IV. USE OF THE MODEL TABLES

How the model tables are used for estimating the age pattern of mortality in a given country will depend on the data available and the researcher's confidence in those data. For example, under some circumstances, when no data are available, the user may wish to assume that the age pattern of mortality is identical to that of one of the patterns presented here, or is similar to an actual observed age pattern in a nearby country and use the first-component vector with an appropriate factor loading to adjust the mortality level to a desired life expectancy. Under circumstances when death rates by age and sex are available, the models can be used to smooth the data or to adjust the data for perceived errors. For use in population projections, projected life tables can be generated from a known current life table and the age pattern of mortality change implied by the first principal-component vector. New model patterns can be generated based on an average age pattern of mortality for a country or region and use of the first-component vector to generate life tables for a series of life expectancies.

Fitting of empirical data to models can be made in various ways. Empirical life tables based on recorded death rates by age can be constructed and a model chosen which has the same life expectancy at birth or at age 10, the same infant mortality rate, or the same value of any mortality parameter. This is a simple matter of interpolating between the published tables or choosing the published table with the closest values. However, another procedure would be to find the model which makes the best fit by principal components or least-squares procedures.

For this purpose, one would define the principal-components model as:

${}_nY_x = {}_n\bar{Y}^s_x + \Sigma^k_{m-1}\, a_m U_{mx}$ where ${}_nY_x$ is the logit $[{}_nq_x]$ from an empirical table, ${}_n\bar{Y}^s_x$ is the average logit $[{}_nq_x]$ value for one of the models (chosen from one of the columns of table 5) or from a different population assumed to have a similar pattern of mortality, and a_m are the unknown country-specific factor loadings to be estimated. Values of a_m can be estimated, via least-squares procedures, which minimize the sum of squared deviations between empirical ${}_nY_x$ values and predicted values. When the number of age-groups considered is identical to that in the model (i.e., 18 age-groups of 0-1, 1-4, 5-9, . . ., 80-84) the least-squares fit is identical to the principal-components fit.

Assuming a 3-component fit, when minimizing the function

$$\sum_{\forall x} [{}_nY_x - {}_n\bar{Y}^s_x - \sum_{m-1}^{3} a_m U_{mx}]^2$$

the least-squares estimates of a_m are as follows:

$$\left.\begin{aligned}
a_1 &= \frac{\alpha_1(\gamma_2\gamma_3 - \beta_3^2) + \alpha_2(\beta_2\beta_3 - \beta_1\gamma_3) + \alpha_3(\beta_1\beta_3 - \beta_2\gamma_2)}{D}\\
a_2 &= \frac{\alpha_1(\beta_2\beta_3 - \beta_1\gamma_3) + \alpha_2(\gamma_1\gamma_3 - \beta_2^2) + \alpha_3(\beta_1\beta_2 - \beta_3\gamma_1)}{D}\\
a_3 &= \frac{\alpha_1(\beta_1\beta_3 - \beta_2\gamma_2) + \alpha_2(\beta_1\beta_2 - \beta_3\gamma_1) + \alpha_3(\gamma_1\gamma_2 - \beta_1^2)}{D}
\end{aligned}\right\} \quad (1)$$

where

$$\gamma_i = \sum_{\forall x} U^2_{ix}, \qquad i = 1, 2, 3;$$

$$\alpha_i = \sum_{\forall x} ({}_nY_x - {}_n\bar{Y}^s_x)\, U_{ix}, \qquad i = 1, 2, 3;$$

$$\beta_1 = \sum_{\forall x} U_{1x}U_{2x};$$

$$\beta_2 = \sum_{\forall x} U_{1x}U_{3x};$$

$$\beta_3 = \sum_{\forall x} U_{2x}U_{3x};$$

and

$$D = \gamma_1\gamma_2\gamma_3 - \gamma_3\beta_1^2 - \gamma_2\beta_2^2 - \gamma_1\beta_3^2 + 2\beta_1\beta_2\beta_3.$$

However, if all 18 age-groups (through ${}_5q_{80}$) can be used, the above equations simplify considerably as, for all i, β_i will equal zero and γ_i will equal 1. The simplified equations would be:

$$\left.\begin{aligned}
a_1 &= \alpha_1 = \sum_{\forall x} ({}_nY_x - {}_n\bar{Y}^s_x)U_{1x}\\
a_2 &= \alpha_2 = \sum_{\forall x} ({}_nY_x - {}_n\bar{Y}^s_x)U_{2x}\\
a_3 &= \alpha_3 = \sum_{\forall x} ({}_nY_x - {}_n\bar{Y}^s_x)U_{3x}
\end{aligned}\right\} \quad (1a)$$

TABLE 8A. CALCULATION OF LOADING FACTORS (a_m VALUES) FOR FIT OF CUBAN DATA TO THE LATIN AMERICAN PATTERN: AN EXAMPLE IN WHICH A FULL SET OF ${}_nq_x$ VALUES IS AVAILABLE

Age x (1)	${}_nq_x$ values: Cuban males (2)	${}_nY_x$ (3) = logit (2)	${}_n\bar{Y}^s_x$ (Latin American pattern) (4)	${}_nY_x - {}_n\bar{Y}^s_x$ (5) = (3) − (2)	U_{1x} (6)	U_{2x} (7)	U_{3x} (8)	$({}_nY_x - {}_n\bar{Y}^s_x)U_{ix}$ (9) = (5) × (6)	(10) = (5) × (7)	(11) = (5) × (8)
0	0.04207	−1.56272	−1.12977	−0.43295	0.23686	−0.46007	0.09331	−0.10255	0.19919	−0.04040
1	0.00518	−2.62888	−1.49128	−1.13760	0.36077	−0.68813	−0.29269	−0.41041	0.78282	0.33296
5	0.00250	−2.99448	−2.13021	−0.86428	0.33445	0.06414	−0.47139	−0.28906	−0.05543	0.40741
10	0.00250	−2.99448	−2.40763	−0.58685	0.30540	0.12479	−0.17403	−0.17923	−0.07323	0.10213
15	0.00648	−2.51627	−2.21906	−0.29720	0.28931	0.24384	0.10715	−0.08598	−0.07247	−0.03185
20	0.00747	−2.44468	−2.01163	−0.43305	0.28678	0.10713	0.28842	−0.12419	−0.04639	−0.12490
25	0.00797	−2.41203	−1.93580	−0.47623	0.27950	0.06507	0.33620	−0.13311	−0.03099	−0.16011
30	0.00896	−2.35299	−1.86962	−0.48337	0.28023	0.03339	0.33692	−0.13545	−0.01614	−0.16286
35	0.01094	−2.25216	−1.76141	−0.49076	0.26073	0.02833	0.21354	−0.12796	−0.01390	−0.10480
40	0.01440	−2.11301	−1.64220	−0.47081	0.23626	0.06473	0.15269	−0.11123	−0.03048	−0.07189
45	0.02030	−1.93831	−1.49653	−0.44178	0.20794	0.08705	0.06569	−0.09186	−0.03846	−0.02902
50	0.03153	−1.71239	−1.34162	−0.37077	0.17804	0.10620	0.00045	−0.06601	−0.03938	−0.00017
55	0.04791	−1.49467	−1.15718	−0.33748	0.15136	0.11305	−0.03731	−0.05108	−0.03815	0.01259
60	0.07805	−1.23457	−0.96944	−0.26513	0.13217	0.09467	−0.10636	−0.03504	−0.02510	0.02820
65	0.12037	−0.99447	−0.74707	−0.24739	0.12243	0.10809	−0.11214	−0.03029	−0.02674	0.02774
70	0.21917	−0.63525	−0.52259	−0.11266	0.11457	0.14738	−0.22258	−0.01291	−0.01660	0.02508
75	0.28179	−0.46780	−0.29449	−0.17331	0.10445	0.21037	−0.19631	−0.01810	−0.03646	0.03402
80	0.38013	−0.24450	−0.04030	−0.20420	0.08878	0.30918	−0.38123	−0.01813	−0.06313	0.07785
								α_1 = −2.02260	α_2 = 0.35894	α_3 = 0.32201

NOTE: For 1- 2- and 3-component fits, equations (1a) give:

$a_1 = \alpha_1 = -2.02260$
$a_2 = \alpha_2 = 0.35894$
$a_3 = \alpha_3 = 0.32201$

Table 8B. One-, 2- and 3-component fits to Cuban data using the Latin American pattern as a model

Age x	Cuba observed ${}_nq_x$	Fitted ${}_nq_x$ values based on: 1 component	2 components	3 components
0	0.04207	0.03851	0.02798	0.02966
1	0.00518	0.01164	0.00713	0.00591
5	0.00250	0.00364	0.00381	0.00281
10	0.00250	0.00235	0.00257	0.00230
15	0.00648	0.00365	0.00435	0.00466
20	0.00747	0.00558	0.00602	0.00724
25	0.00797	0.00668	0.00700	0.00867
30	0.00896	0.00759	0.00778	0.00964
35	0.01094	0.01018	0.01038	0.01190
40	0.01440	0.01420	0.01487	0.01638
45	0.02030	0.02116	0.02249	0.02344
50	0.03153	0.03219	0.03465	0.03466
55	0.04791	0.05085	0.05491	0.05368
60	0.07805	0.07773	0.08275	0.07770
65	0.12037	0.12032	0.12878	0.12089
70	0.21917	0.18114	0.19737	0.17564
75	0.28179	0.26669	0.29724	0.27152
80	0.38013	0.39180	0.44577	0.38620

Note: Fitted ${}_nq_x$ values were calculated according to the following equations:

1-component fit—logit $[{}_nq_x] = {}_n\overline{Y}^s_x + a_1U_{1x}$

2-component fit—logit $[{}_nq_x] = {}_n\overline{Y}^s_x + a_1U_{1x} + a_2U_{2x}$

3-component fit—logit $[{}_nq_x] = {}_n\overline{Y}^s_x + a_1U_{1x} + a_2U_{2x} + a_3U_{3x}$.

Values of the terms in the equations are from table 8.A.

Table 9A. Calculation of the loading factors (a_m values) for fit of Afghan data to the South Asian pattern: an example in which a partial set of ${}_nq_x$ values is available

Age x (1)	${}_nq_x$ values Afghan males (2)	${}_nY_x$ (3) = logit(2)	${}_n\overline{Y}^s_x$ (South Asian pattern) (4)	${}_nY_x - {}_n\overline{Y}^s_x$ (5) = (3) − (4)	U_{1x} (6)	U_{2x} (7)	U_{3x} (8)	U^2_{1x} (9) = (6)²	U^2_{2x} (10) = (7)²
0	0.18708	−0.73455	−0.97864	0.24410	0.23686	−0.46007	0.09331	0.05610	0.21166
1	0.14917	−0.87056	−1.24228	0.37170	0.36077	−0.68813	−0.29269	0.13015	0.47352
5	0.02518	−1.82810	−2.01695	0.18876	0.33445	0.06414	−0.47139	0.11186	0.00411
10	0.02469	−1.83818	−2.44280	0.60448	0.30540	0.12479	−0.17403	0.09327	0.01557
15	0.02274	−1.88031	−2.35424	0.47381	0.28931	0.24384	0.10715	0.08370	0.05946
20	0.02809	−1.77192	−2.27012	0.49811	0.28678	0.10713	0.28842	0.08224	0.01148
25	0.01833	−1.99036	−2.16833	0.17802	0.27950	0.06507	0.33620	0.07812	0.00423
30	0.02519	−1.82790	−2.05942	0.23162	0.28023	0.03339	0.33692	0.07853	0.00111
35	0.03297	−1.68932	−1.90053	0.21118	0.26073	0.02833	0.21354	0.06798	0.00080
40	0.04454	−1.53290	−1.71213	0.17916	0.23626	0.06473	0.15269	0.05582	0.00419
45	0.06303	−1.34952	−1.51120	0.16173	0.20794	0.08705	0.06569	0.04324	0.00758
50	0.08072	−1.21630	−1.28493	0.06825	0.17804	0.10620	0.00045	0.03170	0.01128
55	0.10736	−1.05900	−1.08192	0.02290	0.15136	0.11305	−0.03731	0.02291	0.01278
60	0.21916	−0.63528	−0.84671	0.21141	0.13217	0.09467	−0.10636	0.01747	0.00896
65	0.14722	−0.87829	−0.62964	−0.24865	0.12243	0.10809	−0.11214	0.01499	0.01168
70	0.17645	−0.77029	−0.40229	−0.36801	0.11457	0.14738	−0.22258	0.01313	0.02172
								$\gamma_1 =$ 0.98121	$\gamma_2 =$ 0.86015

1-component fit (from equations (3))

$$a_1 = \frac{0.93629}{0.98121} = 0.95422$$

2-component fit (from equations (2))

$$a_1 = \frac{(0.93629)(0.86015) - (-0.11189)(-0.04942)}{(0.98121)(0.86015) - (-0.04942)^2} = 0.95042$$

$$a_2 = \frac{-(0.93629)(-0.04942) + (-0.11189)(0.98121)}{(0.98121)(0.86015) - (-0.04942)^2} = 0.07547$$

The above equations are also greatly simplified if a 2-component or a 1-component fit is carried out. For a 2-component fit the general equations will be:

$$\left.\begin{aligned} a_1 &= \frac{\alpha_1\gamma_2 - \alpha_2\beta_1}{\gamma_1\gamma_2 - \beta_1^{\,2}} \\ a_2 &= \frac{\alpha_1\beta_1 + \alpha_2\gamma_1}{\gamma_1\gamma_2 - \beta_1^{\,2}} \end{aligned}\right\} \qquad (2)$$

When the 18 age-groups are used, this simplifies even more to the first two equations of (1a), i.e.,

$$a_1 = \alpha_1 = \sum_{\forall x} ({}_nY_x - {}_n\bar{Y}^s_x)\, U_{1x};$$

and

$$a_2 = \alpha_2 = \sum_{\forall x} ({}_nY_x - {}_n\bar{Y}^s_x)\, U_{2x}.$$

One-component fits are very simple to calculate as

$$a_1 = \frac{\alpha_1}{\gamma_1} \qquad (3)$$

for the general case, and

$$a_1 = \alpha_1 = \sum_{\forall x} ({}_nY_x - {}_n\bar{Y}^s_x)\, U_{1x}$$

when the full set of age-groups is used.

Most users will be making 1-component fits (when the model age pattern of mortality is being accepted and the first component is used to adjust for level), or 2-component fits (when adjustments are being made to the model to account for perceived differences under age 5). Luckily, 1- and 2-component fits are rather simple and straightforward to undertake. Calculation of 3-component fits is equally straightforward, but the arithmetic is somewhat more involved and tedious, in the absence of a computer or programmable calculator. However, because the demographic interpretation of the third component is less clear, 3-component fits may not be undertaken quite as often and when undertaken should be carefully evaluated.

Some of these points are demonstrated in the following examples. Life tables were constructed for Cuban males, 1970, using central death rates presented in the Historical Supplement to the *Demographic Yearbook*.[20] Table 8A shows the ${}_nq_x$ values from this life table and calculation of the a_m values necessary for estimating the best 1-, 2- and 3-component fits to the Latin American pattern. Since a full set of ${}_nq_x$ values is available for Cuba (i.e., values are available for age-groups 0-1 and 1-4 and five-year age-groups thereafter up to 80-84), it is possible to use the simple equations (1a) to estimate the a_m values. Table 8B presents the results of the fitting. It is clear from comparing the observed ${}_nq_x$ values to the 1-component model that Cuban mortality is described very well by the Latin American pattern of mortality shown in the present publication. Differences appear in the childhood age-group 1-4 where Cuban male mortality is approximately half of that expected by the Latin American

[20] *Demographic Yearbook, special issue: Historical Supplement* (United Nations publication, Sales No. E/F.79.XIII.8), pp. 800-801.

U_{3x}^2	$({}_nY_x - {}_n\bar{Y}^s_x)U_{ix}$			$U_{ix}U_{jx}$		
(11) = (8)²	(12) = (5) × (6)	(13) = (5) × (7)	(14) = (5) × (8)	(15) = (6) × (7)	(16) = (6) × (8)	(17) = (7) × (8)
0.00871	0.05782	0.11230	0.02278	−0.10897	0.02210	−0.04293
0.08567	0.13410	−0.25578	−0.10879	−0.24826	−0.10559	0.20141
0.22221	0.06313	0.01211	−0.08898	0.02145	−0.15776	−0.03023
0.03029	0.18461	0.07543	−0.10520	0.03811	−0.05315	−0.02172
0.01148	0.13708	0.11553	0.05077	0.07055	0.03100	0.02613
0.08319	0.14285	0.05336	0.14366	0.03072	0.08271	0.03090
0.11303	0.04976	0.01158	0.05985	0.01819	0.09397	0.02188
0.11352	0.06491	0.00773	0.07804	0.00936	0.09442	0.01125
0.04560	0.05506	0.00598	0.04510	0.00739	0.05568	0.00605
0.02331	0.04233	0.01160	0.02736	0.01529	0.03607	0.00988
0.00432	0.03363	0.01408	0.01062	0.01810	0.01366	0.00572
0.00000	0.01222	0.00729	0.00003	0.01891	0.00008	0.00005
0.00139	0.00347	0.00259	−0.00085	0.01711	−0.00565	−0.00422
0.01131	0.02794	0.02001	−0.02249	0.01251	−0.01406	−0.01007
0.01258	−0.03044	−0.02688	−0.02788	0.01323	−0.01373	−0.01212
0.04954	−0.04216	−0.05424	0.08191	0.01689	−0.02550	−0.03280
γ_3 = 0.81613	α_1 = 0.93629	α_2 = −0.11189	α_3 = 0.22169	β_1 = −0.04942	β_2 = 0.05435	β_3 = 0.15917

3-component fit

(from equations (1))

$$D = (0.98121)(0.86015)(0.81613) - (0.81613)(-0.04942)^2 - (0.86015)(0.05435)^2 - (0.98121)(0.15917)^2 + 2(-0.04942)(0.05435)(0.15917) = 0.65856$$

$$a_1 = \{0.93629[(0.86015)(0.81613) - 0.15917^2] - 0.11189[(0.05435)(0.15917) - (-0.04942)(0.81613)] + 0.22169[(-0.04942)(0.15917) - (0.05435)(0.86015)]\}/0.65856 = 0.93532$$

$$a_2 = \{0.93629[(0.05435)(0.15917) - (-0.04942)(0.81613)] - 0.11189[(0.98121)(0.81613) - 0.05435^2] + 0.22169[(-0.04942)(0.05435) - (0.15917)(0.98121)]\}/0.65856 = -0.11939$$

$$a_3 = \{0.93629\,[(-0.04942)(0.15917) - (0.05435)(0.86015)] - 0.11189[(-0.04942)(0.05435) - (0.15917)(0.98121)] + 0.22169[(0.98121)(0.86015) - (-0.04942)^2]\}/0.65856 = 0.23262$$

TABLE 9B. ONE-, 2- AND 3-COMPONENT FITS TO AFGHAN DATA USING THE SOUTH ASIAN PATTERN AS A MODEL

Age x	*Afghanistan observed* $_nq_x$	*Fitted* $_nq_x$ *values based on:* 1 component	2 components	3 components
0	0.18708	0.18164	0.19191	0.20409
1	0.14917	0.14234	0.15513	0.14412
5	0.02518	0.03244	0.03206	0.02551
10	0.02469	0.01335	0.01308	0.01183
15	0.02274	0.01543	0.01485	0.01514
20	0.02809	0.01811	0.01779	0.01998
25	0.01833	0.02181	0.02156	0.02477
30	0.02519	0.02701	0.02682	0.03089
35	0.03297	0.03545	0.03524	0.03840
40	0.04454	0.04865	0.04812	0.05086
45	0.06303	0.06751	0.06658	0.06763
50	0.08072	0.09708	0.09556	0.09432
55	0.10736	0.13297	0.13089	0.12731
60	0.21916	0.19137	0.18901	0.17972
65	0.14722	0.26393	0.26060	0.24820
70	0.17645	0.35757	0.35228	0.32542

NOTE: Fitted $_nq_x$ values were calculated according to the following equations:

1-component fit—logit $[_nq_x] = {}_n\overline{Y}^s_x + a_1 U_{1x}$

2-component fit—logit $[_nq_x] = {}_n\overline{Y}^s_x + a_1 U_{1x} + a_2 U_{2x}$

3-component fit—logit $[_nq_x] = {}_n\overline{Y}^s_x + a_1 U_{1x} + a_2 U_{2x} + a_3 U_{3x}$.

Values of the terms in the equations are from table 9.A.

TABLE 10A. CALCULATION OF LOADING FACTORS (a_m VALUES) FOR FIT OF AFGHAN DATA TO THE INDIAN MORTALITY PATTERN: AN EXAMPLE IN WHICH THE LIFE TABLE FOR ANOTHER COUNTRY IS USED AS THE STANDARD

Age x *(1)*	$_nq_x$ *values Afghan males* *(2)*	$_nY_x$ *(3) = logit (2)*	$_nq_x$ *values (India)* *(4)*	$_n\overline{Y}^s_x$ *(5) = logit (4)*	$_nY_x - {}_n\overline{Y}^s_x$ *(6) = (3) − (5)*	U_{1x} *(7)*	U_{2x} *(8)*	U_{3x} *(9)*	U^2_{1x} *(10) = (6)*^{2}
0	0.18708	−0.73455	0.12066	−0.99130	0.25855	0.23686	−0.46007	0.09331	0.05610
1	0.14917	−0.87056	0.10236	−1.08564	0.21507	0.36077	−0.68813	−0.29269	0.13015
5	0.02518	−1.82810	0.02450	−1.84214	0.01404	0.33445	0.06414	−0.47139	0.11186
10	0.02469	−1.83818	0.01040	−2.27775	0.43957	0.30540	0.12479	−0.17403	0.09327
15	0.02274	−1.88031	0.01183	−2.21261	0.33229	0.28931	0.24384	0.10715	0.08370
20	0.02809	−1.77192	0.01519	−2.08591	0.31398	0.28678	0.10713	0.28842	0.08224
25	0.01833	−1.99036	0.01691	−2.03140	0.04104	0.27950	0.06507	0.33620	0.07812
30	0.02519	−1.82790	0.02079	−1.92614	0.09824	0.28023	0.03339	0.33692	0.07853
35	0.03297	−1.68932	0.02685	−1.79514	0.10582	0.26073	0.02833	0.21354	0.06798
40	0.04454	−1.53290	0.04128	−1.57261	0.03971	0.23626	0.06473	0.15269	0.05582
45	0.06303	−1.34952	0.05892	−1.38542	0.03590	0.20794	0.08705	0.06569	0.04324
50	0.08072	−1.21630	0.09365	−1.13493	−0.08137	0.17804	0.10620	0.00045	0.03170
55	0.10736	−1.05900	0.12778	−0.96037	−0.09863	0.15136	0.11305	−0.03731	0.02291
60	0.21916	−0.63528	0.19538	−0.70771	0.07243	0.13217	0.09467	−0.10636	0.01747
65	0.14722	−0.87829	0.25909	−0.52535	−0.35293	0.12243	0.10809	−0.11214	0.01499
70	0.17645	−0.77029	0.34555	−0.31933	−0.45096	0.11457	0.14738	−0.22258	0.01313
									$\gamma_1 = 0.98121$

1-component fit

(from equations (3))

$$a_1 = \frac{0.43267}{0.98121} = 0.44096$$

2-component fit

(from equations (2))

$$a_1 = \frac{(0.43267)(0.86015) - (-0.19943)(-0.04942)}{(0.98121)(0.86015) - (-0.04942)^2} = 0.43052$$

$$a_2 = \frac{-(0.43267)(-0.04942) + (-0.19943)(0.98121)}{(0.98121)(0.86015) - (-0.04942)^2} = 0.20712$$

model, and in the young adult ages where Cuban mortality is somewhat higher than what would be expected. Adjustment of the Latin American model by application of the succeeding two components provides an excellent fit to the Cuban experience for ages 1 and over. Actual Cuban infant mortality is, however, higher than that predicted on the basis of the 3-component model.

When fewer than the full set of ${}_nq_x$ values are available, the arithmetic for calculating the a_m values is a bit more tedious but not any more difficult, as illustrated in table 9A using the mortality rates for Afghan males recorded in the 1972–1973 survey of the settled population.[21] It is assumed that the South Asian pattern is the relevant model for Afghanistan. Table 9B presents the 1-, 2- and 3-component fits as well as ${}_nq_x$ values from the South Asian model tables with the same life expectancy at birth.

The 1-component South Asian model makes quite a reasonable fit to the Afghan data although model mortality rates at the older ages are higher than those in the Afghan table, especially for ages 65 and older. The model mortality rates under age 5 are also about 5 per cent lower than the empirical rates. Solution for the second component brings the mortality rates under age 5 closer into line with the empirical data. Although the model rates at the older ages are still higher than the Afghan rates, this may indicate under-recording of deaths in the survey at the older ages or overstatement of age. Probably the second-component fit is a reasonable indication of the age pattern of male mortality in Afghanistan. The third-component model shows higher mortality at the earlier ages and lower mortality at the later ages than either the first- or the second-component models. Application of the third component brings older-age mortality rates more in line with those from the survey. However, if the low survey rates at the older ages are due to data errors, it is probably best to accept the 2-component model.

It was not necessary to use one of the models presented here as the base for estimating the Afghan age pattern of mortality. A pattern from a neighbouring country, for example, could have been accepted, its logit $[{}_nq_x]$ values calculated and, in combination with the principal-component vectors from the model tables, employed to estimate necessary loading factors. This possibility is illustrated in tables 10A and 10B using the Indian male life table given in annex V as the base. At this point six alternative fits of the Afghan age pattern of mortality have been presented—three fits using the South Asian model as a base, and three fits using the life table for India as a base. Which fit, if any, is appropriate for Afghanistan is a matter for further demographic analysis.

In the same vein, the principal-component vectors can be used as a basis for projecting mortality to future years. For example, in table 11, the Egyptian male life table for 1938-1942 has been taken, its logit $[{}_nq_x]$ values used as the average pattern, and, in conjunction with the first principal-component vector, the value of a_1 found, which

[21] Data are presented in United States Bureau of the Census, *Afghanistan: A Demographic Uncertainty*, by J. F. Spitler and N. B. Frank, International Research Document No. 6 (Washington, D.C., 1978), p. 4, table E. The recorded death rate for age-group 0-4 was separated into age-groups 0-1 and 1-4 based on the South Asian pattern.

U_{2x}^2	U_{3x}^2	$({}_nY_x - {}_n\bar{Y}_x^s)\,U_{ix}$			$U_{ix}\,U_{jx}$		
(11) = (7)²	(12) = (8)²	(13) = (6) × (7)	(14) = (6) × (8)	(15) = (6) × (9)	(16) = (7) × (8)	(17) = (7) × (9)	(18) = (8) × (9)
0.21166	0.00871	0.06124	−0.11895	0.02413	−0.10897	0.02210	−0.04293
0.47352	0.08567	0.07759	−0.14800	−0.06295	−0.24826	−0.10559	0.20141
0.00411	0.22221	0.00469	0.00090	−0.00662	0.02145	−0.15776	−0.03023
0.01557	0.03029	0.13424	0.05485	−0.07650	0.03811	−0.05315	−0.02172
0.05946	0.01148	0.09614	0.08103	0.03561	0.07055	0.03100	0.02613
0.01148	0.08319	0.09004	0.03364	0.09056	0.03072	0.08271	0.03090
0.00423	0.11303	0.01147	0.00267	0.01380	0.01819	0.09397	0.02188
0.00111	0.11352	0.02753	0.00328	0.03310	0.00936	0.09442	0.01125
0.00080	0.04560	0.02759	0.00300	0.02260	0.00739	0.05568	0.00605
0.00419	0.02331	0.00938	0.00257	0.00606	0.01529	0.03607	0.00988
0.00758	0.00432	0.00747	0.00313	0.00236	0.01810	0.01366	0.00572
0.01128	0.00000	−0.01449	−0.00864	−0.00004	0.01891	0.00008	0.00005
0.01278	0.00139	−0.01493	−0.01115	0.00368	0.01711	−0.00565	−0.00422
0.00896	0.01131	0.00957	0.00686	−0.00770	0.01251	−0.01406	−0.01007
0.01168	0.01258	−0.04321	−0.03815	0.03958	0.01323	−0.01373	−0.01212
0.02172	0.04954	−0.05167	−0.06646	0.10038	0.01689	−0.02550	−0.03280
$\gamma_2 = 0.86015$	$\gamma_3 = 0.81613$	$\alpha_1 = 0.43267$	$\alpha_2 = -0.19943$	$\alpha_3 = 0.21803$	$\beta_1 = -0.04942$	$\beta_2 = 0.05435$	$\beta_3 = 0.15917$

3-component fit

(from equations (1))

$$D = (0.98121)(0.86015)(0.81613) - (0.81613)(-0.04942)^2 - (0.86015)(0.05435)^2 - (0.98121)(0.15913)^2 + 2(-0.04942)(0.05435)(0.15913) = 0.65856$$

$$a_1 = \{0.43267[(0.86015)(0.81613) - 0.15917^2] - 0.19943\,[(0.05435)(0.15917) - (-0.04942)(0.81613)] + 0.21803\,[(-0.04942)(0.15917) - (0.05435)(0.86015)]\}/0.65856 = 0.41165$$

$$a_2 = \{0.43267\,[(0.05435)(0.15917) - (-0.04942)(0.81613)] - 0.19943\,[(0.98121)(0.81613) - 0.05435^2] + 0.21803\,[(-0.04942)(0.05435) - (0.15917)(0.98121)]\}/0.65856 = -0.26203$$

$$a_3 = \{0.43267\,[(-0.04942)(0.15917) - (0.05435)(0.86015)] - 0.19943\,[(-0.04942)(0.05435) - (0.15917)(0.98121)] + 0.21803\,[(0.98121)(0.86015) - (-0.04942)^2]\}/0.65856 = 0.29084$$

TABLE 10B. ONE-, 2- AND 3-COMPONENT FITS TO AFGHAN DATA USING THE INDIAN LIFE TABLE AS A MODEL

Age x	Afghanistan observed ${}_nq_x$	Fitted ${}_nq_x$ values based on:		
		1 component	2 components	3 components
0	0.18708	0.14464	0.16915	0.18036
1	0.14917	0.13551	0.17142	0.15658
5	0.02518	0.03263	0.03159	0.02374
10	0.02469	0.01357	0.01282	0.01131
15	0.02274	0.01522	0.01369	0.01403
20	0.02809	0.01948	0.01854	0.02137
25	0.01833	0.02154	0.02085	0.02481
30	0.02519	0.02646	0.02596	0.03098
35	0.03297	0.03356	0.03301	0.03675
40	0.04454	0.05036	0.04886	0.05236
45	0.06303	0.06995	0.06737	0.06869
50	0.08072	0.10785	0.10335	0.10168
55	0.10736	0.14341	0.13738	0.13273
60	0.21916	0.21436	0.20737	0.19496
65	0.14722	0.28035	0.27090	0.25506
70	0.17645	0.36874	0.35410	0.32060

NOTE: Fitted ${}_nq_x$ values were calculated according to the following equations:

$$\text{1-component fit—logit } [{}_nq_x] = {}_n\bar{Y}_x^s + a_1 U_{1x}$$

$$\text{2-component fit—logit } [{}_nq_x] = {}_n\bar{Y}_x^s + a_1 U_{1x} + a_2 U_{2x}$$

$$\text{3-component fit—logit } [{}_nq_x] = {}_n\bar{Y}_x^s + a_1 U_{1x} + a_2 U_{2x} + a_3 U_{3x}.$$

Values of the terms in the equations are from table 10.A.

leads to a life table with the same life expectancy at birth as Egyptian males had in 1958-1962. The calculation of the value a_1 which leads to the life table with the desired life expectancy was done by computer program and is not shown here. The procedure is essentially one of trial and error, with interpolation for improved guesses as to the correct value of a_1. Table 11 presents the empirical ${}_nq_x$ values for 1938-1942 and 1958-1962 along with the predicted values for 1958-1962. The predicted 1958-1962 values are quite reasonable considering the large change in mortality that took place. This may, of course, partially reflect similarity of errors in data in both years.

The final illustration combines elements of the previous examples to demonstrate construction of a new model age pattern of mortality which is perhaps applicable to West African populations. The source of data for this pattern is the data collected in the population laboratory at Ngayorkheme, a small rural area in Senegal. Death rates by age and sex for this area are presented in table 12.[22] Because of the nature of the data collection system, under-recording of deaths is unlikely in these data. In addition there is probably little mis-statement of age for the population under age 10 since most of this population was born during the observation period. However, mis-

[22] The data for Ngayorheme are from M. Garenne, *Age Patterns of Mortality in West Africa*, Working Paper No. 6, Population Studies Center, University of Pennsylvania (1981).

TABLE 11. PROBABILITY OF DYING (${}_nq_x$) FOR EGYPTIAN MALES: ACTUAL VALUES FOR 1938-1942 AND 1958-1962, AND PREDICTED VALUES FOR 1958-1962 BASED ON FIRST PRINCIPAL-COMPONENT VECTOR

Age x	1938-1942 actual	1958-1962 actual	1958-1962 predicted
0	0.21000	0.12640	0.12219
1	0.28461	0.12933	0.12931
5	0.01916	0.00750	0.00777
10	0.01410	0.00396	0.00617
15	0.02565	0.01109	0.01180
20	0.03113	0.01475	0.01447
25	0.03745	0.01917	0.01781
30	0.04850	0.02586	0.02316
35	0.06280	0.03430	0.03183
40	0.07973	0.04548	0.04347
45	0.10060	0.06033	0.05961
50	0.12700	0.08000	0.08211
55	0.16020	0.10610	0.11203
60	0.20200	0.14070	0.14997
65	0.25490	0.18660	0.19670
70	0.32170	0.24750	0.25752
75	0.40590	0.32820	0.33934
80	0.51210	0.43520	0.45163
e_0 =	32.43	49.84	49.84

TABLE 12. OBSERVED ${}_nq_x$ VALUES FOR NGAYORKHEME, SENEGAL, 1963-1973, AND SMOOTHED VALUES FOR AGES 10 AND OVER BASED ON 3-COMPONENT FIT TO THE GENERAL PATTERN

Age x	Males		Females	
	Observed ${}_nq_x$ values	Smoothed ${}_nq_x$ values	Observed ${}_nq_x$ values	Smoothed ${}_nq_x$ values
0	0.21927	0.21927[a]	0.19477	0.19477[a]
1	0.34913	0.34913[a]	0.33636	0.33636[a]
5	0.05131	0.05131[a]	0.05331	0.05331[a]
10	0.03008	0.01786	0.02620	0.01763
15	0.01591	0.01534	0.01896	0.03446
20	0.01216	0.02286	0.05961	0.04680
25	0.03722	0.02620	0.04730	0.05004
30	0.05039	0.03298	0.03046	0.05807
35	0.05744	0.04562	0.05571	0.06188
40	0.04210	0.05659	0.06884	0.05798
45	0.05050	0.07533	0.05772	0.06126
50	0.11029	0.10068	0.05764	0.07178
55	0.11436	0.13491	0.11008	0.09159
60	0.18460	0.20023	0.10352	0.12522
65	0.24199	0.27143	0.15429	0.16673
70	0.34292	0.37415	0.15782	0.22541
75	0.34784	0.43983	0.35812	0.30539

[a]Assumed equal to observed value.

statement of age is clearly prevalent throughout the adult years. As a result, smoothing was necessary before the recorded death rates could be accepted as the mortality pattern. After experimenting with the various patterns, a good fit to the observed data was found by a 3-component adjustment to the general pattern, constructed in the same manner as the Afghan example above. The resulting ${}_nq_x$ values, also presented in table 12, reliably follow the recorded data although without the effects of age mis-statement that appear in the recorded data. Because the recorded rates under age 10 are thought to be extremely accurate, the 3-component smoothing of the observed data is accepted only for ages 10 and over. Hypothesizing that the essential features of the Ngayorheme pattern are general to West Africa as a whole, a West African model life table set can be constructed from this pattern in conjunction with the first eigenvector. Using the procedure outlined in the Egyptian example, values of the loading factor, a_1, can be calculated which produce model life tables for a series of life expectancies at birth. An abbreviated set of West African model life tables is presented in tables 13 and 14 for life expectancies at birth from 25 years to 55 years at five-year intervals.

TABLE 13. HYPOTHETICAL WEST AFRICAN MODEL LIFE TABLES, MALES

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.30078	0.25033	100000.	25033.	83228.	2499992.	25.000	0.330
1	0.14122	0.41115	74967.	30822.	218250.	2416764.	32.238	1.352
5	0.01335	0.06460	44144.	2852.	213593.	2198514.	49.803	2.500
10	0.00450	0.02223	41293.	918.	204170.	1984921.	48.069	2.500
15	0.00381	0.01888	40375.	762.	200000.	1780752.	44.105	2.541
20	0.00568	0.02804	39613.	1111.	195396.	1580751.	39.905	2.599
25	0.00649	0.03195	38502.	1230.	189511.	1385355.	35.981	2.563
30	0.00819	0.04017	37272.	1497.	182761.	1195844.	32.084	2.597
35	0.01123	0.05467	35774.	1956.	174148.	1013082.	28.319	2.585
40	0.01375	0.06654	33819.	2250.	163626.	838934.	24.807	2.571
45	0.01808	0.08662	31568.	2734.	151217.	675308.	21.392	2.578
50	0.02393	0.11309	28834.	3261.	136241.	524091.	18.176	2.569
55	0.03196	0.14835	25573.	3794.	118684.	387850.	15.166	2.580
60	0.04834	0.21615	21779.	4707.	97389.	269166.	12.359	2.556
65	0.06766	0.28948	17072.	4942.	73045.	171777.	10.062	2.508
70	0.09894	0.39395	12130.	4779.	48296.	98732.	8.140	2.415
75	0.12093	0.45871	7351.	3372.	27885.	50436.	6.861	2.369
80	0.17645	******	3979.	3979.	22551.	22551.	5.667	5.667

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.25663	0.21898	100000.	21898.	85328.	3000000.	30.000	0.330
1	0.11327	0.34854	78102.	27222.	240325.	2914671.	37.319	1.352
5	0.01051	0.05119	50880.	2605.	247890.	2674346.	52.562	2.500
10	0.00360	0.01782	48276.	860.	239227.	2426456.	50.263	2.500
15	0.00308	0.01531	47415.	726.	235294.	2187229.	46.129	2.545
20	0.00461	0.02281	46689.	1065.	230894.	1951935.	41.807	2.603
25	0.00530	0.02615	45624.	1193.	225218.	1721041.	37.722	2.566
30	0.00669	0.03292	44431.	1462.	218651.	1495824.	33.666	2.604
35	0.00931	0.04554	42969.	1957.	210139.	1277172.	29.723	2.596
40	0.01162	0.05650	41012.	2317.	199460.	1067034.	26.018	2.583
45	0.01561	0.07523	38695.	2911.	186465.	867574.	22.421	2.592
50	0.02114	0.10056	35784.	3599.	170225.	681108.	19.034	2.584
55	0.02883	0.13478	32185.	4338.	150490.	510884.	15.873	2.594
60	0.04433	0.20008	27847.	5572.	125694.	360393.	12.942	2.569
65	0.06267	0.27126	22276.	6042.	96410.	234699.	10.536	2.523
70	0.09257	0.37396	16233.	6071.	65578.	138288.	8.519	2.432
75	0.11416	0.43965	10163.	4468.	39139.	72711.	7.155	2.387
80	0.16963	******	5695.	5695.	33572.	33572.	5.895	5.895

TABLE 13 (*continued*)

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.21924	0.19116	100000.	19116.	87192.	3500000.	35.000	0.330
1	0.09049	0.29200	80884.	23618.	260994.	3412808.	42.194	1.352
5	0.00830	0.04067	57266.	2329.	280506.	3151814.	55.038	2.500
10	0.00289	0.01435	54937.	788.	272714.	2871307.	52.266	2.500
15	0.00251	0.01246	54149.	675.	269090.	2598594.	47.990	2.550
20	0.00376	0.01863	53474.	996.	264985.	2329504.	43.563	2.606
25	0.00434	0.02148	52478.	1127.	259649.	2064519.	39.341	2.570
30	0.00548	0.02705	51351.	1389.	253431.	1804871.	35.148	2.609
35	0.00775	0.03803	49961.	1900.	245257.	1551439.	31.053	2.606
40	0.00984	0.04307	48061.	2310.	234751.	1306182.	27.177	2.595
45	0.01351	0.06543	45751.	2994.	221587.	1071431.	23.419	2.606
50	0.01871	0.08953	42757.	3828.	204590.	849844.	19.876	2.598
55	0.02604	0.12255	38929.	4771.	183233.	645254.	16.575	2.608
60	0.04070	0.18525	34158.	6328.	155494.	462021.	13.526	2.582
65	0.05811	0.25416	27830.	7073.	121726.	306528.	11.014	2.536
70	0.08666	0.35482	20757.	7365.	84992.	184801.	8.903	2.448
75	0.10781	0.42118	13392.	5640.	52319.	99810.	7.453	2.404
80	0.16322	******	7752.	7752.	47491.	47491.	6.127	6.127

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.18664	0.16590	100000.	16590.	88885.	4000000.	40.000	0.330
1	0.07161	0.24078	83410.	20083.	280460.	3911115.	46.890	1.352
5	0.00654	0.03216	63327.	2036.	311543.	3630655.	57.332	2.500
10	0.00232	0.01152	61290.	706.	304687.	3319112.	54.154	2.500
15	0.00203	0.01012	60584.	613.	301422.	3014425.	49.756	2.553
20	0.00306	0.01517	59971.	910.	297682.	2713003.	45.238	2.610
25	0.00355	0.01759	59061.	1039.	292785.	2415321.	40.895	2.572
30	0.00448	0.02217	58023.	1286.	287044.	2122536.	36.581	2.614
35	0.00643	0.03166	56736.	1796.	279397.	1835492.	32.351	2.615
40	0.00832	0.04078	54940.	2241.	269337.	1556094.	28.324	2.607
45	0.01167	0.05676	52699.	2991.	256373.	1286757.	24.417	2.619
50	0.01653	0.07951	49708.	3952.	239099.	1030384.	20.729	2.611
55	0.02348	0.11118	45756.	5087.	216675.	791285.	17.294	2.621
60	0.03730	0.17116	40669.	6961.	186602.	574610.	14.129	2.595
65	0.05379	0.23763	33708.	8010.	148909.	388008.	11.511	2.549
70	0.08099	0.33596	25698.	8633.	106594.	239099.	9.304	2.464
75	0.10167	0.40275	17064.	6873.	67596.	132505.	7.765	2.421
80	0.15701	******	10192.	10192.	64909.	64909.	6.369	6.369

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.15761	0.14255	100000.	14255.	90449.	4500001.	45.000	0.330
1	0.05579	0.19443	85745.	16671.	298833.	4409552.	51.427	1.352
5	0.00509	0.02515	69073.	1737.	341023.	4110719.	59.513	2.500
10	0.00184	0.00916	67336.	617.	335138.	3769696.	55.983	2.500
15	0.00164	0.00814	66719.	543.	332268.	3434558.	51.478	2.557
20	0.00246	0.01225	66176.	811.	328943.	3102290.	46.880	2.613
25	0.00288	0.01429	65365.	934.	324561.	2773347.	42.429	2.575
30	0.00363	0.01801	64431.	1160.	319395.	2448785.	38.006	2.619
35	0.00529	0.02614	63271.	1654.	312427.	2129391.	33.655	2.625
40	0.00698	0.03433	61617.	2116.	303047.	1816963.	29.488	2.618
45	0.01001	0.04890	59502.	2910.	290617.	1513916.	25.443	2.632
50	0.01452	0.07019	56592.	3972.	273525.	1223299.	21.616	2.625
55	0.02107	0.10036	52620.	5281.	250603.	949774.	18.050	2.634
60	0.03405	0.15744	47339.	7453.	218864.	699170.	14.769	2.607
65	0.04960	0.22125	39886.	8825.	177919.	480306.	12.042	2.562
70	0.07543	0.31690	31061.	9843.	130497.	302387.	9.735	2.480
75	0.09558	0.38389	21218.	8145.	85218.	171890.	8.101	2.438
80	0.15083	******	13073.	13073.	86672.	86672.	6.630	6.630

TABLE 13 (*continued*)

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.13132	0.12070	100000.	12070.	91913.	5000006.	50.000	0.330
1	0.04248	0.15274	87930.	13431.	316155.	4908093.	55.818	1.352
5	0.00390	0.01930	74499.	1438.	368902.	4591937.	61.637	2.500
10	0.00144	0.00717	73061.	524.	363996.	4223036.	57.801	2.500
15	0.00130	0.00646	72537.	468.	361544.	3859040.	53.201	2.561
20	0.00196	0.00974	72069.	702.	358671.	3497496.	48.530	2.615
25	0.00230	0.01143	71367.	816.	354860.	3138825.	43.981	2.577
30	0.00290	0.01441	70552.	1017.	350343.	2783965.	39.460	2.624
35	0.00430	0.02127	69535.	1479.	344175.	2433622.	34.999	2.635
40	0.00578	0.02853	68056.	1942.	335675.	2089447.	30.702	2.630
45	0.00850	0.04165	66114.	2753.	324085.	1753771.	26.527	2.645
50	0.01264	0.06135	63360.	3887.	307623.	1429686.	22.564	2.639
55	0.01876	0.08983	59473.	5343.	284794.	1122064.	18.867	2.647
60	0.03087	0.14377	54131.	7782.	252131.	837269.	15.468	2.620
65	0.04544	0.20466	46348.	9486.	208742.	585139.	12.625	2.575
70	0.06983	0.29719	36863.	10955.	156875.	376396.	10.211	2.495
75	0.08939	0.36412	25907.	9433.	105527.	219521.	8.473	2.455
80	0.14452	******	16474.	16474.	113994.	113994.	6.920	6.920

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.10725	0.10006	100000.	10006.	93296.	5500000.	55.000	0.330
1	0.03131	0.11566	89994.	10408.	332413.	5406704.	60.079	1.352
5	0.00290	0.01441	79585.	1147.	395060.	5074291.	63.759	2.500
10	0.00110	0.00548	78439.	430.	391120.	4679231.	59.655	2.500
15	0.00100	0.00500	78009.	390.	389097.	4288111.	54.969	2.565
20	0.00152	0.00756	77619.	587.	386699.	3899014.	50.233	2.618
25	0.00179	0.00893	77032.	688.	383496.	3512315.	45.595	2.580
30	0.00227	0.01127	76344.	860.	379682.	3128819.	40.983	2.629
35	0.00342	0.01694	75484.	1279.	374408.	2749137.	36.420	2.645
40	0.00470	0.02325	74205.	1725.	366957.	2374729.	32.002	2.642
45	0.00709	0.03486	72480.	2526.	356485.	2007772.	27.701	2.659
50	0.01084	0.05284	69953.	3696.	341093.	1651287.	23.606	2.653
55	0.01650	0.07941	66257.	5262.	318978.	1310195.	19.774	2.661
60	0.02768	0.12989	60995.	7923.	286224.	991217.	16.251	2.633
65	0.04123	0.18750	53072.	9951.	241370.	704993.	13.284	2.589
70	0.06408	0.27635	43121.	11916.	185960.	463623.	10.752	2.512
75	0.08295	0.34288	31205.	10700.	128985.	277662.	8.898	2.473
80	0.13792	******	20505.	20505.	148678.	148678.	7.251	7.251

TABLE 14. HYPOTHETICAL WEST AFRICAN MODEL LIFE TABLES, FEMALES

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.26197	0.22385	100000.	22385.	85449.	2499992.	25.000	0.350
1	0.13899	0.40676	77615.	31570.	227144.	2414542.	31.109	1.361
5	0.01472	0.07098	46044.	3268.	222050.	2187398.	47.506	2.500
10	0.00478	0.02360	42776.	1009.	211356.	1965348.	45.945	2.500
15	0.00949	0.04644	41766.	1940.	204349.	1753992.	41.995	2.689
20	0.01300	0.06297	39827.	2508.	192986.	1549643.	38.910	2.549
25	0.01368	0.06616	37319.	2469.	180447.	1356657.	36.353	2.510
30	0.01567	0.07538	34850.	2627.	167690.	1176210.	33.751	2.503
35	0.01626	0.07805	32223.	2515.	154707.	1008520.	31.298	2.453
40	0.01469	0.07080	29708.	2103.	143184.	853813.	28.740	2.454
45	0.01511	0.07281	27604.	2010.	133006.	710629.	25.743	2.504
50	0.01745	0.08365	25595.	2141.	122712.	577623.	22.568	2.543
55	0.02213	0.10498	23454.	2462.	111282.	454911.	19.396	2.569
60	0.03030	0.14106	20991.	2961.	97741.	343629.	16.370	2.563
65	0.04056	0.18442	18030.	3325.	81983.	245888.	13.638	2.543
70	0.05600	0.24587	14705.	3616.	64567.	163906.	11.146	2.522
75	0.07907	0.32955	11089.	3654.	46217.	99338.	8.958	2.474
80	0.13996	******	7435.	7435.	53121.	53121.	7.145	7.145

TABLE 14 (*continued*)

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.23051	0.20047	100000.	20047.	86969.	2999999.	30.000	0.350
1	0.11389	0.35028	79953.	28006.	245903.	2913030.	36.434	1.361
5	0.01164	0.05655	51947.	2937.	252389.	2667127.	51.344	2.500
10	0.00378	0.01872	49009.	917.	242753.	2414737.	49.271	2.500
15	0.00745	0.03664	48092.	1762.	236392.	2171985.	45.163	2.691
20	0.01020	0.04975	46330.	2305.	226021.	1935593.	41.778	2.558
25	0.01089	0.05300	44025.	2333.	214344.	1709572.	38.832	2.522
30	0.01264	0.06127	41692.	2555.	202117.	1495228.	35.864	2.517
35	0.01342	0.06491	39137.	2540.	189257.	1293111.	33.040	2.469
40	0.01246	0.06041	36597.	2211.	177389.	1103854.	30.162	2.469
45	0.01311	0.06347	34386.	2183.	166510.	926465.	26.943	2.516
50	0.01537	0.07407	32204.	2385.	155181.	759955.	23.599	2.553
55	0.01974	0.09420	29818.	2809.	142291.	604774.	20.282	2.579
60	0.02737	0.12833	27009.	3466.	126640.	462483.	17.123	2.575
65	0.03714	0.17023	23543.	4008.	107919.	335843.	14.265	2.555
70	0.05176	0.22949	19535.	4483.	86623.	227924.	11.667	2.534
75	0.07350	0.31025	15052.	4670.	63535.	141301.	9.387	2.489
80	0.13351	******	10382.	10382.	77765.	77765.	7.490	7.490

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.20341	0.17966	100000.	17966.	88322.	3500000.	35.000	0.350
1	0.09327	0.29940	82034.	24561.	263321.	3411678.	41.588	1.361
5	0.00926	0.04525	57473.	2601.	280865.	3148357.	54.779	2.500
10	0.00301	0.01494	54873.	820.	272313.	2867492.	52.257	2.500
15	0.00589	0.02907	54053.	1571.	266637.	2595179.	48.012	2.693
20	0.00805	0.03950	52481.	2073.	257357.	2328542.	44.369	2.565
25	0.00872	0.04266	50408.	2150.	246734.	2071185.	41.088	2.532
30	0.01026	0.05002	48258.	2414.	235327.	1824451.	37.806	2.530
35	0.01114	0.05419	45844.	2484.	222970.	1589124.	34.664	2.484
40	0.01062	0.05174	43360.	2243.	211153.	1366154.	31.507	2.483
45	0.01142	0.05552	41117.	2283.	199939.	1155001.	28.091	2.528
50	0.01359	0.06578	38834.	2555.	187943.	955062.	24.594	2.563
55	0.01767	0.08472	36279.	3074.	173984.	767120.	21.145	2.588
60	0.02479	0.11697	33205.	3884.	156649.	593136.	17.863	2.585
65	0.03408	0.15736	29322.	4614.	135379.	436487.	14.886	2.566
70	0.04792	0.21440	24708.	5297.	110535.	301108.	12.187	2.545
75	0.06843	0.29220	19410.	5672.	82888.	190573.	9.818	2.503
80	0.12758	******	13739.	13739.	107685.	107685.	7.838	7.838

Age	M(X)	Q(X)	l(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.17938	0.16065	100000.	16065.	89558.	4000000.	40.000	0.350
1	0.07600	0.25321	83935.	21254.	279652.	3910442.	46.589	1.361
5	0.00737	0.03617	62681.	2267.	307740.	3630791.	57.925	2.500
10	0.00240	0.01193	60414.	721.	300270.	3323051.	55.004	2.500
15	0.00466	0.02306	59693.	1376.	295293.	3022781.	50.638	2.693
20	0.00636	0.03132	58317.	1827.	287149.	2727488.	46.770	2.571
25	0.00698	0.03430	56490.	1937.	277689.	2440339.	43.199	2.541
30	0.00832	0.04077	54553.	2224.	267297.	2162650.	39.643	2.541
35	0.00925	0.04519	52329.	2365.	255728.	1895354.	36.220	2.498
40	0.00906	0.04428	49964.	2212.	244280.	1639626.	32.816	2.496
45	0.00994	0.04854	47751.	2318.	233052.	1395345.	29.221	2.538
50	0.01202	0.05839	45434.	2653.	220726.	1162294.	25.582	2.572
55	0.01581	0.07616	42781.	3258.	206075.	941567.	22.009	2.597
60	0.02246	0.10653	39523.	4210.	187488.	735492.	18.609	2.595
65	0.03127	0.14533	35312.	5132.	164125.	548004.	15.519	2.577
70	0.04436	0.20010	30180.	6039.	136139.	383879.	12.720	2.556
75	0.06367	0.27486	24141.	6635.	104220.	247740.	10.262	2.515
80	0.12197	******	17506.	17506.	143520.	143520.	8.198	8.198

TABLE 14 (*continued*)

Age	M(X)	Q(X)	I(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.15760	0.14296	100000.	14296.	90708.	4500003.	45.000	0.350
1	0.06135	0.21119	85704.	18100.	295051.	4409295.	51.448	1.361
5	0.00583	0.02871	67604.	1941.	333168.	4114244.	60.858	2.500
10	0.00190	0.00948	65663.	622.	326760.	3781076.	57.583	2.500
15	0.00366	0.01817	65041.	1182.	322477.	3454316.	53.110	2.693
20	0.00500	0.02468	63859.	1576.	315475.	3131839.	49.043	2.576
25	0.00555	0.02740	62283.	1706.	307235.	2816364.	45.219	2.550
30	0.00672	0.03304	60577.	2001.	297985.	2509129.	41.421	2.552
35	0.00764	0.03748	58575.	2196.	287415.	2211144.	37.749	2.512
40	0.00769	0.03773	56380.	2127.	276601.	1923729.	34.121	2.509
45	0.00863	0.04227	54252.	2293.	265640.	1647128.	30.360	2.549
50	0.01060	0.05166	51959.	2684.	253300.	1381488.	26.588	2.580
55	0.01411	0.06824	49275.	3363.	238324.	1128188.	22.896	2.606
60	0.02029	0.09673	45912.	4441.	218925.	889864.	19.382	2.605
65	0.02862	0.13386	41471.	5551.	193960.	670939.	16.178	2.587
70	0.04097	0.18626	35920.	6690.	163314.	476979.	13.279	2.566
75	0.05910	0.25783	29230.	7536.	127518.	313665.	10.731	2.528
80	0.11654	******	21693.	21693.	186147.	186147.	8.581	8.581

Age	M(X)	Q(X)	I(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.13752	0.12624	100000.	12624.	91795.	5000000.	50.000	0.350
1	0.04882	0.17300	87376.	15116.	309613.	4908206.	56.173	1.361
5	0.00456	0.02252	72260.	1627.	357230.	4598593.	63.640	2.500
10	0.00150	0.00745	70632.	526.	351847.	4241363.	60.048	2.500
15	0.00285	0.01415	70106.	992.	348241.	3889516.	55.480	2.693
20	0.00388	0.01920	69114.	1327.	342359.	3541275.	51.238	2.581
25	0.00437	0.02164	67787.	1467.	335352.	3198915.	47.191	2.559
30	0.00536	0.02647	66320.	1756.	327322.	2863563.	43.178	2.563
35	0.00625	0.03079	64564.	1988.	317904.	2536242.	39.282	2.526
40	0.00648	0.03189	62576.	1995.	307939.	2218338.	35.450	2.523
45	0.00744	0.03656	60581.	2215.	297499.	1910398.	31.535	2.559
50	0.00929	0.04541	58366.	2650.	285441.	1612899.	27.634	2.589
55	0.01252	0.06079	55716.	3387.	270499.	1327458.	23.826	2.614
60	0.01823	0.08736	52329.	4571.	250740.	1056960.	20.198	2.615
65	0.02608	0.12270	47757.	5860.	224705.	806220.	16.882	2.597
70	0.03767	0.17260	41898.	7231.	191956.	581515.	13.879	2.576
75	0.05463	0.24079	34666.	8347.	152799.	389559.	11.237	2.540
80	0.11116	******	26319.	26319.	236760.	236760.	8.996	8.996

Age	M(X)	Q(X)	I(X)	D(X)	L(X)	T(X)	E(X)	A(X)
0	0.11877	0.11026	100000.	11026.	92833.	5500000.	55.000	0.350
1	0.03810	0.13847	88974.	12320.	323384.	5407167.	60.772	1.361
5	0.00350	0.01735	76654.	1330.	379945.	5083783.	66.321	2.500
10	0.00115	0.00576	75324.	434.	375537.	4703838.	62.448	2.500
15	0.00218	0.01083	74891.	811.	372581.	4328301.	57.795	2.691
20	0.00296	0.01467	74080.	1087.	367774.	3955720.	53.398	2.586
25	0.00339	0.01679	72993.	1226.	361982.	3587946.	49.155	2.567
30	0.00422	0.02087	71767.	1498.	355203.	3225964.	44.950	2.574
35	0.00504	0.02492	70270.	1751.	347042.	2870761.	40.854	2.541
40	0.00539	0.02662	68519.	1824.	338102.	2523719.	36.833	2.537
45	0.00635	0.03128	66695.	2086.	328407.	2185617.	32.770	2.570
50	0.00806	0.03953	64609.	2554.	316909.	1857210.	28.745	2.598
55	0.01102	0.05368	62055.	3331.	302357.	1540301.	24.822	2.623
60	0.01626	0.07826	58724.	4596.	282702.	1237944.	21.081	2.625
65	0.02359	0.11167	54128.	6044.	256176.	955241.	17.648	2.607
70	0.03442	0.15889	48083.	7640.	221970.	699066.	14.539	2.585
75	0.05018	0.22346	40443.	9037.	180099.	477096.	11.797	2.553
80	0.10575	******	31406.	31406.	296997.	296997.	9.457	9.457