23	0.37
(2) SIX AGES*			0.89	0.26	0.75	0.41	1.07
			II - FROM MODEL LIFE TABLES				
BIRTH/ 0- 4			0.89810	0.90877	0.91181	0.89358	0.88259
0- 4/ 5- 9			0.96803	0.97438	0.96392	0.97589	0.96631
5- 9/10-14			0.99016	0.99046	0.98466	0.99192	0.99171
10-14/15-19			0.98926	0.98946	0.98654	0.99118	0.99178
15-19/20-24			0.98369	0.98442	0.98088	0.98630	0.98766
20-24/25-29			0.98052	0.98113	0.97699	0.98368	0.98507
25-29/30-34			0.97972	0.97919	0.97570	0.98271	0.98353
30-34/35-39			0.97772	0.97543	0.97329	0.97973	0.98064
35-39/40-44			0.97299	0.96889	0.96869	0.97380	0.97574
40-44/45-49			0.96391	0.95857	0.96149	0.96361	0.96748
45-49/50-54			0.94943	0.94252	0.94924	0.94686	0.95451
50-54/55-59			0.92802	0.91847	0.93194	0.92172	0.93450
55-59/60-64			0.89546	0.88264	0.90515	0.88601	0.90398
60-64/65-69			0.84656	0.83082	0.86086	0.83361	0.85735
65-69/70-74			0.77497	0.75729	0.79437	0.75527	0.78218
70-74/75-79			0.67662	0.65513	0.69890	0.64582	0.66546
75+ /80+			0.45187	0.41411	0.43970	0.40982	0.42092
INDEX OF RELATIVE DIFFERENCE (1) ALL AGES			0.67	0.50	0.96	0.72	1.07
(2) SIX AGES*			1.70	1.79	3.00	2.39	2.98

E - EXPECTATION OF LIFE AT BIRTH

* - BIRTH/0-4,0-4/5-9,5-9/10-14,65-69/70-74,70-74/75-79,75+/80+

EXAMPLE NO. 22 - SWEDEN FEMALES, 1930-1960

AGE	NATIONAL LIFE TABLE SURVIVAL RATIOS 1930 E=64.18	1960 E=74.89	DERIVED SURVIVAL RATIOS AND MODEL LIFE TABLES USED, E = 74.89 U.N.	WEST	NORTH	EAST	SOUTH
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			I - FROM THE MODIFIED METHOD				
BIRTH/ 0- 4	0.94733	0.98224	0.98640	0.99070	0.98713	0.98591	0.96630
0- 4/ 5- 9	0.98657	0.99730	0.99730	0.99904	0.99823	0.99897	0.99647
5- 9/10-14	0.99233	0.99856	0.99900	0.99839	0.99902	0.99946	0.99933
10-14/15-19	0.98843	0.99841	0.99820	0.99491	0.99749	0.99594	0.99924
15-19/20-24	0.98223	0.99791	0.99438	0.99099	0.99238	0.99120	0.99454
20-24/25-29	0.98066	0.99724	0.99438	0.99124	0.99210	0.99107	0.99399
25-29/30-34	0.98034	0.99636	0.99421	0.99226	0.99306	0.99185	0.99426
30-34/35-39	0.97902	0.99505	0.99296	0.99233	0.99311	0.99170	0.99352
35-39/40-44	0.97672	0.99288	0.99092	0.99149	0.99214	0.99069	0.99210
40-44/45-49	0.97192	0.98809	0.98713	0.98830	0.98825	0.98745	0.98833
45-49/50-54	0.96118	0.98117	0.97819	0.98076	0.97906	0.97979	0.97960
50-54/55-59	0.94856	0.97225	0.96857	0.97321	0.97021	0.97312	0.97079
55-59/60-64	0.92460	0.95565	0.94934	0.95721	0.95265	0.95891	0.95580
60-64/65-69	0.88788	0.92574	0.91960	0.93015	0.92545	0.93593	0.93381
65-69/70-74	0.81720	0.86669	0.86092	0.86946	0.86678	0.88042	0.88306
70-74/75-79	0.71736	0.76999	0.77307	0.77823	0.77802	0.79296	0.80397
75+ /80+	0.49725	0.51607	0.52560	0.53919	0.55475	0.53970	0.56265
INDEX OF RELATIVE (1) ALL AGES			0.20	0.30	0.35	0.41	0.57
DIFFERENCE (2) SIX AGES*			0.56	1.15	1.53	1.63	2.85
			II - FROM MODEL LIFE TABLES				
BIRTH/ 0- 4			0.98548	0.98358	0.98001	0.97713	0.95602
0- 4/ 5- 9			0.99695	0.99779	0.99639	0.99776	0.99410
5- 9/10-14			0.99886	0.99880	0.99813	0.99894	0.99881
10-14/15-19			0.99852	0.99855	0.99759	0.99869	0.99871
15-19/20-24			0.99779	0.99779	0.99630	0.99802	0.99810
20-24/25-29			0.99705	0.99705	0.99518	0.99742	0.99747
25-29/30-34			0.99605	0.99624	0.99445	0.99677	0.99685
30-34/35-39			0.99455	0.99492	0.99353	0.99555	0.99604
35-39/40-44			0.99202	0.99253	0.99106	0.99343	0.99445
40-44/45-49			0.98751	0.98812	0.98726	0.98956	0.99180
45-49/50-54			0.98011	0.98111	0.98102	0.98327	0.98734
50-54/55-59			0.96897	0.97038	0.97234	0.97399	0.98069
55-59/60-64			0.95033	0.95268	0.95784	0.95774	0.96926
60-64/65-69			0.91836	0.92059	0.92967	0.92656	0.94645
65-69/70-74			0.86472	0.86448	0.88159	0.86812	0.89989
70-74/75-79			0.78209	0.77507	0.80432	0.77160	0.81248
75+ /80+			0.52359	0.51895	0.53611	0.51810	0.54335
INDEX OF RELATIVE (1) ALL AGES			0.17	0.08	0.36	0.07	0.69
DIFFERENCE (2) SIX AGES*			0.61	0.28	1.74	0.23	2.94

l = 74.31
5 = 74.25

E - EXPECTATION OF LIFE AT BIRTH
* - BIRTH/0-4,0-4/5-9,5-9/10-14,65-69/70-74,70-74/75-79,75+/80+

EXAMPLE NO. 30 - CHILE FEMALES, 1950-1964

AGE	NATIONAL LIFE TABLE SURVIVAL RATIOS 1950 E=51.31 (2)	1964 E=61.66 (3)	DERIVED SURVIVAL RATIOS AND MODEL LIFE TABLES USED, E = 61.66 U.N. (4)	WEST (5)	NORTH (6)	EAST (7)	SOUTH (8)
(1)							
			I - FROM THE MODIFIED METHOD				
BIRTH/ 0- 4	0.83307	0.88944	0.89169	0.89239	0.88672	0.90104	0.88948
0- 4/ 5- 9	0.95186	0.97664	0.97736	0.97923	0.98646	0.97790	0.98482
5- 9/10-14	0.98918	0.99487	0.99706	0.99723	0.99902	0.99644	0.99814
10-14/15-19	0.98556	0.99478	0.99352	0.99360	0.99420	0.99155	0.99295
15-19/20-24	0.97803	0.99206	0.98919	0.98851	0.98712	0.98614	0.98773
20-24/25-29	0.97456	0.98948	0.98816	0.98694	0.98488	0.98467	0.98572
25-29/30-34	0.97122	0.98553	0.98550	0.98500	0.98328	0.98272	0.98295
30-34/35-39	0.96754	0.98055	0.98231	0.98247	0.98144	0.97995	0.97970
35-39/40-44	0.96231	0.97778	0.97748	0.97776	0.97713	0.97513	0.97462
40-44/45-49	0.95476	0.97320	0.97091	0.97015	0.96970	0.96771	0.96706
45-49/50-54	0.94434	0.96113	0.96271	0.96130	0.96004	0.95896	0.95818
50-54/55-59	0.92283	0.94513	0.94472	0.94326	0.94189	0.94231	0.94073
55-59/60-64	0.89663	0.91888	0.92424	0.92273	0.92181	0.92408	0.92276
60-64/65-69	0.85032	0.90980	0.88538	0.88260	0.88354	0.88776	0.88830
65-69/70-74	0.77883	0.79256	0.82224	0.81603	0.82176	0.82544	0.82962
70-74/75-79	0.71001	0.73563	0.76146	0.75125	0.76103	0.76225	0.77091
75+ /80+	0.50320	0.56913	0.52560	0.53919	0.54864	0.53970	0.55463
INDEX OF RELATIVE DIFFERENCE (1) ALL AGES			0.59	0.47	0.53	0.61	0.56
(2) SIX AGES*			2.57	1.86	2.08	2.42	2.20
			II - FROM MODEL LIFE TABLES				
BIRTH/ 0- 4			0.91844	0.92582	0.92656	0.91022	0.89518
0- 4/ 5- 9			0.97225	0.97814	0.96923	0.97845	0.97001
5- 9/10-14			0.99114	0.99149	0.98690	0.99269	0.99303
10-14/15-19			0.99033	0.99078	0.98902	0.99279	0.99306
15-19/20-24			0.98613	0.98719	0.98647	0.98991	0.99030
20-24/25-29			0.98346	0.98419	0.98375	0.98742	0.98809
25-29/30-34			0.98213	0.98171	0.98138	0.98536	0.98667
30-34/35-39			0.98063	0.97870	0.97867	0.98273	0.98505
35-39/40-44			0.97783	0.97466	0.97460	0.97917	0.98217
40-44/45-49			0.97221	0.96853	0.96975	0.97361	0.97799
45-49/50-54			0.96252	0.95785	0.96165	0.96380	0.97042
50-54/55-59			0.94753	0.94116	0.94833	0.94739	0.95790
55-59/60-64			0.92293	0.91404	0.92585	0.91946	0.93534
60-64/65-69			0.88137	0.87064	0.88602	0.87202	0.89484
65-69/70-74			0.81479	0.80310	0.82325	0.79593	0.82466
70-74/75-79			0.71800	0.70392	0.73250	0.68527	0.71313
75+ /80+			0.48100	0.45006	0.46771	0.44093	0.45869
INDEX OF RELATIVE DIFFERENCE (1) ALL AGES			0.91	1.16	1.02	1.13	1.05
(2) SIX AGES*			4.13	5.19	4.64	5.42	4.67

E - EXPECTATION OF LIFE AT BIRTH

* - BIRTH/0-4,0-4/5-9,5-9/10-14,65-69/70-74,70-74/75-79,75+/80+