

TRANSACTIONS OF SOCIETY OF ACTUARIES
1995-96 REPORTS

ANNUITY 2000 MORTALITY TABLES*

ROBERT J. JOHANSEN

The NAIC LHATF Annuity Working Group (AWG), at its teleconference on Friday, June 21, 1996, expressed a desire for a set of interim updated individual annuity valuation mortality tables. The group "agreed that no generational approach was feasible at this time." Since a generational approach seemed to be "at least four or five years away," the AWG "voted to utilize Projection Scale G to project the 1983 Table *a* forward to the year 2000." I agreed to supply the AWG with "a table produced essentially in this manner." Subsequently, the Society of Actuaries Life Practice Research Committee set up a Project Oversight Group (POG)† to review the results. The tables and a preliminary report were submitted to the POG.

The POG reviewed the tables submitted with the preliminary report, including some data relating to mortality improvement rates since the 1980s. Using this data plus some annuity mortality studies developed at the company of one of the POG members, the POG questioned the use of Scale G to project new female mortality rates. The group thought that female mortality improvement rates had dropped since Scale G had been formed. Considering that the 1976–86 intercompany mortality experience contained unexplained anomalies and that an unpublished intercompany study for the period 1987–91 included contributions from only five companies and that the proportions of the data contributed by the individual companies varied by kind of business, the POG relied primarily on population and Social Security data for its finding that the female Scale G rates were too high.

There was considerable discussion back and forth, but the lack of solid intercompany annuity experience and the support from population data resulted in a recommendation that the new Annuity 2000 mortality tables be based on 100% of male Scale G and 50% of female Scale G. I concur in the use of 100% of Male Scale G and 50% of Female Scale G as a reasonable method of meeting the current need for an updated annuity valuation table. It is, however, intended as an interim table, and I wish to call attention

*The Society of Actuaries Board of Governors authorized the Committee on Life Insurance Research (COLIFER) to make a statement of opinion accepting the table. The opinions states: "The Annuity 2000 *Basic* Table represents the COLIFER's best estimate of the mortality pattern that has resulted from the mortality improvement experienced since 1983. The committee believes that the Annuity 2000 *Mortality* Table is a suitable basis for the statutory valuation of individual annuity business written on lives in the U.S. Note that this recommendation does not apply to structured settlements." [Editor's Note: This report was referenced in a model regulation approved at the December 19, 1996 National Association of Insurance Commissioners Plenary Session.]

†Harry Klaristenfeld, chair, Steve Garavaglia, John Paddon, Mark Peavy, and Jonathan Wooley.

to the need for a comprehensive study of individual annuity mortality experience.

Table 5 summarizes pertinent data with respect to annuitant mortality experience since 1971. Table 6 provides annual mortality improvement rates based on the 1971-76 and 1987-91 intercompany mortality studies. Table 7 shows annual improvement rates based on the 1976-86 and 1987-91 mortality studies. The figures provide a good indication that something affected the 1976-86 immediate nonrefund experience; the refund experience should be viewed with caution. The 1976-86 settlement annuity and matured deferred annuity data look more reasonable. Table 8 shows annual mortality improvement rates for the U.S. population over the period 1985-95.

The Annuity 2000 Basic Table has been produced by applying appropriate percentages of Scale G to the (unloaded) 1983 Basic Table for 17 years and graduating the results with a Jenkins Modified Osculatory interpolation formula and a cubic curve fitted at the high ages. A loading of 10% was deducted and the results graduated to produce the Annuity 2000 Mortality Table. The graduated mortality rates were adjusted to remove a small dip in the male mortality rates in the 30s in both the Basic Table and the Annuity 2000 table.

The 10% loading is intended to provide a safety margin to allow for the fact that some companies experience lower-than-average annuitant mortality. [For a discussion of the 10% loading, see pages 702 and 703 of "Report of the Committee to Recommend a New Mortality Basis for Individual Annuity Valuation (Derivation of the 1983 Table *a*)," TSA XXXIII (1981).]

This report includes the Annuity 2000 Basic (unloaded) Table (see Table 1), the Annuity 2000 (loaded) Mortality Table (see Table 2), a comparison with the 1983 Table *a* (see Table 3), a test of smoothness using first and second differences (see Table 9), and a comparison of immediate annuity single premiums on the 1983 and 2000 tables at 5%, 7%, and 9% interest (see Table 4).

Appendix A presents the life expectancies for these tables. Appendix B develops seven blended tables based on these tables.

TABLE 1
ANNUITY 2000 BASIC TABLE

Age Nearest Birthday (x)	1000g.		Age Nearest Birthday (x)	1000g.	
	Male	Female*		Male	Female*
5	0.324	0.189	61	7.714	4.699
6	0.301	0.156	62	8.348	5.181
7	0.286	0.131	63	9.093	5.732
8	0.328	0.131	64	9.968	6.347
9	0.362	0.134	65	10.993	7.017
10	0.390	0.140	66	12.188	7.734
11	0.413	0.148	67	13.572	8.491
12	0.431	0.158	68	15.160	9.288
13	0.446	0.170	69	16.946	10.163
14	0.458	0.183	70	18.920	11.165
15	0.470	0.197	71	21.071	12.339
16	0.481	0.212	72	23.388	13.734
17	0.495	0.228	73	25.871	15.391
18	0.510	0.244	74	28.552	17.326
19	0.528	0.260	75	31.477	19.551
20	0.549	0.277	76	34.686	22.075
21	0.573	0.294	77	38.225	24.910
22	0.599	0.312	78	42.132	28.074
23	0.627	0.330	79	46.427	31.612
24	0.657	0.349	80	51.128	35.580
25	0.686	0.367	81	56.250	40.030
26	0.714	0.385	82	61.809	45.017
27	0.738	0.403	83	67.826	50.600
28	0.758	0.419	84	74.322	56.865
29	0.774	0.435	85	81.326	63.907
30	0.784	0.450	86	88.863	71.815
31	0.789	0.463	87	96.958	80.682
32	0.789	0.476	88	105.631	90.557
33	0.790	0.488	89	114.858	101.307
34	0.791	0.500	90	124.612	112.759
35	0.792	0.515	91	134.861	124.733
36	0.794	0.534	92	145.575	137.054
37	0.823	0.558	93	156.727	149.552
38	0.872	0.590	94	168.290	162.079
39	0.945	0.630	95	180.245	174.492
40	1.043	0.677	96	192.565	186.647
41	1.168	0.732	97	205.229	198.403
42	1.322	0.796	98	218.683	210.337
43	1.505	0.868	99	233.371	233.027
44	1.715	0.950	100	249.741	237.051
45	1.948	1.043	101	268.237	252.985
46	2.198	1.148	102	289.305	271.406
47	2.463	1.267	103	313.391	292.893
48	2.740	1.400	104	340.940	318.023
49	3.028	1.548	105	372.398	347.373
50	3.330	1.710	106	408.210	381.520
51	3.647	1.888	107	448.823	421.042
52	3.980	2.079	108	494.681	466.516
53	4.331	2.286	109	546.231	518.520
54	4.698	2.507	110	603.917	577.631
55	5.077	2.746	111	668.186	644.427
56	5.465	3.003	112	739.483	719.484
57	5.861	3.280	113	818.254	803.380
58	6.265	3.578	114	904.945	896.693
59	6.694	3.907	115	1000.000	1000.000
60	7.170	4.277			

*Based on 50% of Female Improvement Scale G.

TABLE 2
ANNUITY 2000 MORTALITY TABLE

Age Nearest: Birthday (x)	1000q _x		Age Nearest Birthday (x)	1000q _x	
	Male	Female*		Male	Female*
5	0.291	0.171	61	6.933	4.242
6	0.270	0.141	62	7.520	4.668
7	0.257	0.118	63	8.207	5.144
8	0.294	0.118	64	9.008	5.671
9	0.325	0.121	65	9.940	6.250
10	0.350	0.126	66	11.016	6.878
11	0.371	0.133	67	12.251	7.555
12	0.388	0.142	68	13.657	8.287
13	0.402	0.152	69	15.233	9.102
14	0.414	0.164	70	16.979	10.034
15	0.425	0.177	71	18.891	11.117
16	0.437	0.190	72	20.967	12.386
17	0.449	0.204	73	23.209	13.871
18	0.463	0.219	74	25.644	15.592
19	0.480	0.234	75	28.304	17.564
20	0.499	0.250	76	31.220	19.805
21	0.519	0.265	77	34.425	22.328
22	0.542	0.281	78	37.948	25.158
23	0.566	0.298	79	41.812	28.341
24	0.592	0.314	80	46.037	31.933
25	0.616	0.331	81	50.643	35.985
26	0.639	0.347	82	55.651	40.552
27	0.659	0.362	83	61.080	45.690
28	0.675	0.376	84	66.948	51.456
29	0.687	0.389	85	73.275	57.913
30	0.694	0.402	86	80.076	65.119
31	0.699	0.414	87	87.370	73.136
32	0.700	0.425	88	95.169	81.991
33	0.701	0.436	89	103.455	91.577
34	0.702	0.449	90	112.208	101.758
35	0.704	0.463	91	121.402	112.395
36	0.719	0.481	92	131.017	123.349
37	0.749	0.504	93	141.030	134.486
38	0.796	0.532	94	151.422	145.689
39	0.864	0.567	95	162.179	156.846
40	0.953	0.609	96	173.279	167.841
41	1.065	0.658	97	184.706	178.563
42	1.201	0.715	98	196.946	189.604
43	1.362	0.781	99	210.484	201.557
44	1.547	0.855	100	225.806	215.013
45	1.752	0.939	101	243.398	230.565
46	1.974	1.035	102	263.745	248.805
47	2.211	1.141	103	287.334	270.326
48	2.460	1.261	104	314.649	295.719
49	2.721	1.393	105	346.177	325.576
50	2.994	1.538	106	382.403	360.491
51	3.279	1.695	107	423.813	401.054
52	3.576	1.864	108	470.893	447.860
53	3.884	2.047	109	524.128	501.498
54	4.203	2.244	110	584.004	562.563
55	4.534	2.457	111	651.007	631.645
56	4.876	2.689	112	725.622	709.338
57	5.228	2.942	113	808.336	796.233
58	5.593	3.218	114	899.633	892.923
59	5.988	3.523	115	1000.000	1000.000
60	6.428	3.863			

*Based on 50% of Female Improvement Scale G.

TABLE 3

COMPARISON OF ANNUITY 2000 MORTALITY TABLE WITH 1983 TABLE *a*

Age Nearest Birthday (x)	1000 <i>q_x</i>		Ratio 2000/1983	Age Nearest Birthday (x)	1000 <i>q_x</i>		Ratio 2000/1983
	1983 Mortality Table <i>a</i>	Annuity 2000 Mortality Table			1983 Mortality Table <i>a</i>	Annuity 2000 Mortality Table	
Male				Male			
5	0.377	0.291	77.19%	61	8.983	6.933	77.18%
6	0.350	0.270	77.14	62	9.740	7.520	77.21
7	0.333	0.257	77.18	63	10.630	8.207	77.21
8	0.352	0.294	83.52	64	11.664	9.008	77.23
9	0.368	0.325	88.32	65	12.851	9.940	77.35
10	0.382	0.350	91.62	66	14.199	11.016	77.58
11	0.394	0.371	94.16	67	15.717	12.251	77.95
12	0.405	0.388	95.80	68	17.414	13.657	78.43
13	0.415	0.402	96.87	69	19.296	15.233	78.94
14	0.425	0.414	97.41	70	21.371	16.979	79.45
15	0.435	0.425	97.70	71	23.647	18.891	79.89
16	0.446	0.437	97.98	72	26.131	20.967	80.24
17	0.458	0.449	98.03	73	28.835	23.209	80.49
18	0.472	0.463	98.09	74	31.794	25.644	80.66
19	0.488	0.480	98.36	75	35.046	28.304	80.76
20	0.505	0.499	98.81	76	38.631	31.220	80.82
21	0.525	0.519	98.86	77	42.587	34.425	80.83
22	0.546	0.542	99.27	78	46.951	37.948	80.82
23	0.570	0.566	99.30	79	51.755	41.812	80.79
24	0.596	0.592	99.33	80	57.026	46.037	80.73
25	0.622	0.616	99.04	81	62.791	50.643	80.65
26	0.650	0.639	98.31	82	69.081	55.651	80.56
27	0.677	0.659	97.34	83	75.908	61.080	80.47
28	0.704	0.675	95.88	84	83.230	66.948	80.44
29	0.731	0.687	93.98	85	90.987	73.275	80.53
30	0.759	0.694	91.44	86	99.122	80.076	80.79
31	0.786	0.699	88.93	87	107.577	87.370	81.22
32	0.814	0.700	86.00	88	116.316	95.169	81.82
33	0.843	0.701	83.16	89	125.394	103.455	82.50
34	0.876	0.702	80.14	90	134.887	112.208	83.19
35	0.917	0.704	76.77	91	144.873	121.402	83.80
36	0.968	0.719	74.28	92	155.429	131.017	84.29
37	1.032	0.749	72.58	93	166.629	141.030	84.64
38	1.114	0.796	71.45	94	178.537	151.422	84.81
39	1.216	0.864	71.05	95	191.214	162.179	84.82
40	1.341	0.953	71.07	96	204.721	173.279	84.64
41	1.492	1.065	71.38	97	219.120	184.706	84.29
42	1.673	1.201	71.79	98	234.735	196.946	83.90
43	1.886	1.362	72.22	99	251.889	210.484	83.56
44	2.129	1.547	72.66	100	270.906	225.806	83.35
45	2.399	1.752	73.03	101	292.111	243.398	83.32
46	2.693	1.974	73.30	102	315.826	263.745	83.51
47	3.009	2.211	73.48	103	342.377	287.334	83.92
48	3.343	2.460	73.59	104	372.086	314.649	84.56
49	3.694	2.721	73.66	105	405.278	346.177	85.42
50	4.057	2.994	73.80	106	442.277	382.403	86.46
51	4.431	3.279	74.00	107	483.406	423.813	87.67
52	4.812	3.576	74.31	108	528.989	470.893	89.02
53	5.198	3.884	74.72	109	579.351	524.128	90.47
54	5.591	4.203	75.17	110	634.814	584.004	92.00
55	5.994	4.534	75.64	111	695.704	651.007	93.58
56	6.409	4.876	76.08	112	762.343	725.622	95.18
57	6.839	5.228	76.44	113	835.056	808.336	96.80
58	7.290	5.593	76.72	114	914.167	899.633	98.41
59	7.782	5.988	76.95	115	1000.000	1000.000	100.00
60	8.338	6.428	77.09				

TABLE 3—Continued

Age Nearest Birthday (x)	1000q _x		Ratio 2000/1983	Age Nearest Birthday (x)	1000q _x		Ratio 2000/1983
	1983 Mortality Table a	Annuity 2000 Mortality Table			1983 Mortality Table a	Annuity 2000 Mortality Table	
	Female*			Female*			
5	0.194	0.171	88.14%	61	4.908	4.242	86.43%
6	0.160	0.141	88.13	62	5.413	4.668	86.24
7	0.134	0.118	88.06	63	5.990	5.144	85.88
8	0.134	0.118	88.06	64	6.633	5.671	85.50
9	0.136	0.121	88.97	65	7.336	6.250	85.20
10	0.141	0.126	89.36	66	8.090	6.878	85.02
11	0.147	0.133	90.48	67	8.888	7.555	85.00
12	0.155	0.142	91.61	68	9.731	8.287	85.16
13	0.165	0.152	92.12	69	10.653	9.102	85.44
14	0.175	0.164	93.71	70	11.697	10.034	85.78
15	0.188	0.177	94.15	71	12.905	11.117	86.14
16	0.201	0.190	94.53	72	14.319	12.386	86.50
17	0.214	0.204	95.33	73	15.980	13.871	86.80
18	0.229	0.219	95.63	74	17.909	15.592	87.06
19	0.244	0.234	95.90	75	20.127	17.564	87.27
20	0.260	0.250	96.15	76	22.654	19.805	87.42
21	0.276	0.265	96.01	77	25.509	22.328	87.53
22	0.293	0.281	95.90	78	28.717	25.158	87.61
23	0.311	0.298	95.82	79	32.328	28.341	87.67
24	0.330	0.314	95.15	80	36.395	31.933	87.74
25	0.349	0.331	94.84	81	40.975	35.985	87.82
26	0.368	0.347	94.29	82	46.121	40.552	87.93
27	0.387	0.362	93.54	83	51.889	45.690	88.05
28	0.405	0.376	92.84	84	58.336	51.456	88.21
29	0.423	0.389	91.96	85	65.518	57.913	88.39
30	0.441	0.402	91.16	86	73.493	65.119	88.61
31	0.460	0.414	90.00	87	82.318	73.136	88.85
32	0.479	0.425	88.73	88	92.017	81.991	89.10
33	0.499	0.436	87.37	89	102.491	91.577	89.35
34	0.521	0.449	86.18	90	113.605	101.758	89.57
35	0.545	0.463	84.95	91	125.227	112.395	89.75
36	0.574	0.481	83.80	92	137.222	123.349	89.89
37	0.607	0.504	83.03	93	149.462	134.486	89.98
38	0.646	0.532	82.35	94	161.834	145.689	90.02
39	0.691	0.567	82.05	95	174.228	156.846	90.02
40	0.742	0.609	82.08	96	186.535	167.841	89.98
41	0.801	0.658	82.15	97	198.646	178.563	89.89
42	0.867	0.715	82.47	98	211.102	189.604	89.82
43	0.942	0.781	82.91	99	224.445	201.557	89.80
44	1.026	0.855	83.33	100	239.215	215.013	89.88
45	1.122	0.939	83.69	101	255.953	230.565	90.08
46	1.231	1.035	84.08	102	275.201	248.805	90.41
47	1.356	1.141	84.14	103	297.500	270.326	90.87
48	1.499	1.261	84.12	104	323.390	295.719	91.44
49	1.657	1.393	84.07	105	353.414	325.576	92.12
50	1.830	1.538	84.04	106	388.111	360.491	92.88
51	2.016	1.695	84.08	107	428.023	401.054	93.70
52	2.215	1.864	84.15	108	473.692	447.860	94.55
53	2.426	2.047	84.38	109	525.658	501.498	95.40
54	2.650	2.244	84.68	110	584.462	562.563	96.25
55	2.891	2.457	84.99	111	650.646	631.645	97.08
56	3.151	2.689	85.34	112	724.750	709.338	97.87
57	3.432	2.942	85.72	113	807.316	796.233	98.63
58	3.739	3.218	85.07	114	898.885	892.923	99.34
59	4.081	3.523	86.33	115	1000.000	1000.000	100.00
60	4.467	3.863	86.48				

*Based on 50% of Female Improvement Scale G.

TABLE 4
 COMPARISON OF ANNUITY SINGLE PREMIUMS
 1983 TABLE *a* VERSUS ANNUITY 2000 MORTALITY TABLE
 IMMEDIATE ANNUITY \$1 PER ANNUM

Age	5% Interest			7% Interest			9% Interest		
	1983 Table <i>a</i>	Annuity 2000 Table	Ratio 2000/1983	1983 Table <i>a</i>	Annuity 2000 Table	Ratio 2000/1983	1983 Table <i>a</i>	Annuity 2000 Table	Ratio 2000/1983
Male									
60	12.355	12.991	1.051	10.279	10.712	1.042	8.736	9.042	1.035
65	10.918	11.603	1.063	9.265	9.756	1.053	7.999	8.362	1.045
70	9.362	10.075	1.076	8.106	8.643	1.066	7.115	7.528	1.058
75	7.775	8.501	1.093	6.867	7.439	1.083	6.130	6.588	1.075
80	6.237	6.946	1.114	5.613	6.197	1.104	5.092	5.578	1.095
85	4.861	5.502	1.132	4.450	4.996	1.123	4.097	4.568	1.115
90	3.722	4.247	1.141	3.459	3.919	1.133	3.228	3.634	1.126
95	2.757	3.208	1.164	2.598	3.004	1.156	2.455	2.822	1.149
Female									
60	13.613	13.929	1.023	11.148	11.354	1.018	9.356	9.497	1.015
65	12.262	12.617	1.029	10.246	10.491	1.024	8.734	8.909	1.020
70	10.728	11.107	1.035	9.158	9.434	1.030	7.941	8.147	1.026
75	9.016	9.411	1.044	7.868	8.171	1.039	6.948	7.186	1.034
80	7.239	7.635	1.055	6.455	6.774	1.049	5.807	6.068	1.045
85	5.543	5.913	1.067	5.041	5.353	1.062	4.615	4.880	1.057
90	4.100	4.429	1.080	3.793	4.079	1.075	3.525	3.776	1.071
95	3.033	3.318	1.094	2.845	3.101	1.090	2.677	2.908	1.086
Ratio of Female to Male Annuity Single Premiums									
60	1.102	1.072		1.085	1.060		1.071	1.050	
65	1.123	1.087		1.106	1.075		1.092	1.065	
70	1.146	1.102		1.130	1.092		1.116	1.082	
75	1.160	1.107		1.146	1.098		1.133	1.091	
80	1.161	1.099		1.150	1.093		1.140	1.088	
85	1.140	1.075		1.133	1.071		1.126	1.068	
90	1.102	1.043		1.097	1.041		1.092	1.039	
95	1.100	1.034		1.095	1.032		1.090	1.030	

TABLE 5
 RATIOS OF ACTUAL TO EXPECTED MORTALITY ON VARIOUS TABLES
 FROM 1971-76, 1976-86, AND 1987-91: ANNUITY MORTALITY STUDIES
 BY AMOUNTS OF ANNUAL INCOME FOR ALL CONTRACT YEARS
 (EXPECTED DEATHS BASED ON TABLE INDICATED)

Age Group	A/E Ratio for Male Lives (%)					A/E Ratio for Female Lives (%)				
	Based on 1983 Table <i>a</i>			Based on 1996 Table	Based on 2000 Table	Based on 1983 Table <i>a</i>			Based on 1996 Table	Based on 2000 Table ^c
	1971-76 ^a	1976-86	1987-91 ^b	1987-91 ^b	1987-91 ^b	1971-76 ^b	1976-86	1987-91	1987-91 ^b	1987-91 ^b
Nonrefund Annuities										
<50	c	c	c	c	c	c	c	c	c	c
50-59	93 ^d	84 ^d	c	c	c	308 ^d	338 ^d	c	c	c
60-69	129	138	82 ^d	99 ^d	106 ^d	107	131	84 ^d	107 ^d	99
70-79	104	151	92	108	114	91	156	82	101	94
80-89	81	114	83	98	103	93	115	90	109	102
90 and Up	102	112	137	155	162	92	114	77	90	86
All	94	121	98			94	120	82		
Refund Annuities										
<50	352 ^c	508 ^d	c	c	c	354 ^d	442 ^d	c	c	c
50-59	174	158 ^d	c	c	c	264	242 ^d	c	c	c
60-69	108	105	93	112	120	129	129	174	222	204
70-79	100	99	88	104	109	94	105	109	134	125
80-89	96	101	80	94	99	105	98	98	119	111
90 and Up	107	119	86	98	101	102	96	92	108	102
All	102	104	86			104	103	102		
Settlements from Maturities and Surrenders (Excluding Pension Trust)—Refund										
<50	c	c	c	c	c	c	1,891 ^a	c	c	c
50-59	239	105	c	c	c	154 ^d	103	c	c	c
60-69	135	123	108	130	140	126	110	110	140	129
70-79	143	117	87	102	108	132	121	102	126	117
80-89	144	118	111	131	138	134	105	93	113	105
90 and Up	136	117	127	144	150	133	90	109	128	121
All	142	118	106			132	108	101		
Matured Deferred Annuities (Excluding Pension Trust)—Refund										
<50	c	c	c	c	c	c	c	c	c	c
50-59	c	c	c	c	c	c	389 ^d	c	c	c
60-69	147	134	c	c	c	141	129	c	c	c
70-79	132	99	88	104	109	132	115	124	153	142
80-89	139	128	96	113	119	137	123	110	133	124
90 and Up	141	126	107	121	126	129	130	118	139	131
All	138	119	102			136	124	115		
Matured Deferred Annuities (Excluding Pension Trust)—Nonrefund										
<50	c	c	c	c	c	c	c	c	c	c
50-59	c	c	c	c	c	c	c	c	c	c
60-69	117	109 ^d	c	c	c	131	c	c	c	c
70-79	141	167	c	c	c	147	127	81 ^d	100 ^d	93
80-89	161	124	90	106	112	140	105	95	115	107
90 and Up	138	107	131	149	154	138	110	100	117	111
All	139	126	111			143	109	97		

^aBased on unpublished data.

^bEstimated.

^cLess than 10 deaths.

^d10-49 deaths.

^eAnnuity 2000 using 50% of Scale G.

Note: The 1987-91 Study contains contributions from only five companies.

TABLE 6
 ANNUAL MORTALITY IMPROVEMENT RATES 1973 TO 1989
 1971-76 ANNUITY MORTALITY STUDY AND 1987-91 ANNUITY MORTALITY STUDY^a
 BY AMOUNTS OF ANNUAL INCOME FOR ALL CONTRACT YEARS
 (EXPECTED DEATHS BASED ON 1983 TABLE *a*;
 1971-76 ACT/EXP ADJUSTED TO 1983 TABLE *a*)

Age Group	Male Lives			Female Lives		
	1971-76 A/E Ratio (%)	1987-91 A/E Ratio (%)	Annual Improvement Rate (%)	1971-76 A/E Ratio (%)	1987-91 A/E Ratio (%)	Annual Improvement Rate (%)
Nonrefund Annuities						
<50	b	b	b	b	b	b
50-59	93 ^c	b	b	308 ^c	b	b
60-69	129	82 ^c	2.78 ^c	107	84 ^c	1.51 ^c
70-79	104	92	0.75	91	82	0.66
80-89	81	83	-0.16	93	90	0.17
90 and Up	102	137	-1.84	92	77	1.12
All Ages	94	98	-0.24	94	82	0.84
Refund Annuities						
<50	352 ^c	b	b	354 ^c	b	b
50-59	174	b	b	264	b	b
60-69	108	93	0.91	129	174	-1.89
70-79	100	88	0.81	94	109	-0.95
80-89	96	80	1.16	105	98	0.40
90 and Up	107	86	1.34	102	92	0.67
All Ages	102	86	1.04	104	102	0.14
Settlements from Maturities and Surrenders (Excluding Pension Trust)—Refund						
<50	b	b	b	b	b	b
50-59	239	b	b	154 ^c	b	b
60-69	135	108	1.37	126	110	0.86
70-79	143	87	3.05	132	102	1.60
80-89	144	111	1.62	134	93	2.25
90 and Up	136	127	0.43	133	109	1.24
All Ages	142	106	1.80	132	101	1.68
Matured Deferred Annuities (Excluding Pension Trust)—Refund						
<50	b	b	b	b	b	b
50-59	b	b	b	b	b	b
60-69	147	b	b	141	b	b
70-79	132	88	2.50	132	124	0.40
80-89	139	96	2.31	137	110	1.38
90 and Up	141	107	1.71	129	118	0.56
All Ages	138	102	1.87	136	115	1.02
Matured Deferred Annuities (Excluding Pension Trust)—Nonrefund						
<50	b	b	b	b	b	b
50-59	b	b	b	b	b	b
60-69	117	b	b	131	b	b
70-79	141	b	b	147	81 ^c	3.66 ^c
80-89	161	90	3.58	140	95	2.41
90 and Up	138	131	0.33	138	100	2.00
All Ages	139	111	1.40	143	97	2.39

^aBased on unpublished data.

^bLess than 10 deaths in 1971-76 and/or 1987-91 Study.

^c10-49 deaths in 1976-86 and/or 1987-91.

Note: The 1987-91 Study contains contributions from only five companies.

TABLE 7
 ANNUAL MORTALITY IMPROVEMENT RATES 1983 TO 1989
 1976-86 ANNUITY MORTALITY STUDY AND 1987-91 ANNUITY MORTALITY STUDY^a
 BY AMOUNTS OF ANNUAL INCOME FOR ALL CONTRACT YEARS
 (EXPECTED DEATHS BASED ON 1983 TABLE *a*)

Age Group	Male Lives			Female Lives		
	1976-86 A/E Ratio (%)	1987-91 A/E Ratio (%)	Annual Improvement Rate (%)	1976-86 A/E Ratio (%)	1987-91 A/E Ratio (%)	Annual Improvement Rate (%)
Nonrefund Annuities						
<50	b	b	b	b	b	b
50-59	84 ^c	b	b	338 ^c	b	b
60-69	138	82 ^c	8.31 ^c	131	84 ^c	7.14 ^c
70-79	151	92	7.93	156	82	10.16
80-89	114	83	5.15	115	90	4.00
90 and Up	112	137	-3.42	114	77	6.33
All Ages	121	98	3.45	120	82	6.15
Refund Annuities						
<50	508 ^c	b	b	442 ^c	b	b
50-59	158 ^c	b	b	242 ^c	b	b
60-69	105	93	2.00	129	174	-5.11
70-79	99	88	1.94	105	109	-0.63
80-89	101	80	3.81	98	98	0.00
90 and Up	119	86	5.27	96	92	0.71
All Ages	104	86	3.12	103	102	0.16
Settlements from Maturities and Surrenders (Excluding Pension Trust)—Refund						
<50	b	b	b	1,891	b	b
50-59	105	b	b	103	b	b
60-69	123	108	2.14	110	110	0.00
70-79	117	87	4.82	121	102	2.81
80-89	118	111	1.01	105	93	2.00
90 and Up	117	127	-1.38	90	109	-3.24
All Ages	118	106	1.77	108	101	1.11
Matured Deferred Annuities (Excluding Pension Trust)—Refund						
<50	b	b	b	b	b	b
50-59	b	b	b	389 ^c	b	b
60-69	134	b	b	129	b	b
70-79	99	88	1.94	115	124	-1.26
80-89	128	96	4.68	123	110	1.84
90 and Up	126	107	2.69	130	118	1.60
All Ages	119	102	2.54	124	115	1.25
Matured Deferred Annuities (Excluding Pension Trust)—Nonrefund						
<50	b	b	b	b	b	b
50-59	b	b	b	b	b	b
60-69	109 ^c	b	b	b	b	b
70-79	167	b	b	127	81 ^c	7.22 ^c
80-89	124	90	5.20	105	95	1.65
90 and Up	107	131	-3.43	110	100	1.58
All Ages	126	111	2.09	109	97	1.93

^aBased on unpublished data.

^bLess than 10 deaths in 1976-86 and/or 1987-91.

^c10-49 deaths in 1976-86 and/or 1987-91.

Note: The 1987-91 Study contains contributions from only five companies.

TABLE 8
ANNUAL MORTALITY IMPROVEMENT RATES 1985 TO 1995
FOR THE U.S. WHITE POPULATION

Sex and Age Group	Mortality Rates per 100,000				Improvement Rates (%)			
	1985	1993 ^a	1994 ^a	1995 ^{a,b}	1985-93	1993-94	1994-95	1985-95
Male Lives								
5-14	30.1	26.1	22.8	23.3	1.77	12.64	-2.19	2.53
15-24	134.2	121.7	129.9	127.1	1.21	-6.74	2.16	0.54
25-34	158.8	186.2	179.1	181.0	-2.01	3.81	-1.06	-1.32
35-44	243.1	282.2	288.6	285.5	-1.88	-2.27	1.07	-1.62
45-54	611.7	540.7	523.1	533.6	1.53	3.26	-2.01	1.36
55-64	1,625.8	1,391.3	1,382.4	1,314.8	1.93	0.64	4.89	2.10
65-74	3,770.7	3,334.7	3,260.7	3,188.8	1.52	2.22	2.21	1.66
75-84	8,486.1	7,672.1	7,433.9	7,354.5	1.25	3.10	1.07	1.42
85 and Up	18,980.1	18,229.2	18,126.6	17,962.8	0.50	0.56	0.90	0.55
Female Lives								
5-14	19.5	17.6	17.2	16.1	1.27	2.27	6.40	1.90
15-24	48.1	44.9	43.2	42.8	0.86	3.79	0.93	1.16
25-34	59.4	62.9	62.8	64.6	-0.72	0.16	-2.87	-0.84
35-44	121.9	117.1	119.9	122.5	0.50	-2.39	-2.17	-0.05
45-54	341.7	295.7	291.2	297.5	1.79	1.52	-2.16	1.38
55-64	869.1	810.1	788.7	785.5	0.87	2.64	0.41	1.01
65-74	2,027.1	1,929.2	1,928.7	1,909.7	0.62	0.03	0.99	0.59
75-84	5,111.6	4,787.9	4,878.4	4,823.8	0.81	-1.89	1.12	0.58
85 and Up	14,745.4	14,669.1	14,460.4	14,496.0	0.06	1.42	-0.25	0.17

^a12 months ending November.

^bRates for 1993, 1994 and 1995 are provisional.

Source: *Monthly Vital Statistics Report* (NCHS) Vol. 43, no. 13 (October 23, 1995); Vol. 44, no. 12 (July 24, 1996).

TABLE 9
VALUES OF $1000q_x$ AND FIRST AND SECOND DIFFERENCES
ANNUITY 2000 MORTALITY TABLE

Age (x)	Annuity 2000 Mortality Table $1000q_x$	First Difference	Second Difference	Age (x)	Annuity 2000 Mortality Table $1000q_x$	First Difference	Second Difference
Male				Male			
5	0.291	-0.021	0.008	61	6.933	0.587	0.100
6	0.270	-0.013	0.050	62	7.520	0.687	0.114
7	0.257	0.037	-0.006	63	8.207	0.801	0.131
8	0.294	0.031	-0.006	64	9.008	0.932	0.144
9	0.325	0.025	-0.004	65	9.940	1.076	0.159
10	0.350	0.021	-0.004	66	11.016	1.235	0.171
11	0.371	0.017	-0.003	67	12.251	1.406	0.170
12	0.388	0.014	-0.002	68	13.657	1.576	0.170
13	0.402	0.012	-0.001	69	15.233	1.746	0.166
14	0.414	0.011	0.001	70	16.979	1.912	0.164
15	0.425	0.012	0.000	71	18.891	2.076	0.166
16	0.437	0.012	0.002	72	20.967	2.242	0.193
17	0.449	0.014	0.003	73	23.209	2.435	0.225
18	0.463	0.017	0.002	74	25.644	2.660	0.256
19	0.480	0.019	0.001	75	28.304	2.916	0.289
20	0.499	0.020	0.003	76	31.220	3.205	0.318
21	0.519	0.023	0.001	77	34.425	3.523	0.341
22	0.542	0.024	0.002	78	37.948	3.864	0.361
23	0.566	0.026	-0.002	79	41.812	4.225	0.381
24	0.592	0.024	-0.001	80	46.037	4.606	0.402
25	0.616	0.023	-0.003	81	50.643	5.008	0.421
26	0.639	0.020	-0.004	82	55.651	5.429	0.439
27	0.659	0.016	-0.004	83	61.080	5.868	0.459
28	0.675	0.012	-0.005	84	66.948	6.327	0.474
29	0.687	0.007	-0.002	85	73.275	6.801	0.493
30	0.694	0.005	-0.004	86	80.076	7.294	0.505
31	0.699	0.001	0.000	87	87.370	7.799	0.487
32	0.700	0.001	0.000	88	95.169	8.286	0.467
33	0.701	0.001	0.001	89	103.455	8.753	0.441
34	0.702	0.002	0.013	90	112.208	9.194	0.421
35	0.704	0.015	0.015	91	121.402	9.615	0.398
36	0.719	0.030	0.017	92	131.017	10.013	0.379
37	0.749	0.047	0.021	93	141.030	10.392	0.365
38	0.796	0.068	0.021	94	151.422	10.757	0.343
39	0.864	0.089	0.023	95	162.179	11.100	0.327
40	0.953	0.112	0.024	96	173.279	11.427	0.813
41	1.065	0.136	0.025	97	184.706	12.240	1.298
42	1.201	0.161	0.024	98	196.946	13.538	1.784
43	1.362	0.185	0.020	99	210.484	15.322	2.270
44	1.547	0.205	0.017	100	225.806	17.592	2.755
45	1.752	0.222	0.015	101	243.398	20.347	3.242
46	1.974	0.237	0.012	102	263.745	23.589	3.726
47	2.211	0.249	0.012	103	287.334	27.315	4.213
48	2.460	0.261	0.012	104	314.649	31.528	4.698
49	2.721	0.273	0.012	105	346.177	36.226	5.184
50	2.994	0.285	0.012	106	382.403	41.410	5.670
51	3.279	0.297	0.011	107	423.813	47.080	6.155
52	3.576	0.308	0.011	108	470.893	53.235	6.641
53	3.884	0.319	0.012	109	524.128	59.876	7.127
54	4.203	0.331	0.011	110	584.004	67.003	7.612
55	4.534	0.342	0.010	111	651.007	74.615	8.099
56	4.876	0.352	0.013	112	725.622	82.714	8.583
57	5.228	0.365	0.030	113	808.336	91.297	9.070
58	5.593	0.395	0.045	114	899.633	100.367	
59	5.988	0.440	0.065	115	1000.000		
60	6.428	0.505	0.082				

TABLE 9—Continued

Age (x)	Annuity 2000 Mortality Table 1000 <i>q_x</i>	First Difference	Second Difference	Age (x)	Annuity 2000 Mortality Table 1000 <i>q_x</i>	First Difference	Second Difference
Female*				Female*			
5	0.171	-0.030	0.007	61	4.242	0.426	0.050
6	0.141	-0.023	0.023	62	4.668	0.476	0.051
7	0.118	0.000	0.003	63	5.144	0.527	0.052
8	0.118	0.003	0.002	64	5.671	0.579	0.049
9	0.121	0.005	0.002	65	6.250	0.628	0.049
10	0.126	0.007	0.002	66	6.878	0.677	0.055
11	0.133	0.009	0.001	67	7.555	0.732	0.083
12	0.142	0.010	0.002	68	8.287	0.815	0.117
13	0.152	0.012	0.001	69	9.102	0.932	0.151
14	0.164	0.013	0.000	70	10.034	1.083	0.186
15	0.177	0.013	0.001	71	11.117	1.269	0.216
16	0.190	0.014	0.001	72	12.386	1.485	0.236
17	0.204	0.015	0.000	73	13.871	1.721	0.251
18	0.219	0.015	0.001	74	15.592	1.972	0.269
19	0.234	0.016	-0.001	75	17.564	2.241	0.282
20	0.250	0.015	0.001	76	19.805	2.523	0.307
21	0.265	0.016	0.001	77	22.328	2.830	0.353
22	0.281	0.017	-0.001	78	25.158	3.183	0.409
23	0.298	0.016	0.001	79	28.341	3.592	0.460
24	0.314	0.017	-0.001	80	31.933	4.052	0.515
25	0.331	0.016	-0.001	81	35.985	4.567	0.571
26	0.347	0.015	-0.001	82	40.552	5.138	0.628
27	0.362	0.014	-0.001	83	45.690	5.766	0.691
28	0.376	0.013	0.000	84	51.456	6.457	0.749
29	0.389	0.013	-0.001	85	57.913	7.206	0.811
30	0.402	0.012	-0.001	86	65.119	8.017	0.838
31	0.414	0.011	0.000	87	73.136	8.855	0.731
32	0.425	0.011	0.002	88	81.991	9.586	0.595
33	0.436	0.013	0.001	89	91.577	10.181	0.456
34	0.449	0.014	0.004	90	101.758	10.637	0.317
35	0.463	0.018	0.005	91	112.395	10.954	0.183
36	0.481	0.023	0.005	92	123.349	11.137	0.066
37	0.504	0.028	0.007	93	134.486	11.203	-0.046
38	0.532	0.035	0.007	94	145.689	11.157	-0.162
39	0.567	0.042	0.007	95	156.846	10.995	-0.273
40	0.609	0.049	0.008	96	167.841	10.722	0.319
41	0.658	0.057	0.009	97	178.563	11.041	0.912
42	0.715	0.066	0.008	98	189.604	11.953	1.503
43	0.781	0.074	0.010	99	201.557	13.456	2.096
44	0.855	0.084	0.012	100	215.013	15.552	2.688
45	0.939	0.096	0.010	101	230.565	18.240	3.281
46	1.035	0.106	0.014	102	248.805	21.521	3.872
47	1.141	0.120	0.012	103	270.326	25.393	4.464
48	1.261	0.132	0.013	104	295.719	29.857	5.058
49	1.393	0.145	0.012	105	325.576	34.915	5.648
50	1.538	0.157	0.012	106	360.491	40.563	6.243
51	1.695	0.169	0.014	107	401.054	46.806	6.832
52	1.864	0.183	0.014	108	447.860	53.638	7.427
53	2.047	0.197	0.016	109	501.498	61.065	8.017
54	2.244	0.213	0.019	110	562.563	69.082	8.611
55	2.457	0.232	0.021	111	631.645	77.693	9.202
56	2.689	0.253	0.023	112	709.338	86.895	9.795
57	2.942	0.276	0.029	113	796.233	96.690	10.387
58	3.218	0.305	0.035	114	892.923	107.077	
59	3.523	0.340	0.039	115	1000.000		
60	3.863	0.379	0.047				

*Based on 50% of Female Improvement Scale G.

APPENDIX A

TABLE A-1

ANNUITY 2000 MORTALITY TABLE EXPECTATION OF LIFE

Age	e_x	$100q_x$	Age	e_x	$100q_x$	Age	e_x	$100q_x$
Male			Male			Male		
5	76.62	0.291	45	37.94	1.752	85	7.75	73.275
6	75.64	0.270	46	37.01	1.974	86	7.33	80.076
7	74.67	0.257	47	36.08	2.211	87	6.92	87.370
8	73.68	0.294	48	35.16	2.460	88	6.53	95.169
9	72.71	0.325	49	34.24	2.721	89	6.17	103.455
10	71.73	0.350	50	33.34	2.994	90	5.82	112.208
11	70.75	0.371	51	32.43	3.279	91	5.50	121.402
12	69.78	0.388	52	31.54	3.576	92	5.19	131.017
13	68.81	0.402	53	30.65	3.884	93	4.89	141.030
14	67.83	0.414	54	29.77	4.203	94	4.61	151.422
15	66.86	0.425	55	28.89	4.534	95	4.35	162.179
16	65.89	0.437	56	28.02	4.876	96	4.09	173.279
17	64.92	0.449	57	27.16	5.228	97	3.84	184.706
18	63.95	0.463	58	26.30	5.593	98	3.60	196.946
19	62.98	0.480	59	25.44	5.988	99	3.36	210.484
20	62.01	0.499	60	24.59	6.428	100	3.13	225.806
21	61.04	0.519	61	23.75	6.933	101	2.89	243.398
22	60.07	0.542	62	22.91	7.520	102	2.66	263.745
23	59.10	0.566	63	22.08	8.207	103	2.44	287.334
24	58.14	0.592	64	21.26	9.008	104	2.22	314.649
25	57.17	0.616	65	20.45	9.940	105	2.01	346.177
26	56.20	0.639	66	19.65	11.016	106	1.81	382.403
27	55.24	0.659	67	18.86	12.251	107	1.61	423.813
28	54.28	0.675	68	18.09	13.657	108	1.43	470.893
29	53.31	0.687	69	17.33	15.233	109	1.27	524.128
30	52.35	0.694	70	16.59	16.979	110	1.11	584.004
31	51.38	0.699	71	15.87	18.891	111	0.96	651.007
32	50.42	0.700	72	15.17	20.967	112	0.83	725.622
33	49.46	0.701	73	14.48	23.209	113	0.71	808.336
34	48.49	0.702	74	13.81	25.644	114	0.60	899.633
35	47.52	0.704	75	13.16	28.304	115	0.50	1000.000
36	46.56	0.719	76	12.53	31.220			
37	45.59	0.749	77	11.92	34.425			
38	44.62	0.796	78	11.33	37.948			
39	43.66	0.864	79	10.75	41.812			
40	42.70	0.953	80	10.20	46.037			
41	41.74	1.065	81	9.67	50.643			
42	40.78	1.201	82	9.16	55.651			
43	39.83	1.362	83	8.67	61.080			
44	38.88	1.547	84	8.20	66.948			

q_x Sum = 10,915.26

TABLE A-1—Continued

Age	\dot{e}_x	1000 q_x	Age	\dot{e}_x	1000 q_x	Age	\dot{e}_x	1000 q_x
Female			Female			Female		
5	80.68	0.171	45	41.44	0.939	85	8.37	57.913
6	79.69	0.141	46	40.48	1.035	86	7.85	65.119
7	78.70	0.118	47	39.52	1.141	87	7.37	73.136
8	77.71	0.118	48	38.57	1.261	88	6.91	81.991
9	76.72	0.121	49	37.61	1.393	89	6.48	91.577
10	75.73	0.126	50	36.67	1.538	90	6.08	101.758
11	74.74	0.133	51	35.72	1.695	91	5.72	112.395
12	73.75	0.142	52	34.78	1.864	92	5.38	123.349
13	72.76	0.152	53	33.84	2.047	93	5.06	134.486
14	71.77	0.164	54	32.91	2.244	94	4.77	145.689
15	70.78	0.177	55	31.99	2.457	95	4.50	156.846
16	69.79	0.190	56	31.06	2.689	96	4.24	167.841
17	68.81	0.204	57	30.15	2.942	97	4.00	178.563
18	67.82	0.219	58	29.23	3.218	98	3.76	189.604
19	66.83	0.234	59	28.33	3.523	99	3.52	201.557
20	65.85	0.250	60	27.42	3.863	100	3.29	215.013
21	64.87	0.265	61	26.53	4.242	101	3.05	230.565
22	63.88	0.281	62	25.64	4.668	102	2.81	248.805
23	62.90	0.298	63	24.76	5.144	103	2.58	270.326
24	61.92	0.314	64	23.88	5.671	104	2.35	295.719
25	60.94	0.331	65	23.02	6.250	105	2.12	325.576
26	59.96	0.347	66	22.16	6.878	106	1.91	360.491
27	58.98	0.362	67	21.31	7.555	107	1.70	401.054
28	58.00	0.376	68	20.47	8.287	108	1.51	447.860
29	57.02	0.389	69	19.63	9.102	109	1.33	501.498
30	56.04	0.402	70	18.81	10.034	110	1.16	562.563
31	55.07	0.414	71	17.99	11.117	111	1.00	631.645
32	54.09	0.425	72	17.19	12.386	112	0.86	709.338
33	53.11	0.436	73	16.40	13.871	113	0.73	796.233
34	52.14	0.449	74	15.62	15.592	114	0.61	892.923
35	51.16	0.463	75	14.86	17.564	115	0.50	1000.000
36	50.18	0.481	76	14.12	19.805			
37	49.21	0.504	77	13.40	22.328			
38	48.23	0.532	78	12.69	25.158			
39	47.26	0.567	79	12.01	28.341			
40	46.28	0.609	80	11.34	31.933			
41	45.31	0.658	81	10.70	35.985			
42	44.34	0.715	82	10.08	40.552			
43	43.37	0.781	83	9.48	45.690			
44	42.40	0.855	84	8.91	51.456			

q_x Sum = 10,258.8

TABLE A-2
 ANNUITY 2000 BASIC TABLE EXPECTATION OF LIFE

Age	e_x	1000 q_x	Age	e_x	1000 q_x	Age	e_x	1000 q_x
Male			Male			Male		
5	75.42	0.324	45	36.86	1.948	85	7.19	81.326
6	74.45	0.301	46	35.93	2.198	86	6.79	88.863
7	73.47	0.286	47	35.00	2.463	87	6.40	96.958
8	72.49	0.328	48	34.09	2.740	88	6.03	105.631
9	71.51	0.362	49	33.18	3.028	89	5.69	114.858
10	70.54	0.390	50	32.28	3.330	90	5.36	124.612
11	69.57	0.413	51	31.39	3.647	91	5.05	134.861
12	68.60	0.431	52	30.50	3.980	92	4.76	145.575
13	67.62	0.446	53	29.62	4.331	93	4.49	156.727
14	66.65	0.458	54	28.75	4.698	94	4.23	168.290
15	65.68	0.470	55	27.88	5.077	95	3.98	180.245
16	64.72	0.481	56	27.02	5.465	96	3.75	192.565
17	63.75	0.495	57	26.17	5.861	97	3.52	205.229
18	62.78	0.510	58	25.32	6.265	98	3.30	218.683
19	61.81	0.528	59	24.47	6.694	99	3.09	233.371
20	60.84	0.549	60	23.64	7.170	100	2.88	249.741
21	59.87	0.573	61	22.80	7.714	101	2.67	268.237
22	58.91	0.599	62	21.98	8.348	102	2.46	289.305
23	57.94	0.627	63	21.16	9.093	103	2.26	313.391
24	56.98	0.657	64	20.35	9.968	104	2.07	340.940
25	56.02	0.686	65	19.55	10.993	105	1.88	372.398
26	55.06	0.714	66	18.76	12.188	106	1.70	408.210
27	54.09	0.738	67	17.98	13.572	107	1.53	448.823
28	53.13	0.758	68	17.22	15.160	108	1.36	494.681
29	52.17	0.774	69	16.48	16.946	109	1.21	546.231
30	51.21	0.784	70	15.76	18.920	110	1.07	603.917
31	50.25	0.789	71	15.05	21.071	111	0.94	668.186
32	49.29	0.789	72	14.36	23.388	112	0.81	739.483
33	48.33	0.790	73	13.70	25.871	113	0.70	818.254
34	47.37	0.791	74	13.05	28.552	114	0.60	904.945
35	46.41	0.792	75	12.41	31.477	115	0.50	1000.000
36	45.44	0.794	76	11.80	34.686			
37	44.48	0.823	77	11.21	38.225			
38	43.51	0.872	78	10.63	42.132			
39	42.55	0.945	79	10.08	46.427			
40	41.59	1.043	80	9.55	51.128			
41	40.63	1.168	81	9.03	56.250			
42	39.68	1.322	82	8.54	61.809			
43	38.73	1.505	83	8.07	67.826			
44	37.79	1.715	84	7.62	74.322			

q_x Sum = 11,537.32

TABLE A-2—Continued

Age	\dot{e}_x	$1000q_x$	Age	\dot{e}_x	$1000q_x$	Age	\dot{e}_x	$1000q_x$
Female*			Female*			Female*		
5	79.63	0.189	45	40.47	1.043	85	7.82	63.907
6	78.65	0.156	46	39.51	1.148	86	7.32	71.815
7	77.66	0.131	47	38.55	1.267	87	6.85	80.682
8	76.67	0.131	48	37.60	1.400	88	6.41	90.557
9	75.68	0.134	49	36.65	1.548	89	6.00	101.307
10	74.69	0.140	50	35.71	1.710	90	5.62	112.759
11	73.70	0.148	51	34.77	1.888	91	5.27	124.733
12	72.71	0.158	52	33.84	2.079	92	4.94	137.054
13	71.72	0.170	53	32.90	2.286	93	4.65	149.552
14	70.73	0.183	54	31.98	2.507	94	4.38	162.079
15	69.75	0.197	55	31.06	2.746	95	4.13	174.492
16	68.76	0.212	56	30.14	3.003	96	3.90	186.647
17	67.77	0.228	57	29.23	3.280	97	3.68	198.403
18	66.79	0.244	58	28.33	3.578	98	3.46	210.337
19	65.81	0.260	59	27.43	3.907	99	3.25	223.027
20	64.82	0.277	60	26.53	4.277	100	3.04	237.051
21	63.84	0.294	61	25.64	4.699	101	2.84	252.985
22	62.86	0.312	62	24.76	5.181	102	2.63	271.406
23	61.88	0.330	63	23.89	5.732	103	2.42	292.893
24	60.90	0.349	64	23.02	6.347	104	2.21	318.023
25	59.92	0.367	65	22.17	7.017	105	2.01	347.373
26	58.94	0.385	66	21.32	7.734	106	1.82	381.520
27	57.96	0.403	67	20.48	8.491	107	1.63	421.042
28	56.99	0.419	68	19.65	9.288	108	1.45	466.516
29	56.01	0.435	69	18.83	10.163	109	1.28	518.520
30	55.04	0.450	70	18.02	11.165	110	1.12	577.631
31	54.06	0.463	71	17.22	12.339	111	0.98	644.427
32	53.08	0.476	72	16.43	13.734	112	0.84	719.484
33	52.11	0.488	73	15.65	15.391	113	0.72	803.380
34	51.14	0.500	74	14.89	17.326	114	0.60	896.693
35	50.16	0.515	75	14.14	19.551	115	0.50	1000.000
36	49.19	0.534	76	13.41	22.075			
37	48.21	0.558	77	12.70	24.910			
38	47.24	0.590	78	12.02	28.074			
39	46.27	0.630	79	11.35	31.612			
40	45.30	0.677	80	10.70	35.580			
41	44.33	0.732	81	10.08	40.030			
42	43.36	0.796	82	9.48	45.017			
43	42.39	0.868	83	8.90	50.600			
44	41.43	0.950	84	8.35	56.865			

*Based on 50% of Female Improvement Scale G.
 q_x Sum = 10,778.36

APPENDIX B
BLENDED ANNUITY 2000 MORTALITY TABLES

The accompanying set of annuity mortality tables includes, in addition to the male and female Annuity 2000 valuation mortality tables, seven blended tables varying from 80% male to 20%. The general methodology, as applied to the 1980 CSO tables, appears in "Report of the Society of Actuaries Committee on Nonforfeiture and Valuation Mortality Problems—Individual Life Insurance and Annuities," *TSA XXXVII* (1985): 393. The methodology was later applied to the 1980 CSO Smoker and Nonsmoker tables and to the 1983 individual and group annuity tables.* The formula is as follows:

At the pivotal age, x , in each case two ratios were formed: the ratio to be applied to all the male l_x 's is:

$$MR = (l_x^M + l_x^F) \times Z/l_x^M.$$

where Z is the chosen ratio of male l_x to total l_x ; the other, to be applied to all the female l_x 's is:

$$FR = (l_x^M + l_x^F) \times (1 - Z)/l_x^F.$$

Totals of the adjusted male and female l_x 's were formed at each age and used to calculate the blended mortality rates.

As was done for the 1983 individual and group annuity tables, a pivotal or reference age of 65 was selected. The pivotal age is the age at which the tabular percentage of male to female is applied in the formula quoted above. The 1987 paper described at length the process of selecting the pivotal age for retirement annuities.

The reasons for providing blended versions of the Annuity 2000 tables are the same as in 1987—settlement options in life insurance policies and nonforfeiture benefits in annuities must be on a non-sex-distinct basis for all contracts affected by the Norris decision. The problem is how to provide identification for unisex tables that might be used. Publishing these blended tables will provide a convenient source.

The letters distinguishing the blended tables are the same as those used for the 1980 CSO tables and the 1983 annuity tables where "B" is for 80% male, "C" for 60%, "D" for 50%, "E" for 40%, "F" is for 20% male. "A" would be for 100% male and "G" for 100% female. A set of 25% and 50% male tables is also included; the tables are identified by "2" and "7" for 25% and 75%, respectively.

*"Blended Mortality Tables—Life Insurance and Annuities," Robert J. Johansen, *TSA XXXIX* (1987):41.

For the record, following are the values of MR and FR (to nine significant figures) for each percentage:

Percentage Male	MR	FR
80%	1.64196334	0.390032009
60	1.23147254	0.780064018
50	1.02622707	0.975080080
40	0.820981671	1.17009614
20	0.410490835	1.56012815
25	0.513113536	1.46262012
75	1.53934061	0.487540040

TABLE B-1

ANNUITY 2000 MALE MORTALITY TABLE
 [BLENDED ANNUITY 2000 MORTALITY TABLE A (100% MALE)]

Age Nearest Birthday	1000 q_x	Age Nearest Birthday	1000 q_x
5	0.291	61	6.933
6	0.270	62	7.520
7	0.257	63	8.207
8	0.294	64	9.008
9	0.325	65	9.940
10	0.350	66	11.016
11	0.371	67	12.251
12	0.388	68	13.657
13	0.402	69	15.233
14	0.414	70	16.979
15	0.425	71	18.891
16	0.437	72	20.967
17	0.449	73	23.209
18	0.463	74	25.644
19	0.480	75	28.304
20	0.499	76	31.220
21	0.519	77	34.425
22	0.542	78	37.948
23	0.566	79	41.812
24	0.592	80	46.037
25	0.616	81	50.643
26	0.639	82	55.651
27	0.659	83	61.080
28	0.675	84	66.948
29	0.687	85	73.275
30	0.694	86	80.076
31	0.699	87	87.370
32	0.700	88	95.169
33	0.701	89	103.455
34	0.702	90	112.208
35	0.704	91	121.402
36	0.719	92	131.017
37	0.749	93	141.030
38	0.796	94	151.422
39	0.864	95	162.179
40	0.953	96	173.279
41	1.065	97	184.706
42	1.201	98	196.946
43	1.362	99	210.484
44	1.547	100	225.806
45	1.752	101	243.398
46	1.974	102	263.745
47	2.211	103	287.334
48	2.460	104	314.649
49	2.721	105	346.177
50	2.994	106	382.403
51	3.279	107	423.813
52	3.576	108	470.893
53	3.884	109	524.128
54	4.203	110	584.004
55	4.534	111	651.007
56	4.876	112	725.622
57	5.228	113	808.336
58	5.593	114	899.633
59	5.988	115	1000.000
60	6.428		

Sum = 10,915.256

TABLE B-2

BLENDED ANNUITY 2000 MORTALITY TABLE B (80% MALE)

Age Nearest Birthday	1000 q_x	Age Nearest Birthday	1000 q_x
5	0.268	61	6.400
6	0.245	62	6.954
7	0.230	63	7.598
8	0.260	64	8.342
9	0.286	65	9.202
10	0.307	66	10.186
11	0.325	67	11.306
12	0.341	68	12.572
13	0.354	69	13.989
14	0.366	70	15.563
15	0.377	71	17.297
16	0.390	72	19.196
17	0.402	73	21.269
18	0.416	74	23.540
19	0.433	75	26.037
20	0.451	76	28.790
21	0.470	77	31.826
22	0.492	78	35.173
23	0.514	79	38.859
24	0.538	80	42.911
25	0.561	81	47.357
26	0.583	82	52.226
27	0.602	83	57.546
28	0.617	84	63.346
29	0.630	85	69.658
30	0.638	86	76.510
31	0.644	87	83.934
32	0.647	88	91.951
33	0.650	89	100.522
34	0.653	90	109.602
35	0.657	91	119.136
36	0.673	92	129.073
37	0.702	93	139.360
38	0.745	94	149.951
39	0.807	95	160.804
40	0.887	96	171.870
41	0.986	97	183.107
42	1.107	98	195.024
43	1.250	99	208.131
44	1.413	100	222.938
45	1.595	101	239.953
46	1.792	102	259.685
47	2.003	103	282.644
48	2.227	104	309.339
49	2.463	105	340.284
50	2.711	106	375.995
51	2.971	107	416.992
52	3.242	108	463.802
53	3.525	109	516.953
54	3.820	110	576.989
55	4.127	111	644.456
56	4.447	112	719.914
57	4.779	113	803.933
58	5.125	114	897.096
59	5.502	115	1000.000
60	5.921		

Sum = 10,746.258

TABLE B-3

BLENDED ANNUITY 2000 MORTALITY TABLE C (60% MALE)

Age Nearest Birthday	100 <i>q_x</i>	Age Nearest Birthday	1000 <i>q_x</i>
5	0.244	61	5.864
6	0.220	62	6.386
7	0.203	63	6.987
8	0.226	64	7.676
9	0.246	65	8.464
10	0.263	66	9.357
11	0.279	67	10.364
12	0.293	68	11.493
13	0.305	69	12.754
14	0.317	70	14.160
15	0.329	71	15.723
16	0.341	72	17.454
17	0.354	73	19.366
18	0.368	74	21.484
19	0.384	75	23.832
20	0.402	76	26.437
21	0.420	77	29.321
22	0.441	78	32.513
23	0.462	79	36.044
24	0.484	80	39.950
25	0.505	81	44.264
26	0.525	82	49.023
27	0.543	83	54.264
28	0.559	84	60.025
29	0.571	85	66.348
30	0.580	86	73.270
31	0.588	87	80.836
32	0.593	88	89.069
33	0.598	89	97.914
34	0.603	90	107.299
35	0.610	91	117.145
36	0.626	92	127.373
37	0.654	93	137.906
38	0.693	94	148.674
39	0.748	95	159.614
40	0.819	96	170.655
41	0.906	97	181.732
42	1.011	98	193.377
43	1.135	99	206.125
44	1.277	100	220.505
45	1.435	101	237.051
46	1.607	102	256.293
47	1.793	103	278.765
48	1.991	104	305.000
49	2.201	105	335.536
50	2.424	106	370.915
51	2.658	107	411.683
52	2.904	108	458.395
53	3.162	109	511.610
54	3.433	110	571.898
55	3.716	111	639.837
56	4.014	112	716.014
57	4.326	113	801.027
58	4.654	114	895.483
59	5.012	115	1000.000
60	5.411		

Sum = 10,602.020

TABLE B-4

BLENDED ANNUITY 2000 MORTALITY TABLE D (50% MALE)

Age Nearest Birthday	1000 q_x	Age Nearest Birthday	1000 q_x
5	0.233	61	5.596
6	0.207	62	6.101
7	0.189	63	6.680
8	0.208	64	7.342
9	0.226	65	8.095
10	0.241	66	8.943
11	0.255	67	9.894
12	0.268	68	10.955
13	0.280	69	12.140
14	0.292	70	13.464
15	0.304	71	14.943
16	0.317	72	16.592
17	0.329	73	18.428
18	0.344	74	20.474
19	0.360	75	22.752
20	0.377	76	25.288
21	0.395	77	28.103
22	0.415	78	31.224
23	0.435	79	34.686
24	0.456	80	38.527
25	0.477	81	42.785
26	0.496	82	47.499
27	0.514	83	52.710
28	0.529	84	58.460
29	0.541	85	64.796
30	0.551	86	71.759
31	0.560	87	79.399
32	0.566	88	87.739
33	0.571	89	96.716
34	0.578	90	106.245
35	0.586	91	116.237
36	0.603	92	126.601
37	0.629	93	137.247
38	0.667	94	148.097
39	0.719	95	159.077
40	0.785	96	170.108
41	0.866	97	181.114
42	0.963	98	192.640
43	1.077	99	205.228
44	1.208	100	219.422
45	1.354	101	235.765
46	1.514	102	254.798
47	1.686	103	277.067
48	1.872	104	303.115
49	2.069	105	333.492
50	2.279	106	368.750
51	2.500	107	409.447
52	2.734	108	456.147
53	2.979	109	509.419
54	3.237	110	569.843
55	3.509	111	638.003
56	3.796	112	714.493
57	4.097	113	799.915
58	4.417	114	894.878
59	4.766	115	1000.000
60	5.155		

Sum = 10,536.819

TABLE B-5

BLENDED ANNUITY 2000 MORTALITY TABLE E (40% MALE)

Age Nearest Birthday	1000 <i>q</i> _x	Age Nearest Birthday	1000 <i>q</i> _x
5	0.220	61	5.326
6	0.194	62	5.815
7	0.175	63	6.374
8	0.191	64	7.008
9	0.205	65	7.726
10	0.218	66	8.530
11	0.231	67	9.425
12	0.243	68	10.419
13	0.255	69	11.528
14	0.267	70	12.772
15	0.279	71	14.168
16	0.292	72	15.738
17	0.305	73	17.499
18	0.319	74	19.475
19	0.335	75	21.687
20	0.352	76	24.157
21	0.370	77	26.907
22	0.388	78	29.962
23	0.408	79	33.359
24	0.428	80	37.141
25	0.448	81	41.347
26	0.467	82	46.022
27	0.484	83	51.209
28	0.499	84	56.954
29	0.511	85	63.307
30	0.522	86	70.315
31	0.531	87	78.029
32	0.538	88	86.475
33	0.545	89	95.580
34	0.553	90	105.249
35	0.562	91	115.381
36	0.579	92	125.874
37	0.605	93	136.628
38	0.640	94	147.556
39	0.689	95	158.575
40	0.750	96	169.596
41	0.825	97	180.537
42	0.914	98	191.951
43	1.019	99	204.393
44	1.139	100	218.416
45	1.272	101	234.573
46	1.419	102	253.417
47	1.579	103	275.504
48	1.751	104	301.388
49	1.936	105	331.628
50	2.133	106	366.788
51	2.341	107	407.433
52	2.562	108	454.138
53	2.795	109	507.476
54	3.041	110	568.036
55	3.301	111	636.404
56	3.576	112	713.180
57	3.868	113	798.965
58	4.179	114	894.367
59	4.519	115	1000.000
60	4.898		

Sum = 10,475.372

TABLE B-6

BLENDED ANNUITY 2000 MORTALITY TABLE F (20% MALE)

Age Nearest Birthday	1000 q_x	Age Nearest Birthday	1000 q_x
5	0.196	61	4.785
6	0.168	62	5.243
7	0.147	63	5.760
8	0.155	64	6.340
9	0.163	65	6.988
10	0.173	66	7.703
11	0.183	67	8.488
12	0.193	68	9.350
13	0.204	69	10.311
14	0.216	70	11.396
15	0.229	71	12.633
16	0.241	72	14.049
17	0.255	73	15.668
18	0.270	74	17.512
19	0.285	75	19.598
20	0.302	76	21.948
21	0.318	77	24.577
22	0.335	78	27.512
23	0.354	79	30.794
24	0.372	80	34.472
25	0.390	81	38.592
26	0.408	82	43.204
27	0.424	83	48.358
28	0.438	84	54.105
29	0.451	85	60.504
30	0.463	86	67.608
31	0.473	87	75.473
32	0.482	88	84.127
33	0.491	89	93.479
34	0.501	90	103.413
35	0.513	91	113.807
36	0.530	92	124.541
37	0.555	93	135.496
38	0.587	94	146.568
39	0.628	95	157.659
40	0.680	96	168.666
41	0.742	97	179.489
42	0.815	98	190.704
43	0.901	99	202.884
44	0.998	100	216.602
45	1.107	101	232.432
46	1.229	102	250.948
47	1.362	103	272.724
48	1.508	104	298.334
49	1.666	105	328.356
50	1.837	106	363.369
51	2.020	107	403.954
52	2.215	108	450.697
53	2.423	109	504.183
54	2.645	110	565.005
55	2.881	111	633.754
56	3.135	112	711.028
57	3.407	113	797.426
58	3.700	114	8893.549
59	4.023	115	1000.000
60	4.382		

Sum = 10,361.934

TABLE B-7

BLENDED ANNUITY 2000 MORTALITY TABLE 2 (25% MALE)

Age Nearest Birthday	1000q _x	Age Nearest Birthday	1000q _x
5	0.202	61	4.921
6	0.174	62	5.386
7	0.154	63	5.913
8	0.164	64	6.507
9	0.174	65	7.172
10	0.184	66	7.910
11	0.195	67	8.722
12	0.206	68	9.617
13	0.217	69	10.614
14	0.229	70	11.739
15	0.241	71	13.015
16	0.254	72	14.469
17	0.268	73	16.123
18	0.282	74	17.998
19	0.298	75	20.115
20	0.315	76	22.494
21	0.331	77	25.152
22	0.349	78	28.115
23	0.367	79	31.424
24	0.386	80	35.126
25	0.405	81	39.266
26	0.423	82	43.892
27	0.439	83	49.053
28	0.453	84	54.798
29	0.466	85	61.184
30	0.477	86	68.263
31	0.488	87	76.090
32	0.496	88	84.693
33	0.504	89	93.984
34	0.514	90	103.854
35	0.525	91	114.184
36	0.542	92	124.860
37	0.567	93	135.766
38	0.600	94	146.804
39	0.644	95	157.878
40	0.698	96	168.887
41	0.763	97	179.739
42	0.840	98	191.001
43	0.931	99	203.243
44	1.033	100	217.033
45	1.148	101	232.940
46	1.277	102	251.532
47	1.416	103	273.380
48	1.569	104	299.053
49	1.734	105	329.123
50	1.912	106	364.168
51	2.101	107	404.764
52	2.302	108	451.494
53	2.517	109	504.942
54	2.744	110	565.700
55	2.986	111	634.358
56	3.246	112	711.516
57	3.523	113	797.773
58	3.820	114	893.732
59	4.147	115	1000.000
60	4.511		

Sum = 10,389.230

TABLE B-8

BLENDED ANNUITY 2000 MORTALITY TABLE 7 (75% MALE)

Age Nearest Birthday	1000 q_x	Age Nearest Birthday	1000 q_x
5	0.262	61	6.266
6	0.239	62	6.812
7	0.224	63	7.445
8	0.252	64	8.176
9	0.276	65	9.018
10	0.296	66	9.979
11	0.314	67	11.070
12	0.329	68	12.302
13	0.342	69	13.679
14	0.354	70	15.211
15	0.365	71	16.901
16	0.377	72	18.758
17	0.390	73	20.790
18	0.404	74	23.021
19	0.421	75	25.480
20	0.439	76	28.195
21	0.458	77	31.191
22	0.479	78	34.498
23	0.501	79	38.143
24	0.525	80	42.156
25	0.547	81	46.567
26	0.569	82	51.405
27	0.587	83	56.703
28	0.603	84	62.491
29	0.615	85	68.803
30	0.623	86	75.671
31	0.630	87	83.130
32	0.634	88	91.201
33	0.637	89	99.842
34	0.641	90	109.000
35	0.646	91	118.615
36	0.661	92	128.627
37	0.690	93	138.978
38	0.732	94	149.615
39	0.792	95	160.490
40	0.870	96	171.550
41	0.966	97	182.744
42	1.083	98	194.589
43	1.221	99	207.600
44	1.379	100	222.293
45	1.555	101	239.182
46	1.746	102	258.781
47	1.951	103	281.607
48	2.169	104	308.174
49	2.398	105	339.004
50	2.639	106	374.618
51	2.893	107	415.545
52	3.158	108	462.318
53	3.435	109	515.476
54	3.723	110	575.570
55	4.025	111	643.158
56	4.339	112	718.808
57	4.666	113	803.101
58	5.008	114	896.629
59	5.380	115	1000.000
60	5.794		

Sum = 10,708.228

TABLE B-9

ANNUITY 2000 FEMALE MORTALITY TABLE
 [BLENDED ANNUITY 2000 MORTALITY TABLE G (100% FEMALE)]

Age Nearest Birthday	1000 <i>q_x</i>	Age Nearest Birthday	1000 <i>q_x</i>
5	0.171	61	4.242
6	0.141	62	4.668
7	0.118	63	5.144
8	0.118	64	5.671
9	0.121	65	6.250
10	0.126	66	6.878
11	0.133	67	7.555
12	0.142	68	8.287
13	0.152	69	9.102
14	0.164	70	10.034
15	0.177	71	11.117
16	0.190	72	12.386
17	0.204	73	13.871
18	0.219	74	15.592
19	0.234	75	17.564
20	0.250	76	19.805
21	0.265	77	22.328
22	0.281	78	25.158
23	0.298	79	28.341
24	0.314	80	31.933
25	0.331	81	35.985
26	0.347	82	40.552
27	0.362	83	45.690
28	0.376	84	51.456
29	0.389	85	57.913
30	0.402	86	65.119
31	0.414	87	73.136
32	0.425	88	81.991
33	0.436	89	91.577
34	0.449	90	101.758
35	0.463	91	112.395
36	0.481	92	123.349
37	0.504	93	134.486
38	0.532	94	145.689
39	0.567	95	156.846
40	0.609	96	167.841
41	0.658	97	178.563
42	0.715	98	189.604
43	0.781	99	201.557
44	0.855	100	215.013
45	0.939	101	230.565
46	1.035	102	248.805
47	1.141	103	270.326
48	1.261	104	295.719
49	1.393	105	325.576
50	1.538	106	360.491
51	1.695	107	401.054
52	1.864	108	447.860
53	2.047	109	501.498
54	2.244	110	562.563
55	2.457	111	631.645
56	2.689	112	709.338
57	2.942	113	796.233
58	3.218	114	892.923
59	3.523	115	1000.000
60	3.863		

Sum = 10,258.805