

## MODIFIED 1965-70 SELECT AND ULTIMATE BASIC TABLES—ACTUARIAL NOTE

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This paper presents a technique that develops modified tables of mortality from the 1965-70 Basic Tables. The modified tables provide mortality rates for all ages and contain a more satisfactory grading of select rates into ultimate rates than do the Basic Tables. Age-last-birthday tables are also derived.

Actuarial literature has been silent on such derivations. It is hoped that this note will provide actuaries with an idea of the variety of techniques available for creating such tables.

### INIRODUCIION

**T**HE Committee on Mortality under Ordinary Insurance and Annuities published the 1965-70 Basic Tables in *TSA, 1973 Reports*, pages 199-223. These tables were intended to replace the 1955-60 Basic Tables for various analyses of mortality.

These tables also are used, not infrequently, in the development of gross and GAAP premiums. Because the select data do not grade smoothly into the ultimate data, particularly at the advanced issue ages, and because of the need for mortality rates by individual ages, modified tables overcoming these deficiencies have been developed. These modified tables retain the trends exhibited in the 1965-70 Basic Tables.

### BACKGROUND

While the 1965-70 Basic Tables contain a fifteen-year select period, the ratios of 1965-70 Select Basic Table mortality rates to Ultimate Basic Table mortality rates (Table 11) exhibit several plateaus, with nearly uniform ratios as the effect of selection wears off. Further, the ratios in policy year 15 do not always decrease with advancing issue-age group, leading one to infer that the length of the select period might be a function of the issue-age group itself.

A second problem concerns the graduated mortality rates for issue-age group 70 and over, both for male and female lives combined and for male lives only. Logic dictates that this issue-age group is composed chiefly of entrants aged 70, for two reasons. First, many companies do not

publish rates beyond age 70, and issues beyond this age generally arise only from special requests. Second, the number of issues decreases sharply with advancing age for issue ages over 70. In Table 11 of the 1965-70 Basic Tables, there is a reference that the "central" issue age has been taken as 72 for issue-age group 70 and over, and the title of this last issue-age group ("70 and over") suggests that the central age is other than 70. Mortality rates through the fifth policy year for this group are less than those that would be obtained by simple linear extrapolation of the rates from issue-age groups 60-64 and 65-69. Without some adjustment in either the central-age assumption or the select mortality rates themselves, the conclusion could be reached that the force of mortality is nearly constant for several ages. This is a phenomenon usually observed only around puberty and heretofore not exhibited at this later stage of life. One argument that can be advanced for this result is that more extensive underwriting at the very high issue ages produces a group of insured lives that is "superselect" as opposed to a more normal "select" group.

The question arose as to whether the grading of the select rates into the ultimate rates should be improved by adjusting the ultimate rates or the select rates. Two reasons why the original tables do not grade smoothly are (1) that the ultimate table is based upon both medically and nonmedically examined lives, whereas the select table is based upon medically examined lives only, and (2) that the lives underlying these tables were underwritten at different times. Various tests seemed to indicate that regrading the select data would be more extensive, but that the problems with the original data would not be solved if only the ultimate rates were regraded. For the purposes for which these tables are intended, a regrading of both the select and ultimate rates would destroy an additional element of fit between the 1965-70 Basic Tables and the Modified 1965-70 Basic Tables. Consequently, the modified tables use the ultimate rates without adjustment.

#### CONSTRUCTION OF TABLES

##### *Age Nearest Birthday (Tables 1-3)*

Of paramount importance in developing the modified tables was the maintenance of the basic mortality pattern. For the central age of each adult issue-age group except 70 and over, five durational ratios of 1965-70 Select Basic Table mortality rates to Ultimate Basic Table mortality rates were chosen. These were the ratios for years 1, 15, and 16, and for two intervening durations in order to maximize fit with the original graduated rates. The ratios for years other than 15 and 16 were taken directly from Table 11. The ratios for year 16, naturally, were 1.0. Ratios for the fifteenth year were set empirically; they reduce with increasing

age, consistent with the idea that selection persists for a longer period at the higher issue ages. Intervening durational ratios were then calculated using a Lagrangian interpolation formula that fitted a fourth-degree polynomial to the known ratios.

Variations in the above were dictated by the original tables. The ratios reached 1.0 by the fifteenth year for several lower issue ages. Such ratios were accepted as given, so that the basic mortality rates were regraduated only for issue-age groups 25-29 and above for male lives, 35-39 and above for female lives, and 20-24 and above for combined lives.

Fit obviously could not be maintained toward the end of the select period, so the tests of fit employed were discontinued two years beyond the third durational value used from the ratios of select to ultimate mortality (Table 11)

In reconstructing the mortality rates for issue-age group 70 and over, the first problem was to obtain a higher rate for duration 1. After various tests, the crude mortality rates were used, and new first-year ratios were obtained. In similar fashion, two other intervening ratios were selected. Unlike the values for the other issue-age groups, where fit and smoothness were measured against the graduated mortality rates and the ensuing deaths (by constructing a table with  $l_{[x]} = 1,000$ ), values for issue-age group 70 and over were set by measuring fit and smoothness against the graduated mortality rates and the crude mortality rates.

Finally, the complete mortality table was developed. Mortality rates for ages 0-14 do not vary by age at issue, being equal to the ultimate rates. This follows the premise in the original report that there is no material selection process at these ages. Values for the individual ages were obtained by CURVFIT, an interpolation technique involving the passing of a different cubic polynomial between each pair of points and then fitting these curves together so as to produce one smooth continuous curve.

Ultimate mortality rates in the 1965-70 Basic Tables are truncated at age 100. For consistency with valuation tables, it was decided to set  $q_{99} = 1.0$ . The rates at ages 96-98 were obtained by passing a cubic through  $q_x$  at ages 93, 94, 95, and 99. Curves of higher or lower orders or utilizing different ages did not produce values as aesthetically pleasing.

Once the three basic tables were developed, the following tests for reasonableness were made:

1. Did the regraduated rates for individual ages between central issue ages grade smoothly into the ultimate rates?
2. Did the regraduated rates for individual ages between central issue ages increase with advancing age, except where irregular patterns are implied in the Basic Table?

3. Did the effect of selection wear off with increasing duration, assuming the same attained age, that is, was  $q_{[x]} \leq q_{[x-1]+1} \leq q_{[x-2]+2}$ , and so on?
4. Were the male, male and female combined, and female mortality rates in proper relation to one another, that is, was  $q^M \geq q^{MF} \geq q^F$ ?

(In regard to items 3 and 4, the Basic Tables contain instances where  $q_{[x]} = q_{[x-5]+5} = q_{[x-10]+10}$  and where  $q^M = q^{MF}$ .)

Empirical adjustments were made whenever a test of reasonableness failed or produced results that were not completely satisfactory. While such adjustments detract from the technical beauty desired in this undertaking, they are necessary to avoid the anguished cries that would otherwise be heard. Readers will realize that if the exact curves of the mortality rates or of the force of mortality were known, none of this would be necessary.

#### *Age Last Birthday (Tables 4-6)*

The mortality rates on the age-last-birthday basis were calculated not by obtaining mean mortality rates from the age-nearest-birthday rates but by developing a select and ultimate  $l_x$  table, setting the radix equal to 1,000,000. The steps employed were as follows:

- a) Calculation of  $l_{x+t}$  from  $q_{x+t}$ :

$$l_x = l_{x-1}(1 - q_{x-1}), \quad 1 \leq x \leq 100.$$

- b) Calculation of  $l_{[x]+t}$  from  $q_{[x]+t}$ :

$$l_{[0]} = 1,000,000;$$

$$l_{[x]+t-1} = \frac{l_{[x]+t}}{1 - q_{[x]+t-1}}, \quad 15 \leq x \leq 70 \quad \text{and} \quad 1 \leq t \leq 15.$$

- c) Adjustment to age-last-birthday basis:

$$l_{[x]} = \frac{1}{2}(l_x + l_{x+1}) \quad \text{but} \quad l_{99} = \frac{1}{2}l_{99};$$

$$l_{[x]+t-1} = \frac{1}{2}(l_{[x]+t-1} + l_{[x]+t}).$$

- d) Calculation of age-last-birthday mortality rates:

$$q_{[x]} = \frac{l_{[x]} - l_{[x+1]}}{l_{[x]}}$$

$$q_{[x]+t-1} = \frac{l_{[x]+t-1} - l_{[x]+t}}{l_{[x]+t-1}}$$

This approach was similar to that followed in the construction of the Commissioners 1958 Standard Ordinary Mortality Table (Age Last

Birthday). Extensive theoretical development of  $1,000q_0$ , such as that undertaken in *TSA*, XIII, 609, did not have much appeal, particularly in view of the purpose for which the modified tables are intended and the limitations discussed below.

#### LIMITATIONS

The 1965-70 Basic Tables are based upon medically examined business during the select period. Therefore, the modified tables should be used without adjustment only in connection with this type of business, and then only if the business is reasonably similar to that in the original study. Some of the reasons why one may want to adjust the rates in these tables include the following:

1. *Nonmedically examined business*: No adjustment is required for ages under 15, for reasons mentioned earlier. Adjustments at other ages must grade upward from age 15 to reflect the ratio of nonmedical to medical mortality and to reflect the percentage of nonmedical business in the group being studied. The nonmedical rules and the nature of the underwriting must also be considered.
2. *Features peculiar to the group under study*: Included might be such items as geographical variations, unusually broad or restrictive definitions of underwriting classes, and plan of insurance.

No projections of future mortality are contained in these tables. As new experience unfolds, these tables can be modified appropriately on the basis of the data available from the Committee on Mortality under Ordinary Insurance and Annuities. In due course, the 1965-70 Basic Tables will be replaced, at which time successor modified tables will be developed.

Finally, it must be remembered that these are experience tables (except in the later select years at the higher issue ages, where extensive grading was introduced), and so they contain no margin for adverse contingencies. This is another of the adjustments to be considered when working with these tables.

The reader is well aware that no single table is appropriate for all uses or users. It should be equally obvious that at least as many "modified" tables could be created as there are authors. It is hoped that this note will stimulate others to offer their works of art, together with their logic for adjusting the data contained in the Basic Tables.

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TABLE 1—Continued

ISSUE AGE x	DURATION t															1,000 <sub>0</sub> q <sub>x+t</sub>	ATTAINED AGE x+t-15
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
41	1.25	1.70	2.14	2.55	2.93	3.32	3.74	4.22	4.75	5.31	5.91	6.62	7.40	8.27	9.25	11.17	56
42	1.36	1.87	2.35	2.80	3.22	3.64	4.10	4.62	5.20	5.82	6.49	7.28	8.13	9.07	10.08	12.42	57
43	1.47	2.03	2.56	3.05	3.51	3.97	4.46	5.02	5.63	6.35	7.11	8.01	8.97	10.00	11.10	13.75	58
44	1.58	2.19	2.77	3.31	3.80	4.30	4.83	5.42	6.06	6.80	7.68	8.68	9.75	10.90	12.14	15.10	59
45	1.70	2.36	2.99	3.59	4.12	4.66	5.23	5.85	6.53	7.48	8.51	9.68	10.92	12.25	13.68	16.50	60
46	1.82	2.53	3.22	3.89	4.49	5.07	5.68	6.20	6.90	7.88	9.01	10.31	11.69	13.15	14.70	18.01	61
47	1.94	2.73	3.49	4.23	4.92	5.55	6.24	6.93	7.80	8.88	10.15	11.61	13.17	14.83	16.58	19.69	62
48	2.06	2.95	3.80	4.62	5.42	6.13	6.84	7.64	8.63	9.73	11.08	12.67	14.33	16.07	17.90	21.63	63
49	2.19	3.19	4.14	5.06	5.97	6.78	7.59	8.47	9.53	10.67	12.09	13.80	15.58	17.45	19.40	23.81	64
50	2.32	3.46	4.51	5.53	6.54	7.47	8.39	9.36	10.45	11.68	13.17	14.92	16.75	18.66	20.65	26.17	65
51	2.46	3.74	4.91	6.02	7.12	8.17	9.19	10.25	11.38	12.68	14.24	16.03	17.88	19.79	21.77	28.73	66
52	2.61	4.04	5.32	6.52	7.69	8.83	9.94	11.08	12.29	13.71	15.44	17.33	19.28	21.29	23.34	31.40	67
53	2.77	4.34	5.73	7.00	8.24	9.42	10.59	11.82	13.17	14.72	16.64	18.65	20.73	22.87	25.06	34.21	68
54	2.95	4.65	6.14	7.48	8.77	9.96	11.18	12.51	14.02	15.74	17.87	20.15	22.57	25.03	27.54	36.99	69
55	3.14	4.99	6.59	7.99	9.31	10.52	12.45	13.95	15.78	17.90	19.17	22.35	25.67	29.03	32.46	41.46	70
56	3.37	5.37	7.09	8.56	9.90	11.13	12.45	13.95	16.72	19.12	22.08	25.71	29.03	32.88	36.36	46.32	71
57	3.65	5.82	7.67	9.22	10.57	11.86	13.26	14.83	17.81	20.46	23.77	27.60	31.45	35.81	40.30	51.73	72
58	3.98	6.36	8.37	10.01	11.41	12.79	14.26	15.80	19.12	21.95	25.47	29.80	34.08	38.81	43.32	56.53	73
59	4.37	6.99	9.18	10.93	12.44	13.91	15.45	17.13	20.63	23.60	27.39	31.43	35.82	40.68	45.70	61.64	74
60	5.32	8.43	11.00	13.05	14.87	16.52	18.22	20.04	23.30	25.42	29.51	34.33	39.41	44.81	50.20	67.41	75
61	5.89	9.18	11.93	14.20	16.13	17.90	19.71	21.67	24.11	27.45	31.86	37.48	43.41	49.57	55.94	73.71	76
62	6.52	10.04	12.96	15.39	17.38	19.25	21.18	23.31	25.98	29.59	34.30	40.75	47.45	54.32	61.41	80.05	77
63	7.22	11.05	14.13	16.61	18.66	20.62	22.67	24.99	27.95	32.04	37.08	43.75	50.70	57.92	65.44	88.00	78
64	7.99	12.11	15.35	17.85	20.01	22.09	24.30	26.89	30.21	34.52	40.17	47.51	54.80	62.57	70.80	95.00	79
65	8.82	13.13	16.51	19.10	21.45	23.74	26.22	28.55	32.04	37.69	43.82	51.71	60.06	68.77	78.10	103.29	80
66	9.73	14.02	17.50	20.35	23.02	25.66	28.22	30.88	34.34	41.59	48.22	56.68	65.63	74.88	84.88	111.65	81
67	10.71	14.81	18.37	21.59	24.73	27.92	31.44	35.60	40.59	46.40	53.54	62.40	72.03	81.00	91.00	120.51	82
68	11.77	15.59	19.22	22.84	26.59	30.54	34.91	39.93	45.69	52.13	59.70	69.40	80.00	90.00	100.00	130.63	83
69	12.90	16.33	20.04	24.09	28.58	33.48	38.90	44.04	51.58	58.70	66.88	76.48	86.33	96.00	107.87	141.76	84
70																	85

Attained Age	1,000 <sub>0</sub> q <sub>x</sub>	Attained Age	1,000 <sub>0</sub> q <sub>x</sub>	Attained Age	1,000 <sub>0</sub> q <sub>x</sub>
0	5.80	10	31	91	210.32
1	1.33	11	.31	92	211.77
2	.84	12	.33	93	230.07
3	.65	13	.42	94	248.53
4	.53	14	.52	95	267.95
5	.48	86	153.97	96	319.08
6	.42	87	167.26	97	437.00
7	.39	88	181.42	98	633.41
8	.35	89	193.63	99	1000.00
9	.32	90	202.96		

TABLE 2  
 MODIFIED 1965-70 SELECT AND ULTIMATE BASIC TABLE FOR FEMALES  
 AGE NEAREST BIRTHDAY  
 $1,000q_{[x]+t-1}$

ISSUE AGE $x$	DURATION $t$															1,000 $q_{x+15}$	ATTAINED AGE $x+15$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
0	4.80	1.22	72	55	48	42	37	33	29	27	25	26	27	29	33	36	
1	1.22	.72	55	48	42	37	33	29	27	25	26	27	29	33	36	41	
2	.72	.48	42	37	33	29	27	25	26	27	29	33	36	41	47	53	
3	.48	.37	33	29	27	25	26	27	29	33	36	41	47	53	59	65	
4	.37	.29	29	27	25	26	27	29	33	36	41	47	53	59	65	71	
5	.29	.27	25	26	27	29	33	36	41	47	53	59	65	71	77	83	
6	.27	.25	26	27	29	33	36	41	47	53	59	65	71	77	83	89	
7	.25	.26	27	29	33	36	41	47	53	59	65	71	77	83	89	95	
8	.26	.27	29	33	36	41	47	53	59	65	71	77	83	89	95	101	
9	.27	.29	33	36	41	47	53	59	65	71	77	83	89	95	101	107	
10	.29	.33	36	41	47	53	59	65	71	77	83	89	95	101	107	113	
11	.33	.36	41	47	53	59	65	71	77	83	89	95	101	107	113	119	
12	.36	.41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	
13	.41	.47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	
14	.47	.53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	
15	.53	.59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	
16	.59	.65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	
17	.65	.71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	
18	.71	.77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	
19	.77	.83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	
20	.83	.89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	
21	.89	.95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	
22	.95	1.01	107	113	119	125	131	137	143	149	155	161	167	173	179	185	
23	1.01	1.07	113	119	125	131	137	143	149	155	161	167	173	179	185	191	
24	1.07	1.13	119	125	131	137	143	149	155	161	167	173	179	185	191	197	
25	1.13	1.19	125	131	137	143	149	155	161	167	173	179	185	191	197	203	
26	1.19	1.25	131	137	143	149	155	161	167	173	179	185	191	197	203	209	
27	1.25	1.31	137	143	149	155	161	167	173	179	185	191	197	203	209	215	
28	1.31	1.37	143	149	155	161	167	173	179	185	191	197	203	209	215	221	
29	1.37	1.43	149	155	161	167	173	179	185	191	197	203	209	215	221	227	
30	1.43	1.49	155	161	167	173	179	185	191	197	203	209	215	221	227	233	
31	1.49	1.55	161	167	173	179	185	191	197	203	209	215	221	227	233	239	
32	1.55	1.61	167	173	179	185	191	197	203	209	215	221	227	233	239	245	
33	1.61	1.67	173	179	185	191	197	203	209	215	221	227	233	239	245	251	
34	1.67	1.73	179	185	191	197	203	209	215	221	227	233	239	245	251	257	
35	1.73	1.79	185	191	197	203	209	215	221	227	233	239	245	251	257	263	
36	1.79	1.85	191	197	203	209	215	221	227	233	239	245	251	257	263	269	
37	1.85	1.91	197	203	209	215	221	227	233	239	245	251	257	263	269	275	
38	1.91	1.97	203	209	215	221	227	233	239	245	251	257	263	269	275	281	
39	1.97	2.03	209	215	221	227	233	239	245	251	257	263	269	275	281	287	
40	2.03	2.09	215	221	227	233	239	245	251	257	263	269	275	281	287	293	



TABLE 2—Continued

ISSUE AGE #	DURATION t															1,000q <sub>x+15</sub>	ATTAINED AGE x+15	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
41	84	1.14	1.46	1.70	2.00	2.34	2.73	2.80	3.01	3.24	3.51	3.87	4.28	4.75	5.31	5.94	56	
42	87	1.10	1.54	1.89	2.21	2.58	2.97	2.97	3.18	3.42	3.71	4.09	4.50	4.96	5.51	6.13	6.83	57
43	90	1.35	1.67	1.99	2.33	2.72	2.89	2.89	3.07	3.26	3.56	3.93	4.34	4.80	5.35	5.99	6.74	58
44	93	1.31	1.71	2.09	2.45	2.86	3.04	3.32	3.52	3.71	4.00	4.37	4.78	5.24	5.78	6.42	7.18	59
45	1.00	1.30	1.80	2.20	2.54	2.90	3.20	3.52	3.82	4.20	4.60	5.05	5.55	6.09	6.69	7.39	8.18	60
46	1.05	1.38	1.90	2.31	2.67	3.04	3.38	3.72	4.08	4.50	4.96	5.55	6.10	6.70	7.30	8.09	8.91	61
47	1.12	1.48	2.02	2.42	2.80	3.18	3.56	3.95	4.35	4.80	5.34	5.93	6.58	7.28	8.00	8.85	9.71	62
48	1.20	1.74	2.32	2.64	3.04	3.43	3.85	4.27	4.71	5.19	5.78	6.44	7.16	7.94	8.79	9.75	10.69	63
49	1.28	1.89	2.52	2.81	3.24	3.63	4.07	4.51	4.99	5.50	6.05	6.74	7.48	8.28	9.15	10.10	11.04	64
50	1.38	2.27	2.99	3.01	3.48	3.87	4.27	4.71	5.18	5.70	6.31	7.07	7.88	8.75	9.69	10.67	11.64	65
51	1.58	2.52	3.28	3.45	3.78	4.21	4.70	5.16	5.69	6.26	6.87	7.63	8.53	9.47	10.37	11.34	12.34	66
52	1.68	2.70	3.51	4.08	4.54	4.96	5.44	5.92	6.51	7.17	7.89	8.73	9.70	10.40	11.09	11.91	12.86	67
53	1.80	2.70	3.58	4.12	4.59	5.06	5.48	5.97	6.57	7.24	7.98	8.85	9.84	10.46	11.17	12.06	13.00	68
54	1.94	2.74	3.66	4.17	4.64	5.10	5.55	6.02	6.63	7.35	8.12	9.03	10.00	10.62	11.35	12.32	13.34	69
55	1.94	2.83	3.61	4.21	4.70	5.19	5.63	6.07	6.69	7.42	8.20	9.15	10.18	10.82	11.58	12.64	13.71	70
56	1.98	2.91	3.68	4.26	4.76	5.26	5.71	6.12	6.75	7.53	8.40	9.45	10.50	11.17	12.00	13.08	14.17	71
57	2.13	3.18	4.09	4.50	4.80	5.20	5.61	6.17	6.83	7.70	8.68	9.80	10.90	11.60	12.48	13.60	14.74	72
58	2.29	3.43	4.39	4.79	5.09	5.49	5.91	6.39	7.00	7.97	9.00	10.10	11.20	11.90	12.84	14.00	15.18	73
59	2.47	3.63	4.63	5.01	5.31	5.71	6.17	6.71	7.38	8.35	9.40	10.50	11.60	12.30	13.28	14.50	15.74	74
60	2.66	4.20	5.01	5.31	5.61	6.01	6.53	7.11	7.80	8.77	9.80	10.90	12.00	12.70	13.70	15.00	16.24	75
61	2.80	4.58	5.08	5.31	5.61	6.01	6.53	7.11	7.80	8.77	9.80	10.90	12.00	12.70	13.70	15.00	16.24	76
62	2.99	5.00	5.46	5.61	5.91	6.31	6.83	7.41	8.10	9.07	10.10	11.20	12.30	13.00	14.00	15.30	16.54	77
63	3.29	5.46	5.95	6.05	6.35	6.75	7.27	7.85	8.55	9.50	10.50	11.60	12.70	13.40	14.40	15.80	17.04	78
64	3.78	6.42	6.89	6.95	7.25	7.65	8.17	8.75	9.45	10.40	11.40	12.50	13.60	14.30	15.30	16.80	18.04	79
65	4.08	6.86	7.35	7.41	7.71	8.11	8.63	9.21	9.90	10.80	11.80	12.90	14.00	14.70	15.70	17.20	18.44	80
66	4.42	7.27	7.77	7.83	8.13	8.53	9.05	9.63	10.30	11.20	12.20	13.30	14.40	15.10	16.10	17.60	18.84	81
67	4.80	7.67	8.17	8.23	8.53	8.93	9.45	10.03	10.70	11.60	12.60	13.70	14.80	15.50	16.50	18.00	19.24	82
68	5.21	8.06	8.56	8.62	8.92	9.32	9.84	10.42	11.10	12.00	13.00	14.10	15.20	15.90	16.90	18.40	19.64	83
69	5.60	8.42	8.92	8.98	9.28	9.68	10.20	10.78	11.46	12.36	13.36	14.46	15.56	16.26	17.26	18.76	19.96	84
70	6.00	8.78	9.28	9.34	9.64	10.04	10.56	11.14	11.82	12.72	13.72	14.82	15.92	16.62	17.62	19.12	20.32	85

Attained Age	1,000q <sub>x</sub>		Attained Age	1,000q <sub>x</sub>
	Attained Age	1,000q <sub>x</sub>		
0	4.80	25	91	190.70
1	1.22	26	92	210.42
2	.72	27	93	224.59
3	.55	29	94	234.21
4	.48	33	95	238.33
5	.42	114.83	96	276.96
6	.37	126.27	97	390.11
7	.33	139.82	98	617.79
8	.29	150.31	99	1000.00
9	.27	166.59		



TABLE 3—Continued

ISSUE AGE x	DURATION t															1,000 <sub>t+x-15</sub>	ATTAINED AGE x+15
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
41	1.21	2.05	2.47	2.87	3.28	3.71	4.20	4.72	5.28	5.87	6.56	7.35	8.31	9.44	10.71	56	
42	1.32	2.26	2.72	3.16	3.60	4.07	4.59	5.16	5.77	6.43	7.20	8.07	9.13	10.39	11.85	57	
43	1.43	2.47	2.97	3.45	3.92	4.43	4.98	5.59	6.27	7.01	7.88	8.86	10.04	11.43	13.00	58	
44	1.55	2.70	3.24	3.75	4.25	4.80	5.38	6.01	6.70	7.48	8.36	9.35	10.64	12.15	13.84	59	
45	1.67	2.93	3.53	4.08	4.61	5.21	5.81	6.47	7.19	7.98	8.90	9.95	11.35	12.99	14.80	60	
46	1.80	3.19	3.84	4.45	5.02	5.66	6.30	7.01	7.79	8.65	9.69	10.85	12.36	14.15	16.15	61	
47	1.92	3.47	4.19	4.87	5.51	6.18	6.87	7.59	8.36	9.24	10.33	11.54	13.18	15.08	17.25	62	
48	2.04	3.79	4.57	5.35	6.07	6.79	7.54	8.34	9.21	10.17	11.37	12.74	14.56	16.65	18.95	63	
49	2.16	4.13	4.96	5.88	6.68	7.47	8.29	9.16	10.11	11.14	12.46	13.99	15.94	18.14	20.71	64	
50	2.29	4.50	5.39	6.43	7.31	8.18	9.08	10.01	11.01	12.09	13.56	15.24	17.26	19.64	22.73	65	
51	2.42	4.89	5.84	6.99	7.94	8.80	9.68	10.61	11.64	12.74	14.34	16.18	18.31	20.81	23.70	66	
52	2.56	5.29	6.29	7.54	8.56	9.52	10.44	11.41	12.44	13.54	15.28	17.26	19.51	22.01	25.09	67	
53	2.71	5.69	6.74	8.07	9.14	10.20	11.34	12.52	13.75	15.03	16.93	19.08	21.51	24.22	26.91	68	
54	2.87	6.10	7.21	8.59	9.70	10.78	12.06	13.42	14.84	16.33	18.37	20.64	23.25	26.11	29.14	69	
55	3.06	6.53	7.70	9.12	10.27	11.37	12.66	14.14	15.69	17.33	19.53	22.00	24.84	28.33	31.13	70	
56	3.27	7.00	8.25	9.70	10.87	12.07	13.38	15.06	16.81	18.73	21.05	23.67	26.80	30.08	33.01	71	
57	3.51	7.53	8.84	10.35	11.54	12.77	14.20	15.96	17.87	20.05	22.53	25.40	28.83	32.29	35.08	72	
58	3.78	8.15	9.52	11.14	12.38	13.71	15.20	17.00	19.05	21.37	24.07	27.15	30.85	34.57	37.44	73	
59	4.08	8.83	10.25	12.10	13.45	14.86	16.41	18.27	20.50	23.03	26.00	29.40	33.43	37.43	40.01	74	
60	4.44	9.59	11.05	12.88	14.27	15.71	17.38	19.35	21.67	24.35	27.57	31.33	35.27	39.43	42.59	75	
61	4.86	10.39	11.91	13.83	15.27	16.75	18.58	20.67	23.10	25.87	29.28	33.18	37.38	41.88	45.09	76	
62	5.37	11.21	12.78	14.33	15.81	17.33	19.28	21.45	23.90	26.72	30.24	34.27	38.69	43.00	46.85	77	
63	5.98	12.16	13.78	15.31	16.83	18.40	20.46	22.76	25.34	28.24	31.54	35.40	39.80	44.50	48.80	78	
64	6.67	13.28	14.94	16.94	18.50	20.12	22.26	24.69	27.45	30.47	33.67	37.76	41.71	46.50	50.50	79	
65	7.41	14.43	16.16	18.23	20.00	21.84	24.09	26.75	29.68	32.87	36.20	40.33	44.52	48.83	53.11	80	
66	8.19	15.51	17.30	19.20	21.20	23.09	25.54	28.58	31.75	34.85	38.70	42.57	46.95	51.51	55.58	81	
67	9.07	16.58	18.43	20.26	22.02	24.02	27.09	30.45	33.83	37.10	41.27	45.16	49.82	54.44	59.26	82	
68	9.76	17.60	19.73	21.30	23.33	25.43	28.01	31.05	34.83	38.43	42.57	46.44	51.73	56.44	61.80	83	
69	10.57	18.65	20.97	23.11	25.11	27.12	30.01	33.30	37.30	40.90	44.30	48.35	52.84	57.86	64.84	84	
70	11.40	19.80	22.30	25.16	26.76	28.84	32.01	35.55	39.00	42.55	46.80	51.00	55.58	60.45	67.54	85	

Attained Age	1,000 <sub>t</sub>	Attained Age	1,000 <sub>t</sub>	Attained Age	1,000 <sub>t</sub>
0	5.39	10	29	91	203.36
1	1.70	11	29	92	212.61
2	61	12	32	93	225.12
3	61	13	39	94	238.99
4	52	14	47	95	250.52
5	46	15	151.68	96	296.05
6	41	16	164.01	97	411.91
7	37	17	174.49	98	435.45
8	34	18	186.47	99	1000.00
9	31	19	194.68		



TABLE 4—Continued

ISSUE AGE x	DURATION t															1,000g <sub>x+t</sub>	ATTAINED AGE x+t
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
41	1.30	2.24	2.67	3.07	3.48	3.92	4.42	4.97	5.56	6.20	6.95	7.86	8.99	10.34	11.79	56	
42	1.41	2.45	2.92	3.36	3.80	4.28	4.82	5.41	6.08	6.80	7.64	8.65	9.88	11.36	13.07	57	
43	1.52	2.66	3.18	3.65	4.13	4.64	5.22	5.84	6.62	7.44	8.41	9.53	10.87	12.48	14.41	58	
44	1.64	2.88	3.45	3.96	4.48	5.03	5.63	6.29	7.18	8.14	9.24	10.51	11.97	13.70	15.79	59	
45	1.76	3.10	3.74	4.30	4.86	5.45	6.10	6.81	7.80	8.90	10.11	11.57	13.17	15.03	17.25	60	
46	1.88	3.35	4.06	4.70	5.31	5.94	6.64	7.44	8.50	9.70	11.14	12.70	14.47	16.51	18.84	61	
47	2.00	3.64	4.42	5.17	5.84	6.52	7.28	8.21	9.30	10.61	12.14	13.91	15.88	18.14	20.65	62	
48	2.12	4.32	5.29	6.25	7.12	7.99	8.91	9.99	11.16	12.62	14.39	16.55	19.03	21.86	24.98	63	
49	2.25	4.71	5.77	6.83	7.82	8.79	9.81	10.91	12.17	13.70	15.63	18.00	20.76	23.94	27.43	64	
50	2.39	5.11	6.27	7.40	8.50	9.56	10.66	11.83	13.19	14.85	16.95	19.54	22.60	26.45	30.05	65	
51	2.53	5.52	6.76	7.96	9.12	10.26	11.45	12.73	14.21	16.03	18.33	21.16	24.53	28.45	32.78	66	
52	2.69	5.93	7.24	8.50	9.69	10.88	12.16	13.59	15.22	17.25	19.79	22.88	26.54	30.84	35.58	67	
53	2.86	6.36	7.73	9.04	10.24	11.48	12.85	14.45	16.26	18.51	21.34	24.71	28.68	33.37	38.43	68	
54	3.04	6.84	8.27	9.60	10.82	12.11	13.56	15.33	17.34	19.86	22.99	26.67	30.98	36.12	41.65	69	
55	3.25	7.38	8.89	10.23	11.49	12.85	14.38	16.24	18.50	21.31	24.77	28.80	33.52	39.16	45.42	70	
56	3.51	8.02	9.61	10.98	12.32	13.75	15.35	17.26	19.78	22.87	26.68	31.13	36.33	42.55	49.55	71	
57	3.81	8.77	10.46	11.92	13.34	14.83	16.50	18.45	21.19	24.54	28.72	33.64	39.43	46.32	54.02	72	
58	4.17	9.62	11.43	13.02	14.53	16.11	17.81	19.86	22.76	26.41	30.92	36.37	42.84	50.47	58.96	73	
59	4.59	10.53	12.49	14.23	15.83	17.49	19.26	21.45	24.49	28.43	33.33	39.35	46.56	55.00	64.43	74	
60	5.06	11.46	13.61	15.49	17.20	18.95	20.84	23.18	26.41	30.66	35.99	42.64	50.43	59.93	70.45	75	
61	5.60	12.43	14.78	16.74	18.56	20.43	22.47	25.02	28.49	33.08	38.90	46.22	55.04	65.27	77.04	76	
62	6.20	13.53	15.98	18.00	19.92	21.90	24.13	26.94	30.70	35.68	42.05	50.11	59.81	71.00	84.16	77	
63	6.86	14.72	17.21	19.32	21.33	23.46	25.91	29.04	33.16	38.57	45.53	54.35	64.96	77.18	91.63	78	
64	7.60	15.99	18.46	20.71	22.89	25.23	28.00	31.53	36.05	41.93	49.50	59.06	70.57	83.82	99.25	79	
65	8.39	16.99	19.71	22.21	24.67	27.35	30.55	34.58	39.57	45.93	54.09	64.35	76.69	90.97	107.23	80	
66	9.26	17.92	20.95	23.85	26.75	29.08	33.75	38.39	43.90	50.77	59.45	70.31	83.38	98.66	115.81	81	
67	10.21	18.78	22.20	25.63	29.19	33.11	37.69	43.04	49.15	56.51	65.63	76.96	89.64	106.88	125.25	82	
68	11.22	19.62	23.44	27.55	31.96	36.83	42.34	48.51	55.27	63.12	72.60	84.29	98.46	115.63	135.81	83	
69	12.32	19.62	24.70	29.60	35.02	41.04	47.63	54.72	62.19	70.54	80.30	92.25	106.83	124.90	147.40	84	
70	13.48	20.41	24.70	29.60	35.02	41.04	47.63	54.72	62.19	70.54	80.30	92.25	106.83	124.90	147.40	85	

Attained Age	1,000g <sub>x</sub>	Attained Age	1,000g <sub>x</sub>
0	3.57	10	31
1	1.09	11	32
2	1.75	12	33
3	2.59	13	47
4	.51	14	.59
5	45	86	160.06
6	41	87	173.69
7	37	88	186.92
8	34	89	197.79
9	32	90	206.22
213.60		91	
223.16		92	
238.23		93	
257.02		94	
289.93		95	
367.59		96	
515.28		97	
742.62		98	
1000.00		99	



TABLE 5 (Continued)

ISSUE AGE $x$	DURATION $t$															1,000 $\frac{1000}{x+15}$	ATTAINED AGE $x+15$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
41	.85	1.16	1.50	1.84	2.15	2.41	2.65	2.88	3.09	3.33	3.61	3.98	4.42	4.93	5.53	6.18	56
42	.88	1.22	1.58	1.94	2.27	2.55	2.81	3.05	3.27	3.53	3.83	4.22	4.73	5.35	6.03	6.73	57
43	.92	1.28	1.66	2.04	2.38	2.69	2.96	3.23	3.48	3.77	4.11	4.53	5.13	5.84	6.61	7.41	58
44	.97	1.35	1.75	2.14	2.49	2.83	3.12	3.42	3.70	4.05	4.43	4.91	5.60	6.40	7.25	8.18	59
45	1.02	1.43	1.85	2.25	2.61	2.97	3.29	3.62	3.95	4.35	4.78	5.33	6.11	7.09	8.04	9.07	60
46	1.08	1.53	1.96	2.36	2.73	3.10	3.47	3.83	4.21	4.65	5.15	5.79	6.63	7.64	8.64	9.73	61
47	1.17	1.66	2.12	2.53	2.92	3.30	3.70	4.11	4.53	4.99	5.56	6.28	7.16	8.20	9.34	10.44	62
48	1.31	1.86	2.39	2.82	3.23	3.61	4.06	4.49	4.94	5.44	6.04	6.80	7.69	8.79	10.03	11.35	63
49	1.48	2.13	2.74	3.22	3.66	4.03	4.48	4.94	5.43	5.98	6.59	7.35	8.24	9.40	10.73	12.19	64
50	1.66	2.39	3.10	3.57	4.02	4.47	4.90	5.39	5.92	6.52	7.14	7.91	8.83	10.06	11.50	13.09	65
51	1.81	2.61	3.39	3.89	4.40	4.82	5.25	5.76	6.33	6.97	7.65	8.47	9.46	10.78	12.38	14.15	66
52	1.89	2.72	3.52	4.10	4.66	5.08	5.46	5.99	6.59	7.28	8.07	9.01	10.12	11.59	13.41	15.31	67
53	1.91	2.76	3.56	4.14	4.67	5.03	5.46	5.99	6.59	7.28	8.07	9.01	10.12	11.59	13.41	15.31	68
54	1.93	2.80	3.59	4.19	4.67	5.08	5.50	6.04	6.71	7.43	8.26	9.23	10.40	12.00	14.00	16.00	69
55	1.95	2.85	3.63	4.23	4.72	5.12	5.55	6.09	6.81	7.57	8.45	9.48	10.75	12.45	14.65	17.00	70
56	1.97	2.89	3.66	4.28	4.77	5.17	5.59	6.14	7.02	7.92	8.96	10.16	11.60	13.45	15.80	18.50	71
57	2.05	3.04	3.88	4.54	5.00	5.40	5.89	6.74	7.92	9.16	10.38	12.12	14.15	16.80	20.00	24.00	72
58	2.21	3.33	4.33	4.99	5.40	5.89	6.74	7.92	9.16	10.38	12.12	14.15	16.80	20.00	24.00	28.00	73
59	2.38	3.66	4.82	5.40	5.89	6.74	7.92	9.16	10.38	12.12	14.15	16.80	20.00	24.00	28.00	32.00	74
60	2.56	4.01	5.34	5.89	6.74	7.92	9.16	10.38	12.12	14.15	16.80	20.00	24.00	28.00	32.00	36.00	75
61	2.76	4.39	5.89	6.74	7.92	9.16	10.38	12.12	14.15	16.80	20.00	24.00	28.00	32.00	36.00	40.00	76
62	2.96	4.79	6.45	7.30	8.50	10.25	11.39	13.33	15.20	17.33	19.90	22.00	24.60	27.60	31.00	34.80	77
63	3.18	5.23	7.01	8.30	9.64	11.15	12.33	13.50	14.89	16.87	19.08	21.70	24.70	28.10	31.90	35.70	78
64	3.40	5.70	7.59	8.99	10.40	12.04	13.50	14.76	16.36	18.74	22.46	26.60	30.90	35.40	40.10	44.80	79
65	3.65	6.18	8.18	9.72	11.20	12.96	14.70	16.10	18.10	20.94	25.22	31.06	38.42	47.31	57.72	69.07	80
66	3.93	6.64	8.78	10.51	12.10	13.90	15.78	17.76	20.26	23.62	28.46	34.90	42.85	52.32	63.43	75.70	81
67	4.25	7.06	9.39	11.37	13.17	15.05	17.12	19.91	23.01	26.82	32.30	39.30	47.85	57.90	69.07	81.80	82
68	4.61	7.47	10.00	12.31	14.47	16.69	19.19	22.73	26.43	30.88	36.76	44.25	53.33	64.06	76.48	89.41	83
69	5.00	7.86	10.62	13.34	16.02	18.88	22.07	26.21	30.49	35.49	41.82	49.75	59.58	70.78	83.81	102.04	84
70	5.43	8.25	11.25	14.43	17.76	21.46	25.54	30.24	35.12	40.69	47.44	55.77	66.27	78.03	91.65	110.60	85

Attained Age	1,000 $\frac{1000}{x}$	Attained Age	1,000 $\frac{1000}{x}$
0	3.01	10	.25
1	.97	11	.26
2	.64	12	.28
3	.52	13	.31
4	.45	14	.34
5	.40	86	120.20
6	.35	87	132.59
7	.31	88	144.67
8	.28	89	157.79
9	.26	90	177.55

TABLE 6  
 MODIFIED 1965-70 SELECT AND ULTIMATE BASIC TABLE FOR MALES AND FEMALES COMBINED  
 AGE LAST BIRTHDAY  
 $1,000q_{[x]+t}^{(M+F)}$

Issue Age $\frac{x}{1}$	Duration $t$															1,000 $q_{[x]+15}^{(M+F)}$	Attained Age $x+15$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
0	3.34	1.04	.70	.57	.49	.44	.39	.36	.33	.30	.29	.30	.35	.43	.52	.62	15
1	1.04	.70	.57	.49	.44	.39	.36	.33	.30	.29	.30	.35	.43	.52	.62	.74	16
2	.70	.57	.49	.44	.39	.36	.33	.30	.29	.30	.35	.43	.52	.62	.74	.86	17
3	.57	.49	.44	.39	.36	.33	.30	.29	.30	.35	.43	.52	.62	.74	.86	.96	18
4	.49	.44	.39	.36	.33	.30	.29	.30	.35	.43	.52	.62	.74	.86	.96	1.04	19
5	.44	.39	.36	.33	.30	.29	.30	.35	.43	.52	.62	.74	.86	.96	1.04	1.08	20
6	.39	.36	.33	.30	.29	.30	.35	.43	.52	.62	.74	.86	.96	1.04	1.08	1.09	21
7	.36	.33	.30	.29	.30	.35	.43	.52	.62	.74	.86	.96	1.04	1.08	1.07	1.05	22
8	.33	.30	.29	.30	.35	.43	.52	.62	.74	.86	.96	1.04	1.08	1.07	1.05	1.03	23
9	.30	.29	.30	.35	.43	.52	.62	.74	.86	.96	1.04	1.08	1.07	1.05	1.03	1.02	24
10	.29	.30	.35	.43	.52	.62	.74	.86	.96	1.04	1.08	1.07	1.05	1.03	1.02	1.01	25
11	.30	.35	.43	.52	.62	.74	.86	.96	1.04	1.08	1.07	1.05	1.03	1.02	1.01	1.00	26
12	.35	.43	.52	.62	.74	.86	.96	1.04	1.08	1.07	1.05	1.03	1.02	1.01	1.00	1.00	27
13	.43	.52	.62	.74	.86	.96	1.04	1.08	1.07	1.05	1.03	1.02	1.01	1.00	1.00	1.00	28
14	.52	.62	.74	.86	.96	1.04	1.08	1.07	1.05	1.03	1.02	1.01	1.00	1.00	1.00	1.00	29
15	.61	.73	.83	.91	1.01	1.04	1.06	1.05	1.04	1.04	1.03	1.02	1.01	1.01	1.01	1.01	30
16	.73	.82	.89	.95	1.02	1.04	1.06	1.05	1.04	1.04	1.03	1.02	1.01	1.01	1.01	1.01	31
17	.87	.87	.91	.97	1.01	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	32
18	.77	.89	.90	.95	.97	.94	.93	.93	.95	.96	.99	1.01	1.01	1.01	1.01	1.01	33
19	.75	.87	.88	.91	.91	.88	.87	.89	.92	.94	.96	1.02	1.02	1.02	1.02	1.02	34
20	.72	.83	.86	.86	.84	.81	.82	.86	.89	.91	.94	1.00	1.00	1.00	1.00	1.00	35
21	.69	.79	.83	.82	.79	.77	.79	.83	.86	.88	.93	1.00	1.00	1.00	1.00	1.00	36
22	.66	.76	.80	.79	.77	.76	.77	.81	.84	.87	.94	1.00	1.00	1.00	1.00	1.00	37
23	.63	.72	.77	.77	.76	.75	.77	.81	.84	.89	.99	1.00	1.00	1.00	1.00	1.00	38
24	.61	.68	.73	.75	.75	.76	.76	.84	.88	.96	1.05	1.05	1.05	1.05	1.05	1.05	39
25	.58	.65	.70	.74	.76	.78	.82	.88	.95	1.05	1.16	1.20	1.20	1.20	1.20	1.20	40
26	.57	.63	.69	.74	.78	.82	.88	.95	1.04	1.16	1.32	1.48	1.58	1.58	1.58	1.58	41
27	.56	.63	.69	.76	.82	.88	.95	1.04	1.15	1.29	1.44	1.64	1.84	1.84	1.84	1.84	42
28	.58	.65	.72	.80	.88	.95	1.04	1.13	1.23	1.44	1.62	1.84	2.08	2.08	2.08	2.08	43
29	.62	.69	.77	.86	.95	1.04	1.15	1.23	1.44	1.62	1.84	2.08	2.33	2.33	2.33	2.33	44
30	.67	.74	.83	.92	1.03	1.15	1.28	1.42	1.62	1.82	2.03	2.31	2.60	2.60	2.60	2.60	45
31	.71	.79	.89	1.00	1.13	1.27	1.42	1.59	1.81	2.04	2.29	2.58	2.89	2.89	2.89	2.89	46
32	.74	.84	.96	1.08	1.23	1.40	1.58	1.77	2.01	2.28	2.55	2.86	3.21	3.21	3.21	3.21	47
33	.76	.88	1.02	1.17	1.35	1.54	1.75	1.97	2.23	2.52	2.82	3.17	3.56	3.56	3.56	3.56	48
34	.77	.93	1.09	1.27	1.48	1.70	1.93	2.19	2.48	2.79	3.11	3.50	3.93	3.93	3.93	3.93	49
35	.79	.98	1.17	1.39	1.63	1.87	2.14	2.43	2.74	3.08	3.44	3.83	4.34	4.34	4.34	4.34	50
36	.83	1.05	1.27	1.53	1.80	2.07	2.37	2.70	3.03	3.40	3.79	4.23	4.79	4.79	4.79	4.79	51
37	.88	1.14	1.40	1.70	1.99	2.30	2.62	2.99	3.36	3.76	4.19	4.69	5.28	5.28	5.28	5.28	52
38	.96	1.25	1.56	1.89	2.22	2.55	2.90	3.30	3.71	4.15	4.62	5.17	5.81	5.81	5.81	5.81	53
39	1.05	1.39	1.74	2.11	2.46	2.82	3.21	3.65	4.10	4.58	5.09	5.69	6.39	6.39	6.39	6.39	54
40	1.15	1.55	1.94	2.34	2.73	3.12	3.54	4.01	4.51	5.04	5.60	6.26	7.02	7.02	7.02	7.02	55



TABLE 6—Continued

ISSUE AGE x <sub>1</sub>	DURATION t															1,000 <sub>gr</sub> <sup>15</sup>	ATTAINED AGE x <sub>t+15</sub>
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
41	1.26	1.71	2.15	2.59	3.01	3.44	3.89	4.39	4.94	5.52	6.15	6.88	7.71	8.72	9.91	11.28	56
42	1.37	1.82	2.26	2.70	3.20	3.70	4.25	4.78	5.37	6.02	6.72	7.54	8.46	9.58	10.91	12.47	57
43	1.49	1.94	2.38	2.82	3.30	3.80	4.31	4.85	5.40	6.03	6.72	7.54	8.46	9.58	10.91	12.47	58
44	1.61	2.06	2.50	2.94	3.42	3.92	4.43	4.97	5.52	6.15	6.88	7.71	8.72	9.91	11.28	13.06	59
45	1.73	2.18	2.62	3.06	3.54	4.04	4.55	5.09	5.64	6.27	6.99	7.91	8.92	10.11	11.50	13.19	60
46	1.86	2.31	2.75	3.19	3.67	4.17	4.68	5.22	5.77	6.40	7.12	8.04	9.05	10.24	11.63	13.48	61
47	1.98	2.43	2.87	3.31	3.79	4.29	4.80	5.34	5.89	6.52	7.24	8.16	9.17	10.36	11.75	13.70	62
48	2.10	2.55	2.99	3.43	3.91	4.41	4.92	5.46	6.01	6.64	7.36	8.28	9.29	10.48	11.87	13.84	63
49	2.22	2.67	3.11	3.55	4.03	4.53	5.04	5.58	6.13	6.76	7.48	8.40	9.41	10.60	12.00	14.00	64
50	2.35	2.80	3.24	3.68	4.16	4.66	5.17	5.71	6.26	6.89	7.61	8.53	9.54	10.73	12.12	14.10	65
51	2.49	2.94	3.38	3.82	4.30	4.80	5.31	5.85	6.40	7.03	7.75	8.67	9.68	10.87	12.21	14.20	66
52	2.63	3.08	3.52	3.96	4.44	4.94	5.45	5.99	6.54	7.17	7.89	8.81	9.82	11.01	12.30	14.30	67
53	2.76	3.21	3.65	4.09	4.57	5.07	5.58	6.12	6.67	7.30	8.02	8.94	9.95	11.14	12.40	14.40	68
54	2.90	3.35	3.79	4.23	4.71	5.21	5.72	6.26	6.81	7.44	8.16	9.08	10.09	11.28	12.50	14.50	69
55	3.04	3.49	3.93	4.37	4.85	5.35	5.86	6.40	6.95	7.58	8.30	9.22	10.23	11.42	12.64	14.60	70
56	3.18	3.63	4.07	4.51	5.00	5.50	6.01	6.55	7.10	7.73	8.45	9.37	10.38	11.57	12.79	14.70	71
57	3.32	3.77	4.21	4.65	5.14	5.64	6.15	6.69	7.24	7.87	8.59	9.51	10.52	11.71	12.93	14.80	72
58	3.46	3.91	4.35	4.79	5.28	5.78	6.29	6.83	7.38	8.01	8.73	9.65	10.66	11.85	13.07	14.90	73
59	3.60	4.05	4.49	4.93	5.42	5.92	6.43	6.97	7.52	8.15	8.87	9.79	10.80	12.00	13.22	15.00	74
60	3.74	4.19	4.63	5.07	5.56	6.06	6.57	7.11	7.66	8.29	9.01	9.93	10.94	12.14	13.36	15.10	75
61	3.88	4.33	4.77	5.21	5.70	6.20	6.71	7.25	7.80	8.43	9.15	10.07	11.08	12.28	13.50	15.20	76
62	4.02	4.47	4.91	5.35	5.84	6.34	6.85	7.39	7.94	8.57	9.29	10.21	11.22	12.42	13.64	15.30	77
63	4.16	4.61	5.05	5.49	5.98	6.48	6.99	7.53	8.08	8.71	9.43	10.35	11.36	12.56	13.78	15.40	78
64	4.30	4.75	5.19	5.63	6.12	6.62	7.13	7.67	8.22	8.85	9.57	10.49	11.50	12.70	13.92	15.50	79
65	4.44	4.89	5.33	5.77	6.26	6.76	7.27	7.81	8.36	9.00	9.72	10.64	11.65	12.85	14.07	15.60	80
66	4.58	5.03	5.47	5.91	6.40	6.90	7.41	7.95	8.50	9.14	9.86	10.78	11.79	12.99	14.21	15.70	81
67	4.72	5.17	5.61	6.05	6.54	7.04	7.55	8.09	8.64	9.28	10.00	10.92	11.93	13.13	14.35	15.80	82
68	4.86	5.31	5.75	6.19	6.68	7.18	7.69	8.23	8.78	9.42	10.14	11.06	12.07	13.27	14.49	15.90	83
69	5.00	5.45	5.89	6.33	6.82	7.32	7.83	8.37	8.92	9.56	10.28	11.20	12.21	13.41	14.63	16.00	84
70	5.14	5.59	6.03	6.47	6.96	7.46	7.97	8.51	9.06	9.70	10.42	11.34	12.35	13.55	14.77	16.10	85

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Attained Age	1,000 <sub>gr</sub>	Attained Age	1,000 <sub>gr</sub>
0	3.34	10	29
1	1.04	11	30
2	1.70	12	35
3	.37	13	43
4	.49	14	52
5	.44	86	157.34
6	.39	87	169.69
7	.36	88	181.00
8	.33	89	190.15
9	.30	90	198.55
91	207.46	96	343.92
92	218.12	97	494.32
93	231.18	98	752.31
94	243.97	99	1000.00
95	270.03		

## DISCUSSION OF PRECEDING PAPER

CLAUDE Y. PAQUIN:

Mr. Green is to be complimented for offering his "work of art" to the profession. His presentation is interesting, and I find that this paper is as practical as its author, which I well appreciate and respect.

The greatest virtue of Mr. Green's tables is that they offer a focus of reference or, in other words, are a quotable source. In a GAAP report, the conscientious actuary now can spare himself having to attach a lengthy exhibit or appendix simply by stating that he used  $(100 + x)$  percent of the tables shown on certain pages of a particular volume of the *Transactions*. (The not-so-conscientious actuary can continue to state that he used an "appropriate modification and extension" of the 1965-70 Basic Tables )

I shall not submit the tables I developed, which were derived without the use of CURVFII and Lagrangian interpolations, because the values are very close to Mr. Green's. I thus am satisfied that Mr. Green's tables are good ones, and that it still is possible to do reasonably competent actuarial work without using the types of techniques employed by Mr. Green.

CARI J. SIRUNK:

Mr. Green has recognized and dealt adequately with the problems associated with using the 1965-70 Basic Tables. However, his solution leaves several unanswered questions. For example: Which two intervening durations were chosen besides 1, 15, and 16? What interpolation formula was used? What is CURVFII?

Our company was faced with the same problem of deriving mortality rates for every age, and we took a more direct approach, as follows:

1. Ultimate rates were retained, with  $q_{99} = 1.000$ .
2. At issue age 0, all select rates were retained.
3. Rates for policy year 1 at issue ages 0, 2, and every fifth age thereafter up to 67 were retained.
4. In order to obtain additional smoothness, the rates for policy year 6 for the same issue ages as in item 2 above were derived by averaging the rates for policy years 5-7.
5. Similarly, the rates for policy year 11 were obtained by averaging the rates for years 10-12.
6. All intervening durations at the quinquennial ages selected above were obtained by interpolation, using the four-point central interpolation formula of Karup-King for policy years 7-10 and Newton's advancing difference formulas for policy years 2-5 and 12-15.

7. Select mortality rates for intervening issue ages from 3 to 66 were then determined by utilizing the same interpolation formulas as in step 6.
8. For ages below 16, rates were made constant by attained age.
9. Rates were extended to issue age 70 by multiplying the ultimate rates at ages 70 and over by the ratio of select to ultimate mortality for issue age 67.
10. The ultimate rates were terminated by a cubic equation fitted to ages 92, 93, 94, and 99 ( $q_{99} = 1.00$ )

The results are shown in Tables 1-3 of this discussion. An APL program that produces such a complete table is available. The advantage of the approach just described is that if one does not have a computer with APL the procedure can be done even with a desk calculator.

Our company is not on an age-last-birthday basis, so we did not develop such rates. If one desires those rates, the procedure followed by Mr. Green can be used. However, a cursory examination indicates that age-last-birthday rates could be obtained as the mean of age-nearest-birthday rates. Such results would be as accurate as the data warrant; however, the accuracy would not equal the pseudoaccuracy of the age-last-birthday rates in the *Basic Values* of the *Monetary Tables* published by the Society of Actuaries.

THOMAS R. HUBER:

As vice-chairman of the Society of Actuaries' Committee on Mortality under Ordinary Insurance and Annuities, I was in charge of constructing the 1965-70 Basic Tables. In the course of that work, it occurred to me that the contributing companies could almost as easily have submitted their data by individual issue age instead of by issue-age group. The main drawback in submitting data by individual issue age would have been the greatly expanded number of IBM cards that would have had to be submitted. However, the time probably has come for switching from cards to magnetic tape, which would alleviate this problem. Thus, in modifying the Intercompany 1965-70 Select Basic Tables to show mortality rates at individual issue ages, Mr. Green has gone part of the way toward doing something the Mortality Committee might consider in the future.

In connection with Mr. Green's paper, I would like to make the following points:

1. The 1965-70 Basic Tables were constructed to facilitate the analysis by the Mortality Committee of future mortality trends and to provide companies with an up-to-date basis for mortality comparison. The tables were not intended for the development of gross or GAAP premiums.
2. I tend to agree with Mr. Green's statement that the length of the select period might be a function of the issue-age group. I believe that a



TABLE i—Continued

ISSUE AGE $x$	POLICY YEAR $t$															1,000 $q_{x+t}$	ATTAINED AGE $x+t$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
20	0.81	0.86	0.89	0.91	0.93	0.94	0.95	0.95	0.96	0.97	1.01	1.05	1.11	1.19	1.29	1.40	35
21	0.74	0.78	0.82	0.84	0.86	0.87	0.89	0.89	0.92	0.95	1.00	1.06	1.14	1.24	1.36	1.50	36
22	0.69	0.73	0.76	0.78	0.81	0.83	0.86	0.88	0.91	0.96	1.02	1.10	1.20	1.32	1.46	1.63	37
23	0.65	0.69	0.72	0.75	0.78	0.81	0.84	0.88	0.92	0.98	1.07	1.16	1.28	1.42	1.59	1.79	38
24	0.62	0.66	0.69	0.73	0.76	0.79	0.84	0.89	0.95	1.02	1.12	1.24	1.38	1.55	1.74	1.98	39
25	0.59	0.63	0.67	0.71	0.75	0.79	0.85	0.91	0.99	1.08	1.20	1.34	1.50	1.69	1.92	2.20	40
26	0.57	0.62	0.66	0.71	0.76	0.81	0.88	0.96	1.05	1.16	1.30	1.46	1.65	1.87	2.12	2.43	41
27	0.57	0.62	0.67	0.72	0.78	0.85	0.94	1.03	1.13	1.26	1.43	1.61	1.83	2.07	2.36	2.68	42
28	0.59	0.64	0.70	0.76	0.83	0.91	1.01	1.12	1.25	1.40	1.58	1.79	2.03	2.30	2.61	2.96	43
29	0.62	0.68	0.74	0.81	0.89	0.99	1.11	1.24	1.39	1.56	1.77	2.00	2.26	2.56	2.89	3.27	44
30	0.67	0.73	0.80	0.88	0.97	1.09	1.22	1.38	1.55	1.75	1.98	2.24	2.52	2.84	3.20	3.62	45
31	0.71	0.78	0.86	0.96	1.07	1.20	1.36	1.53	1.73	1.95	2.21	2.50	2.81	3.16	3.55	3.99	46
32	0.75	0.83	0.93	1.04	1.17	1.33	1.51	1.70	1.92	2.17	2.46	2.78	3.13	3.52	3.95	4.42	47
33	0.77	0.88	1.00	1.14	1.29	1.46	1.66	1.88	2.13	2.41	2.73	3.09	3.48	3.91	4.39	4.92	48
34	0.78	0.92	1.07	1.23	1.41	1.61	1.84	2.08	2.35	2.66	3.02	3.41	3.85	4.33	4.87	5.51	49
35	0.79	0.97	1.15	1.35	1.55	1.77	2.03	2.30	2.59	2.93	3.33	3.76	4.25	4.79	5.40	6.17	50
36	0.81	1.04	1.25	1.48	1.71	1.96	2.24	2.54	2.86	3.23	3.67	4.15	4.69	5.30	5.98	6.84	51
37	0.86	1.13	1.38	1.64	1.90	2.17	2.49	2.81	3.16	3.57	4.05	4.59	5.19	5.87	6.64	7.50	52
38	0.93	1.24	1.54	1.82	2.11	2.42	2.76	3.11	3.49	3.94	4.47	5.06	5.73	6.49	7.36	8.23	53
39	1.03	1.38	1.72	2.04	2.36	2.69	3.07	3.44	3.86	4.34	4.93	5.58	6.32	7.16	8.13	9.05	54
40	1.14	1.54	1.92	2.27	2.62	2.98	3.40	3.80	4.25	4.77	5.42	6.13	6.95	7.89	8.97	10.03	55
41	1.25	1.71	2.13	2.52	2.91	3.30	3.75	4.19	4.67	5.23	5.94	6.73	7.63	8.68	9.88	11.17	56
42	1.36	1.88	2.35	2.79	3.21	3.63	4.12	4.59	5.11	5.72	6.50	7.36	8.37	9.53	10.88	12.42	57
43	1.47	2.06	2.59	3.07	3.52	3.98	4.51	5.01	5.56	6.23	7.08	8.02	9.13	10.42	11.92	13.73	58
44	1.58	2.25	2.83	3.36	3.85	4.34	4.90	5.44	6.02	6.74	7.67	8.70	9.91	11.34	13.01	15.10	59

TABLE 1—Continued

ISSUE AGE #	POLICY YEAR <i>t</i>															1,000 <sub>qr</sub> +15	ATTAINED AGE <i>x</i> +15
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
45	1.70	2.45	3.09	3.66	4.20	4.72	5.33	5.90	6.52	7.29	8.30	9.43	10.76	12.34	14.19	16.50	60
46	1.82	2.65	3.37	4.00	4.58	5.14	5.80	6.41	7.07	7.90	9.01	10.24	11.72	13.46	15.51	18.01	61
47	1.94	2.87	3.67	4.36	4.99	5.61	6.32	6.98	7.71	8.61	9.83	11.18	12.81	14.74	17.02	19.69	62
48	2.06	3.10	3.99	4.75	5.45	6.13	6.92	7.64	8.43	9.43	10.77	12.27	14.06	16.20	18.72	21.63	63
49	2.18	3.34	4.33	5.18	5.96	6.70	7.58	8.37	9.24	10.34	11.82	13.47	15.44	17.80	20.58	23.81	64
50	2.31	3.60	4.68	5.63	6.49	7.31	8.28	9.15	10.11	11.32	12.94	14.76	16.93	19.53	22.59	26.17	65
51	2.45	3.87	5.06	6.10	7.04	7.94	9.00	9.96	11.01	12.33	14.12	16.12	18.51	21.37	24.75	28.73	66
52	2.61	4.15	5.45	6.58	7.60	8.58	9.73	10.77	11.92	13.36	15.32	17.52	20.15	23.30	27.03	31.40	67
53	2.78	4.45	5.85	7.05	8.14	9.19	10.43	11.55	12.78	14.35	16.49	18.89	21.79	25.25	29.35	34.21	68
54	2.94	4.74	6.24	7.53	8.68	9.80	11.12	12.31	13.62	15.32	17.64	20.26	23.42	27.21	31.72	36.99	69
55	3.13	5.06	6.66	8.03	9.25	10.43	11.84	13.11	14.51	16.34	18.86	21.71	25.17	29.32	34.27	39.92	70
56	3.36	5.42	7.13	8.58	9.88	11.14	12.65	14.01	15.53	17.51	20.26	23.38	27.16	31.71	37.14	43.46	71
57	3.65	5.85	7.67	9.22	10.61	11.96	13.60	15.09	16.75	18.92	21.94	25.35	29.50	34.50	40.45	47.47	72
58	4.00	6.32	8.26	9.92	11.43	12.90	14.69	16.33	18.18	20.58	23.90	27.66	32.22	37.70	44.21	51.73	73
59	4.38	6.84	8.89	10.67	12.31	13.92	15.89	17.71	19.76	22.43	26.08	30.22	35.22	41.22	48.32	56.43	74
60	4.82	7.41	9.59	11.50	13.27	15.03	17.19	19.21	21.50	24.45	28.47	33.02	38.50	45.05	52.80	61.64	75
61	5.32	8.06	10.38	12.42	14.33	16.25	18.61	20.84	23.37	26.62	31.03	36.02	42.02	49.19	57.65	67.41	76
62	5.89	8.81	11.28	13.47	15.52	17.60	20.16	22.59	25.35	28.91	33.73	39.20	45.78	53.62	62.88	73.71	77
63	6.52	9.63	12.27	14.61	16.81	19.05	21.82	24.46	27.47	31.35	36.62	42.60	49.78	58.35	68.47	80.63	78
64	7.21	10.55	13.37	15.87	18.22	20.61	23.60	26.45	29.71	33.93	39.67	46.18	54.03	63.39	74.45	88.00	79
65	7.98	11.56	14.58	17.25	19.75	22.31	25.51	28.56	32.07	36.63	42.86	49.95	58.50	68.72	80.80	95.60	80
66	8.82	12.69	15.93	18.76	21.42	24.13	27.55	30.80	34.54	39.45	46.19	53.88	63.19	74.33	87.54	103.29	81
67	9.74	13.92	17.40	20.42	23.23	26.08	29.72	33.15	37.11	42.37	49.66	57.98	68.09	80.24	94.67	111.63	82
68	10.61	15.06	18.78	22.23	25.37	28.42	32.42	36.21	40.59	46.33	54.32	63.28	73.97	86.69	102.31	120.51	83
69	11.47	16.25	20.45	24.28	27.65	31.00	35.41	39.60	44.38	50.68	59.28	68.75	79.92	93.69	110.45	130.63	84

TABLE i—Continued

ISSUE AGE $x$	POLICY YEAR $t$															1,000 $_{02}v_{x+15}$	ATTAINED AGE $x+15$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
70	12.38	17.69	22.33	26.46	30.16	33.86	38.73	43.30	48.55	55.31	64.40	74.28	86.38	101.15	119.73	141.76	85
																153.97	86
																167.26	87
																181.42	88
																193.63	89
																202.96	90
																210.32	91
																217.76	92
																230.07	93
																248.83	94
																275.55	95
																354.98	96
																488.87	97
																694.55	98
																1,000.00	99

TABLE 2  
 MODIFIED 1965-70 SELECT AND ULTIMATE TABLE, FEMALE LIVES  
 AGE NEAREST BIRTHDAY  
 $1,000q_{[x]+t-1}$

Issue Age $x$	Policy Year $t$															1,000 $q_{x+15}$	Attained Age $x+15$				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15						
0	4.80	0.42	0.33	0.29	0.27	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.54	0.53	15
1	1.22	0.37	0.33	0.29	0.27	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.54	0.53	0.53	16
2	0.72	0.55	0.48	0.42	0.37	0.33	0.29	0.27	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	17
3	0.55	0.48	0.42	0.37	0.33	0.29	0.27	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	18
4	0.48	0.42	0.37	0.33	0.29	0.27	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	19
5	0.42	0.37	0.33	0.29	0.27	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	20
6	0.37	0.33	0.29	0.27	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	21
7	0.33	0.29	0.27	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	0.53	22
8	0.29	0.27	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	0.53	0.53	23
9	0.27	0.26	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	0.53	0.53	24
10	0.26	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	25
11	0.26	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	26
12	0.27	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	27
13	0.29	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	28
14	0.33	0.36	0.41	0.47	0.53	0.59	0.58	0.55	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	29
15	0.36	0.42	0.46	0.49	0.51	0.53	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	30
16	0.42	0.46	0.49	0.51	0.53	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	31
17	0.45	0.48	0.51	0.53	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	32
18	0.47	0.50	0.52	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	33
19	0.48	0.51	0.53	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	34



TABLE 2—Continued

ISSUE AGE $x$	POLICY YEAR $t$															1,000 $q_{x+t-1}$	ATTAINED AGE $x+t-1$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
20	0.49	0.51	0.53	0.54	0.55	0.55	0.56	0.57	0.58	0.60	0.63	0.66	0.71	0.77	0.85	0.92	35
21	0.49	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.60	0.62	0.66	0.71	0.77	0.84	0.93	1.02	36
22	0.50	0.52	0.53	0.55	0.56	0.57	0.59	0.61	0.63	0.66	0.71	0.77	0.84	0.93	1.03	1.16	37
23	0.51	0.52	0.54	0.55	0.57	0.59	0.61	0.64	0.67	0.72	0.78	0.85	0.93	1.03	1.15	1.31	38
24	0.51	0.52	0.54	0.56	0.58	0.60	0.64	0.68	0.72	0.78	0.85	0.94	1.04	1.15	1.28	1.45	39
25	0.52	0.53	0.54	0.56	0.59	0.63	0.67	0.72	0.79	0.86	0.95	1.04	1.15	1.28	1.42	1.60	40
26	0.52	0.53	0.55	0.58	0.61	0.66	0.72	0.78	0.86	0.95	1.05	1.16	1.29	1.42	1.57	1.76	41
27	0.54	0.55	0.57	0.61	0.65	0.71	0.78	0.86	0.95	1.05	1.16	1.29	1.43	1.58	1.74	1.91	42
28	0.57	0.58	0.61	0.66	0.71	0.78	0.86	0.95	1.05	1.17	1.29	1.43	1.58	1.74	1.91	2.07	43
29	0.60	0.62	0.66	0.72	0.78	0.86	0.95	1.05	1.17	1.30	1.43	1.58	1.74	1.91	2.09	2.26	44
30	0.64	0.67	0.72	0.79	0.86	0.96	1.06	1.17	1.30	1.44	1.59	1.74	1.91	2.09	2.28	2.48	45
31	0.67	0.72	0.79	0.86	0.95	1.06	1.17	1.30	1.44	1.59	1.75	1.92	2.10	2.28	2.48	2.70	46
32	0.70	0.77	0.85	0.94	1.05	1.16	1.29	1.43	1.58	1.74	1.91	2.10	2.29	2.49	2.70	2.92	47
33	0.72	0.81	0.91	1.02	1.14	1.28	1.42	1.57	1.73	1.90	2.09	2.28	2.49	2.71	2.94	3.17	48
34	0.73	0.85	0.98	1.11	1.25	1.40	1.55	1.72	1.89	2.08	2.28	2.48	2.70	2.94	3.19	3.46	49
35	0.74	0.89	1.05	1.20	1.36	1.52	1.70	1.87	2.06	2.25	2.47	2.69	2.93	3.18	3.45	3.74	50
36	0.76	0.94	1.12	1.30	1.47	1.65	1.84	2.03	2.22	2.43	2.66	2.90	3.15	3.43	3.73	4.05	51
37	0.77	0.99	1.20	1.39	1.59	1.78	1.98	2.18	2.38	2.60	2.84	3.10	3.38	3.69	4.02	4.39	52
38	0.79	1.04	1.28	1.50	1.70	1.91	2.12	2.32	2.53	2.75	3.01	3.29	3.59	3.93	4.31	4.76	53
39	0.80	1.10	1.36	1.60	1.82	2.03	2.25	2.46	2.66	2.89	3.17	3.46	3.79	4.17	4.60	5.13	54
40	0.82	1.16	1.45	1.71	1.94	2.16	2.39	2.59	2.80	3.03	3.32	3.64	4.00	4.42	4.91	5.52	55
41	0.84	1.22	1.54	1.82	2.07	2.29	2.53	2.74	2.94	3.19	3.50	3.84	4.24	4.71	5.26	5.94	56
42	0.87	1.29	1.64	1.93	2.19	2.43	2.68	2.89	3.11	3.37	3.71	4.09	4.53	5.06	5.69	6.43	57
43	0.90	1.35	1.72	2.04	2.31	2.56	2.83	3.05	3.29	3.57	3.95	4.37	4.88	5.48	6.19	7.04	58
44	0.93	1.40	1.80	2.13	2.41	2.67	2.96	3.21	3.46	3.78	4.21	4.68	5.26	5.94	6.76	7.78	59

TABLE 2—Continued

ISSUE Age x	POLICY YEAR t															1,000 $_{t+15}$	ATTAINED Age x+15
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
45	0.98	1.47	1.88	2.23	2.53	2.80	3.11	3.38	3.66	4.01	4.49	5.03	5.68	6.45	7.38	8.58	60
46	1.03	1.56	1.99	2.36	2.68	2.97	3.30	3.59	3.89	4.28	4.82	5.41	6.13	7.00	8.04	9.37	61
47	1.12	1.69	2.15	2.54	2.88	3.20	3.55	3.86	4.19	4.60	5.19	5.84	6.63	7.59	8.73	10.09	62
48	1.25	1.88	2.40	2.83	3.20	3.53	3.91	4.23	4.57	5.01	5.63	6.31	7.16	8.17	9.40	10.79	63
49	1.42	2.13	2.71	3.19	3.59	3.96	4.36	4.69	5.04	5.49	6.13	6.84	7.71	8.77	10.05	11.52	64
50	1.60	2.40	3.04	3.57	4.01	4.40	4.83	5.18	5.53	5.99	6.66	7.40	8.30	9.42	10.76	12.44	65
51	1.76	2.63	3.34	3.91	4.38	4.80	5.26	5.62	5.99	6.48	7.19	7.98	8.97	10.17	11.64	13.54	66
52	1.88	2.81	3.55	4.15	4.64	5.07	5.56	5.95	6.35	6.90	7.70	8.59	9.71	11.09	12.76	14.77	67
53	1.93	2.85	3.58	4.18	4.68	5.12	5.65	6.08	6.54	7.18	8.11	9.17	10.49	12.10	14.06	16.27	68
54	1.93	2.80	3.49	4.05	4.54	4.99	5.56	6.05	6.60	7.35	8.46	9.72	11.28	13.19	15.49	17.98	69
55	1.92	2.73	3.38	3.91	4.38	4.84	5.45	6.00	6.64	7.53	8.82	10.32	12.17	14.43	17.14	20.05	70
56	1.92	2.74	3.38	3.90	4.37	4.83	5.48	6.07	6.79	7.81	9.31	11.06	13.24	15.90	19.11	22.64	71
57	1.98	2.92	3.62	4.18	4.65	5.12	5.81	6.41	7.17	8.29	10.01	12.03	14.56	17.69	21.49	26.04	72
58	2.10	3.29	4.16	4.80	5.30	5.77	6.49	7.08	7.83	9.02	10.96	13.25	16.17	19.84	24.34	29.98	73
59	2.26	3.82	4.91	5.67	6.22	6.69	7.44	7.98	8.68	9.93	12.08	14.65	18.01	22.28	27.59	34.51	74
60	2.45	4.43	5.79	6.69	7.30	7.76	8.54	9.02	9.67	10.95	13.35	16.22	20.04	24.98	31.17	39.06	75
61	2.65	5.06	6.70	7.76	8.42	8.87	9.69	10.11	10.71	12.05	14.70	17.91	22.23	27.87	35.00	43.74	76
62	2.86	5.67	7.56	8.75	9.46	9.92	10.79	11.17	11.75	13.17	16.11	19.68	24.54	30.92	39.02	49.09	77
63	3.09	6.32	8.48	9.82	10.59	11.05	11.97	12.32	12.87	14.38	17.63	21.59	27.02	34.18	43.33	54.79	78
64	3.33	6.97	9.38	10.85	11.68	12.15	13.13	13.46	14.00	15.63	19.21	23.59	29.63	37.61	47.84	60.39	79
65	3.58	7.58	10.22	11.82	12.70	13.18	14.23	14.56	15.13	16.91	20.85	25.68	32.36	41.20	52.53	66.05	80
66	3.83	8.14	10.98	12.69	13.61	14.12	15.25	15.60	16.23	18.18	22.52	27.84	35.19	44.93	57.39	72.30	81
67	4.08	8.64	11.62	13.41	14.38	14.91	16.14	16.54	17.27	19.45	24.22	30.07	38.12	48.77	62.39	79.36	82
68	4.49	9.55	12.96	15.14	16.54	17.17	18.57	18.72	19.34	21.83	27.03	33.14	41.70	53.39	68.49	87.55	83
69	4.97	10.65	14.64	17.42	19.04	19.76	21.02	20.97	21.70	24.36	29.80	36.25	45.64	58.60	75.55	97.73	84

TABLE 2—Continued

ISSUE AGE x	POLICY YEAR t															1,000 <sub>t+15</sub>	ATTAINED AGE x+15
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
70	5.54	12.02	16.84	20.05	21.92	22.36	23.54	23.53	24.22	26.85	32.59	39.68	50.10	64.65	84.34	106.82	85
																114.83	86
																126.27	87
																139.82	88
																150.31	89
																166.59	90
																190.70	91
																210.42	92
																224.59	93
																234.21	94
																261.74	95
																329.62	96
																460.32	97
																676.30	98
																1,000.00	99

TABLE 3  
 MODIFIED 1965-70 SELECT AND ULTIMATE TABLE, MALE AND FEMALE LIVES COMBINED  
 AGE NEAREST BIRTHDAY  
 $1,000q_{[x]+t-1}$

Issue Age #	Policy Year t															1,000 $q_{[x]+15}$	Attained Age x+15																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																			
0	5.39	1.28	0.79	0.61	0.52	0.46	0.41	0.37	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25
1	1.28	0.79	0.61	0.52	0.46	0.41	0.37	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25	
2	0.79	0.61	0.52	0.46	0.41	0.37	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25		
3	0.61	0.52	0.46	0.41	0.37	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25			
4	0.52	0.46	0.41	0.37	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25				
5	0.46	0.41	0.37	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25					
6	0.41	0.37	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25						
7	0.37	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25							
8	0.34	0.31	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25								
9	0.31	0.30	0.29	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25								
10	0.30	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25										
11	0.29	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25											
12	0.32	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25												
13	0.39	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25													
14	0.47	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25														
15	0.57	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25															
16	0.68	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																
17	0.80	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																	
18	0.92	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																		
19	1.01	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																			
20	1.07	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																				
21	1.09	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																					
22	1.08	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																						
23	1.07	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																							
24	1.06	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																								
25	1.04	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																									
26	1.02	1.02	1.07	1.13	1.17	1.18	1.20	1.25																										
27	1.02	1.07	1.13	1.17	1.18	1.20	1.25																											
28	1.07	1.13	1.17	1.18	1.20	1.25																												
29	1.13	1.17	1.18	1.20	1.25																													
30	1.17	1.18	1.20	1.25																														
31	1.18	1.20	1.25																															
32	1.18	1.20	1.25																															
33	1.20	1.25																																
34	1.25																																	

TABLE 3—Continued

ISSUE AGE $x$	POLICY YEAR $t$															1,000 $z_{x+15}$	ATTAINED AGE $x+15$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
20	0.75	0.80	0.84	0.86	0.88	0.89	0.90	0.90	0.90	0.92	0.95	0.99	1.04	1.12	1.21	1.32	35
21	0.70	0.75	0.78	0.81	0.82	0.83	0.85	0.86	0.87	0.89	0.94	0.99	1.06	1.15	1.27	1.42	36
22	0.67	0.71	0.75	0.77	0.79	0.80	0.82	0.84	0.86	0.88	0.95	1.02	1.11	1.23	1.37	1.54	37
23	0.64	0.68	0.72	0.74	0.76	0.78	0.81	0.84	0.88	0.92	1.00	1.09	1.20	1.33	1.50	1.68	38
24	0.61	0.65	0.69	0.71	0.74	0.77	0.82	0.86	0.91	0.97	1.07	1.17	1.30	1.46	1.65	1.85	39
25	0.58	0.62	0.66	0.70	0.73	0.77	0.83	0.89	0.95	1.04	1.15	1.28	1.44	1.62	1.83	2.07	40
26	0.56	0.61	0.65	0.69	0.74	0.79	0.86	0.94	1.02	1.13	1.26	1.42	1.59	1.80	2.04	2.31	41
27	0.56	0.60	0.65	0.70	0.76	0.83	0.92	1.01	1.11	1.24	1.40	1.58	1.78	2.01	2.27	2.57	42
28	0.58	0.62	0.68	0.74	0.81	0.89	0.99	1.10	1.23	1.38	1.56	1.76	1.99	2.25	2.53	2.86	43
29	0.61	0.66	0.72	0.79	0.87	0.97	1.09	1.22	1.37	1.55	1.75	1.98	2.23	2.51	2.82	3.19	44
30	0.65	0.70	0.77	0.85	0.95	1.07	1.21	1.36	1.54	1.74	1.96	2.22	2.49	2.80	3.13	3.54	45
31	0.69	0.76	0.83	0.93	1.04	1.18	1.34	1.52	1.72	1.94	2.20	2.48	2.78	3.12	3.48	3.91	46
32	0.73	0.81	0.90	1.02	1.15	1.31	1.49	1.69	1.92	2.17	2.45	2.76	3.10	3.47	3.88	4.31	47
33	0.75	0.85	0.97	1.11	1.27	1.45	1.65	1.88	2.13	2.41	2.72	3.07	3.44	3.85	4.30	4.77	48
34	0.76	0.90	1.05	1.21	1.39	1.60	1.83	2.08	2.35	2.66	3.01	3.39	3.80	4.26	4.76	5.31	49
35	0.78	0.95	1.13	1.33	1.54	1.76	2.02	2.30	2.60	2.93	3.32	3.73	4.19	4.70	5.26	5.91	50
36	0.80	1.02	1.23	1.46	1.70	1.95	2.24	2.54	2.86	3.23	3.66	4.12	4.63	5.19	5.82	6.55	51
37	0.85	1.10	1.35	1.61	1.88	2.16	2.48	2.81	3.16	3.57	4.04	4.55	5.11	5.74	6.44	7.22	52
38	0.92	1.21	1.49	1.78	2.08	2.39	2.74	3.10	3.50	3.94	4.46	5.02	5.65	6.35	7.13	7.96	53
39	1.01	1.33	1.64	1.96	2.29	2.64	3.03	3.43	3.86	4.35	4.92	5.54	6.24	7.01	7.87	8.76	54
40	1.11	1.46	1.81	2.16	2.52	2.91	3.34	3.77	4.25	4.79	5.42	6.10	6.87	7.72	8.68	9.67	55
41	1.21	1.61	2.00	2.39	2.78	3.20	3.67	4.14	4.66	5.25	5.94	6.70	7.54	8.49	9.55	10.71	56
42	1.32	1.77	2.21	2.63	3.06	3.51	4.02	4.53	5.09	5.73	6.49	7.32	8.26	9.31	10.51	11.85	57
43	1.43	1.95	2.44	2.90	3.37	3.84	4.39	4.93	5.51	6.20	7.03	7.94	8.98	10.17	11.52	13.09	58
44	1.55	2.14	2.68	3.19	3.69	4.19	4.77	5.33	5.94	6.67	7.58	8.58	9.73	11.06	12.59	14.43	59

TABLE 3—Continued

ISSUE AGE $x$	POLICY YEAR $t$															$1,000Z_{x+15}$	ATTAINED AGE $x+15$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
45	1.67	2.35	2.95	3.50	4.03	4.56	5.17	5.76	6.40	7.18	8.16	9.25	10.53	12.01	13.74	15.83	60
46	1.80	2.57	3.24	3.84	4.41	4.97	5.63	6.24	6.92	7.74	8.81	10.01	11.42	13.07	15.01	17.32	61
47	1.92	2.80	3.55	4.22	4.83	5.44	6.14	6.79	7.51	8.39	9.57	10.87	12.43	14.27	16.43	18.95	62
48	2.04	3.04	3.89	4.63	5.31	5.97	6.73	7.43	8.19	9.15	10.43	11.86	13.57	15.60	18.00	20.75	63
49	2.16	3.30	4.26	5.09	5.84	6.56	7.39	8.14	8.96	9.99	11.38	12.94	14.81	17.04	19.68	22.73	64
50	2.28	3.57	4.65	5.57	6.40	7.18	8.09	8.90	9.78	10.89	12.41	14.11	16.15	18.60	21.51	24.90	65
51	2.41	3.84	5.04	6.05	6.96	7.81	8.80	9.68	10.63	11.84	13.50	15.35	17.59	20.28	23.48	27.27	66
52	2.56	4.12	5.42	6.53	7.51	8.43	9.51	10.46	11.49	12.81	14.63	16.67	19.14	22.10	25.63	29.79	67
53	2.72	4.39	5.77	6.95	8.00	8.99	10.15	11.18	12.31	13.75	15.75	17.99	20.71	23.97	27.86	32.46	68
54	2.87	4.64	6.10	7.35	8.45	9.51	10.76	11.87	13.09	14.67	16.86	19.33	22.31	25.90	30.18	35.15	69
55	3.05	4.90	6.44	7.75	8.93	10.05	11.39	12.60	13.93	15.66	18.06	20.77	24.05	28.00	32.70	38.03	70
56	3.26	5.21	6.84	8.22	9.47	10.68	12.13	13.44	14.90	16.81	19.44	22.42	26.03	30.36	35.53	41.52	71
57	3.51	5.59	7.32	8.80	10.14	11.45	13.03	14.48	16.09	18.19	21.09	24.37	28.34	33.11	38.79	45.47	72
58	3.80	6.02	7.87	9.48	10.94	12.37	14.11	15.71	17.51	19.83	23.03	26.64	31.01	36.24	42.46	49.77	73
59	4.10	6.49	8.49	10.23	11.83	13.41	15.33	17.10	19.10	21.68	25.19	29.16	33.95	39.68	46.46	54.53	74
60	4.46	7.01	9.17	11.05	12.81	14.54	16.66	18.63	20.85	23.69	27.55	31.92	37.16	43.42	50.82	59.65	75
61	4.87	7.61	9.93	11.97	13.88	15.78	18.10	20.27	22.72	25.86	30.10	34.88	40.63	47.48	55.57	65.15	76
62	5.37	8.30	10.80	12.99	15.05	17.11	19.63	22.01	24.70	28.14	32.79	38.04	44.35	51.87	60.75	71.13	77
63	5.92	9.07	11.74	14.10	16.32	18.55	21.28	23.87	26.81	30.57	35.66	41.42	48.34	56.58	66.30	77.55	78
64	6.55	9.92	12.78	15.31	17.68	20.08	23.04	25.84	29.03	33.14	38.70	45.00	52.58	61.61	72.27	84.47	79
65	7.27	10.87	13.92	16.61	19.14	21.70	24.89	27.91	31.35	35.82	41.88	48.77	57.06	66.96	78.66	91.99	80
66	8.07	11.92	15.17	18.02	20.70	23.42	26.83	30.06	33.77	38.61	45.21	52.53	61.80	72.64	85.48	100.12	81
67	8.97	13.09	16.53	19.54	22.36	25.23	28.87	32.31	36.28	41.49	48.68	56.86	66.78	78.66	92.74	109.27	82
68	9.77	14.17	17.88	21.33	24.49	27.62	31.63	35.34	39.62	45.30	53.07	61.94	72.72	85.61	101.22	118.87	83
69	10.58	15.33	19.52	23.36	26.81	30.26	34.60	38.60	43.26	49.39	57.81	67.45	79.15	93.43	110.11	129.34	84

TABLE 3—Continued

ISSUE AGE x	POLICY YEAR t															1,000 <sub>02x+15</sub>	ATTAINED AGE x+15
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
70	11.45	16.74	21.38	25.57	29.37	33.10	37.78	42.14	47.17	53.80	62.95	73.41	86.38	101.64	119.81	140.38	85
																151.68	86
																164.01	87
																176.49	88
																186.47	89
																194.68	90
																203.36	91
																212.61	92
																225.12	93
																238.99	94
																273.40	95
																347.53	96
																480.55	97
																691.65	98
																1,000.00	99

fifteen-year select period is too short for the higher issue ages. When and if the Mortality Committee switches from IBM cards to tape, I think it should request such contributions on a twenty-year select and ultimate basis

3. I do not agree that the 70 and over issue-age group is comprised chiefly of age 70 entrants, since many of the contributing companies publish premium rates to age 75 and generally will allow policies to be issued by special request at even higher ages. Also, since 1975 the Mortality Committee's instructions to the contributing companies have requested that select data be furnished separately for issue-age groups 70-74 and 75 and over.

4. I fail to understand why it was considered necessary to regrade the ratios of the select to ultimate mortality rates. By smoothing out these ratios, significant increases have been made in the select mortality rates at the longer durations, especially for the higher issue ages. The original 1965-70 Select Tables produced good tests of fit at each of the fifteen durations. For example, the ratio of actual to tabular claims at duration fifteen for all age groups combined was 99.6 percent for males and females combined, 98.4 percent for males, and 97.6 percent for females. By increasing artificially the graduated mortality rates at the longer durations, the ratios of actual to tabular such as those shown above are reduced significantly, that is, the ratios are moved farther away from 100 percent. A good graduation requires some compromise between fit and smoothness, but if I had to make the choice I generally would prefer a table that fits the experience well.

5. The mortality rates on the age-last-birthday basis were calculated using an approach similar to that followed in the construction of the 1958 CSO Table (Age Last Birthday). It would have been more consistent to use the same method as was used for the age-nearest-birthday basis, that is, taking the Mortality Committee's 1965-70 Age Last Birthday Basic Tables as the starting point. (The 1965-70 Age Last Birthday Basic Tables were published in *TSA, 1974 Reports*, pp. 57-62.)

RONALD R. WEGNER:

In his actuarial note Mr. Green has certainly provided us with an adequate method of developing Modified 1965-70 Select and Ultimate Basic Tables. One important area, I believe, requires additional discussion: the mortality rates for ages 0-14.

For these ages, the author has used the same premise as was assumed by the Society's Committee on Mortality in developing the 1965-70 Basic Tables, that is, that "there is no material selection process at these



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ages." As a result, the author has adopted the rates developed by the committee without modification.

However, the comparison shown in the accompanying table between the rates in the 1965-70 Basic Table and the 1959-62 Juvenile Extension Table (*TSA, 1963 Reports*) raises some questions concerning the develop-

ISSUE AGE	MORTALITY RATES PER 1,000— MALE—AGE NEAREST BIRTHDAY		
	1965-70 Basic Table (1)	1959-62 Juvenile Table (2)	(1)÷(2) (3)
0	5 80	1 85	313 5%
1	1 33	0 86	154 7
5	0 48	0 49	98 0
10	0 31	0 27	114 8
14	0 52	0 64	81 3

ment of the juvenile mortality rates for this age group. Why are there such large differences in the rates? One reason, as the Society's Committee on Mortality has noted, is that exposure at the juvenile ages is small and fluctuations are likely. Another possible source for the differences could lie in the way the committee developed the juvenile rates. As the committee noted in developing the 1959-62 Juvenile Extension of the 1955-60 Basic Tables, most of the exposure at these juvenile ages was originally issued on a nonmedical basis. Because of this and the limited amount of available data, the juvenile rates were developed by combining both medical and nonmedical issues. However, in deriving the 1965-70 rates for juvenile ages, only medical issues were used.

In his study note *Juvenile Insurance*, Julius Vogel points out that juvenile insurance is for the most part issued nonmedically. He explains that for juveniles medical examinations do not provide enough significant information to warrant the extra cost. Thus, since medicals generally would be ordered only where suspicion exists, there is a strong likelihood that an insured child who was given a medical might have been a sub-standard risk even though the policy was issued standard. Mr. Vogel's study note also states that "presumably a fair number of the medical examinations required on the juvenile issues were 'judgment' medicals used to check out the possible significance of a history that could not be cleared up by an attending physician's statement, rather than routine

medicals called for automatically by the company's age and amount rules" If this is the practice, it is not unreasonable to conclude that medically issued juvenile policies will have higher mortality than non-medical policies.

One of the major purposes of a Modified 1965-70 Mortality Table is for use in pricing life insurance products, where accurate mortality experience is a necessity. For this reason, and in light of the questions raised above, I believe that both medical and nonmedical experience should be used in developing juvenile mortality rates.

A 1965-70 Modified Juvenile Extension can be developed by combining on an attained-age basis the medical and nonmedical experience from the *TSA Reports* and applying a Whittaker-Henderson Type B formula to the actual and expected deaths. The following is a comparison, for selected ages, of the resulting rates:

ISSUE AGE	MORTALITY RATES PER 1,000— MALE—AGE NEAREST BIRTHDAY		
	1965-70 Modified Juvenile Extension*	1959-62 Juvenile Table	(1) ÷ (2)
	(1)	(2)	(3)
0	1 84	1 85	99 5%
1	0 74	0 86	86 0
5	0 43	0 49	87 8
10	0 29	0 27	107 4
14	0 61	0 64	95 3

\* Constants used were  $k = 50$  and  $z = 4$ , using the Greville notation found in the Society's current study note on graduation

The 1965-70 Modified Juvenile Extension mortality rates shown above appear reasonable and are derived from the most relevant experience base for this age group. The complete tables are given in Table 1 of this discussion.

TABLE 1  
1965-70 MODIFIED JUVENILE EXTENSION TABLES  
1,000 $q_x$

ATTAINED AGE	AGE NEAREST BIRTHDAY			AGE LAST BIRTHDAY		
	Male	Female	Combined	Male	Female	Combined
0	1.84	1.33	1.65	1.47*	1.03*	1.31*
1	0.74	0.43	0.63	0.67	0.42	0.58
2	0.59	0.41	0.53	0.55	0.39	0.51
3	0.50	0.37	0.48	0.48	0.36	0.46
4	0.45	0.34	0.44	0.44	0.33	0.43
5	0.43	0.31	0.42	0.42	0.30	0.40
6	0.41	0.28	0.38	0.39	0.27	0.36
7	0.37	0.26	0.33	0.35	0.25	0.31
8	0.32	0.24	0.28	0.31	0.24	0.27
9	0.29	0.23	0.25	0.29	0.23	0.25
10	0.29	0.23	0.24	0.34	0.26	0.29
11	0.38	0.28	0.33	0.42	0.29	0.37
12	0.46	0.30	0.40	0.50	0.31	0.44
13	0.54	0.32	0.47	0.58	0.33	0.50
14	0.61	0.34	0.52	0.64	0.35	0.55

\* Computed as  $\frac{2}{3}q_0 + \frac{1}{3}q_1$  (to allow for skew distribution of issues)

(AUTHOR'S REVIEW OF DISCUSSION)

O. DAVID GREEN III:

It is appropriate to begin these remarks with thanks to the discussants, for they, through the variety of their remarks, have shown the type of concern that must be felt by anyone using these tables.

Mr. Paquin has noted properly that the tables are now a "quotable source," which was one of the reasons why the paper was offered. I am grateful that Mr. Paquin spared me the task of comparing his tables with mine—and gratified that the results were close.

Having prepared his own tables, Mr. Strunk raises several questions about the mechanics used to develop the tables presented in the paper. First, the two intervening durations between 1 and 15 vary with the central age; the choice was based on the degree of smoothness and fit that emerged when the intervening values were obtained by interpolation. Second, the interpolation formula was one of the Lagrangian family (five-point).

The steps employed by Mr. Strunk are quite acceptable, although I would question the averaging of certain durational values for additional smoothness (steps 4 and 5) without (1) testing for smoothness and (2) selecting the durations to be averaged based on some tests of smoothness and fit.

Mr. Huber's discussion deals with the fundamental reason this project was undertaken. It is well accepted that the 1965-70 Basic Tables were not intended for the development of gross or GAAP premiums. The caveats at the conclusion of this paper caution the user to introduce an appropriate contingency margin based on the intended usage. But without the 1965-70 Basic Tables or these Modified 1965-70 Select and Ultimate Basic Tables, where would the smaller companies turn for current experience tables? Because of the inherent statistical gyrations, any tables they might develop based on their own data might be less representative than these industry tables.

Our work requires a blend of technical accuracy with practical simplicity. Consider the problems of explaining an asset share study to an individual not wholly familiar with our work. If we use mortality rates that do not grade rather smoothly, the results will be questioned. As actuaries, we realize the implications of the imperfect results based on a smoothed mortality scale. Even if the first results are more palatable because the mortality pattern is a closer representation of the underlying experience, we know very well that the actual results will not be in full agreement with our mathematical model in any event. We strive for a close approximation, or at least this should be our aim. Incidentally, we might point out that the merging of the select and ultimate scales does introduce a contingency margin in the later select durations at the higher issue ages.

Since actuaries tend to move quickly in those areas of importance to themselves, I suggest that the Committee on Mortality under Ordinary Insurance and Annuities introduce age-nearest-birthday and age-last-birthday tables at the same time.

Mr. Wegner's arguments about the juvenile mortality rates are well founded. The choice of a proper  $q_{[0]}$  is important. The value presented in Table 1 (Male-Age Nearest Birthday) is 0.00580; the value suggested by Mr. Wegner is 0.00184. This difference of 0.00396 would be most significant in the pricing of a product to a male child aged 0. The differences at the other juvenile ages are not as significant. Even so, Mr. Wegner's theory should be considered when gross premiums for juveniles are developed.

The Society in its *Requirements for Admission* cautions that "the discussions of papers are an essential part of the reading." Claude Paquin, Carl Strunk, Thomas Huber, and Ronald Wegner are due the collective thanks of all Society members for their theoretical and practical contributions. I have the personal privilege of being able to thank them directly.

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