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1971 EXPERIENCE MODIFICATION OF THE 1964 COMMISSIONERS DISABILITY TABLE

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ABSTRACT

This paper seeks to bring to the profession a disability continuance table sufficiently based on recent industry individual policy experience to render it suitable as a standard for expected claims and for adjusted earnings purposes. Until now, the only general continuance table available and not totally obsolete has been the 1964 Commissioners Disability Table. Since that table was constructed for valuation purposes only, it is entirely unsatisfactory as an expected claim standard: reasonably simple modifications of the table (such as a constant percentage) will not produce claim cost configurations even remotely consistent with recent experience, particularly in relation to varying elimination periods.

Even the table presented here remains a "modification" of the 1964 Table. It relies on data presented in the 1969 and 1971 reports of the Committee on Experience under Individual Health Insurance for construction of the first two years of continuance. Extension of the continuance beyond two years falls back on the 1964 Table, using extrapolated ratios to the 1964 Table number of lives disabled which are based on the ratios of the one-year experience values to the corresponding 1964 Table values.

It was found necessary to construct separate male and female tables. The female experience data in the 1969 and 1971 committee reports are too disparate from the male data for any modification of the male table to suffice as a satisfactory approximation of female morbidity. The female experience costs soar far above the male costs in the 30–50 age range, and the ratios tend to rise even higher for longer elimination periods. Above age 50 the ratios fall off sharply, and above age 60 the female costs actually fall below the male costs. This general pattern is roughly consistent with the relation of female to male hospital and medical expense costs and suggests that the high incidence of female disorders in the 30–50 age range has an even more pronounced effect on disability costs than it does on hospital and medical costs.

A final and possibly very significant by-product of the "1971 Table" here presented is an analysis of disabled life reserve values, which suggests that the 1964 Table, a conservative standard for active life reserves, may be, at some durations at least, a seriously deficient standard for disabled life reserves.

OVER the past several years there has been an increasing need for a disability continuance table suitable for gross premium and natural reserve use. In spite of the fact that the 1964 Commissioners Disability Table (hereinafter called the "1964 Table") was developed solely for valuation purposes, it has frequently been relied upon, with varying degrees of modification, for gross premium work, precisely because of the lack of any other table better suited to the purpose.

Recent disability experience data have been available to the profession through the reports of the Committee on Experience under Individual Health Insurance Policies, but the data published have been limited to only a few benefit periods of relatively short term and thus have been of extremely limited application in the derivation of gross premiums or natural reserves for long-term benefits or for widely varying plans of coverage.

The recent attention to adjusted earnings has further spotlighted the vacuum that exists. It has been generally recognized that no appropriate, experience-based industry table is available which can serve as a reasonable basis for expected claims in natural reserve calculations. Here again, the 1964 Table has remained the only general continuance table available and must usually be subjected to considerable modification to render it even marginally satisfactory for the purpose.

What is badly needed, accordingly, is a new continuance table which is based, as fully as possible, on recent industry experience. It is the author's conviction that construction of such a table, even though necessarily limited in its "credibility" by the limited range of the published data, would nevertheless serve a valuable purpose as a usable basis for natural reserve expected claims as well as for gross premium work. The proper source of the experience data for such a table is unquestionably the committee reports; even though, as mentioned before, these published data have severe limitations and any continuance table based upon them is consequently subject to considerable qualification, the need for such a table seems sufficiently acute that the job should be undertaken.

It is the purpose of this paper to present such a table and to investigate certain areas related to its possible uses, such as the testing of disabled life claim reserves. Because of the particular sources and methods employed in its construction, I have thought best to identify it as the "1971 Experience Modification of the 1964 Commissioners Disability Table" (hereinafter called the "1971 Table").

I. SOURCES OF DATA USED

The specific sources of recent experience data employed in construction of the table are the 1969 and 1971 loss-of-time reports of the Committee on Experience under Individual Health Policies (*TSA*, *1969 Reports*, pp. 63–81, and *1971 Reports*, pp. 113–32), which present experience under individual loss-of-time policies reported for the years 1966–69. Tables 8–10 of the 1971 report, which show the 1966–67 and 1968–69 experience compared with earlier two-year periods, indicate that experience of this four-year period was modestly more favorable than the composite experience over the eight-year period 1962–69; hence it must be recognized that the table is based on a relatively favorable recent experience period.

While it would have been possible to use earlier committee reports to expand the volume of part of the data used, these earlier data are not broken out as fully as those in the 1969 and 1971 reports (for example, the experience of the second year of the benefit period). It was the author's judgment that for consistency it would be preferable to rely only on use of the 1969 and 1971 reports data.

The specific data in the 1969 and 1971 reports used for construction of the table were the Male and Female Occupation Group I data in Table 5 of each report and the Male Occupation Group I data in Table 12 in the 1971 report. These data have been combined and are shown in Table 1 of this paper.

These reported data are limited to the first two years of disability, Table 5 showing data for the first benefit year and Table 12 providing data for the second benefit year. In order to construct a complete continuance table, it was consequently necessary to find recourse to some other basis for that portion of the table extending beyond the second benefit year; it was the author's judgment that the best source available here continues to be the 1964 Table, which, in turn, uses, as its own ultimate source for long-term data, the 1952 Disability Study.

Accordingly, number of lives, disabled values, and claim cost values for the first two years of disability were derived from the data in Table 1, which, as mentioned, combines the 1966–69 industry experience from the 1969 and 1971 reports. For this purpose, the data for each ten-year age group were assumed to relate to a central age exactly in the middle (e.g., age 24.5 for age group 20–29), and quinquennial central age values were then obtained by 4-point Karup-King interpolation. Then the 1964 Table was used to extrapolate values for the number of lives disabled as of the twenty-fourth and later months. The resulting table of basic starting values is shown as Table 1A of this paper.

TABLE 1

COMPOSITE OF EXPERIENCE FROM 1969 AND 1971 REPORTS (1966–67 AND 1968–69 EXPERIENCE)
MALE OCCUPATIONAL GROUP I—TOTAL (ACCIDENT AND SICKNESS)
DISABILITY LOSS-OF-TIME EXPERIENCE

AGE GROUP	1969 REPORT			1971 REPORT			COMPOSITE EXPOSURE	COMBINED 1969–71		
	No. Claims	Annual Claim Rate	Annual Claim Cost*	No. Claims	Annual Claim Rate	Annual Claim Cost*		No. Claims	Annual Claim Rate	Annual Claim Cost*
	I. First Year of Benefit Period (Table 5—1969 and 1971 Reports)									
0-day elimination:										
20–29	727	0.172	0.133	712	0.204	0.178	7,716.9	1,439	0.186	0.153
30–39	2,274	0.158	0.148	1,881	0.154	0.130	26,606.7	4,155	0.156	0.140
40–49	4,455	0.160	0.171	3,207	0.153	0.172	48,804.5	7,662	0.157	0.171
50–59	6,881	0.187	0.278	5,307	0.177	0.283	66,779.8	12,188	0.183	0.280
60–69	4,435	0.208	0.386	3,703	0.185	0.373	41,338.3	8,138	0.197	0.380
7-day elimination:										
20–29	857	0.078	0.089	865	0.070	0.084	23,344.3	1,722	0.074	0.086
30–39	2,589	0.080	0.104	2,401	0.079	0.115	62,754.9	4,990	0.080	0.109
40–49	4,555	0.096	0.152	3,616	0.089	0.154	88,077.1	8,171	0.093	0.153
50–59	5,111	0.126	0.250	4,456	0.119	0.236	78,008.9	9,567	0.123	0.243
60–69	1,779	0.148	0.379	1,746	0.140	0.392	24,491.7	3,525	0.144	0.386
14-day elimination:										
20–29	164	0.037	0.058	160	0.030	0.050	9,765.8	324	0.033	0.054
30–39	630	0.039	0.061	465	0.037	0.057	28,721.4	1,095	0.038	0.059
40–49	1,173	0.055	0.099	750	0.054	0.113	35,216.2	1,923	0.055	0.105
50–59	1,044	0.085	0.188	818	0.083	0.211	22,137.8	1,862	0.084	0.198
60–69	298	0.109	0.308	286	0.102	0.322	5,537.9	584	0.105	0.315

* Per $1 monthly.

TABLE 1—*Continued*

Age Group	1969 Report			1971 Report			Composite Exposure	Combined 1969–71		
	No. Claims	Annual Claim Rate	Annual Claim Cost*	No. Claims	Annual Claim Rate	Annual Claim Cost*		No. Claims	Annual Claim Rate	Annual Claim Cost*
	I. First Year of Benefit Period (Table 5—1969 and 1971 Reports)—*Continued*									
30-day elimination:										
20–29	107	0.009	0.019	136	0.009	0.016	27,000.0	243	0.009	0.017
30–39	649	0.011	0.023	653	0.013	0.028	109,230.8	1,302	0.012	0.025
40–49	1,218	0.020	0.049	1,064	0.021	0.056	111,566.7	2,282	0.020	0.052
50–59	1,096	0.040	0.116	1,010	0.039	0.110	53,297.4	2,106	0.040	0.113
60–69	269	0.062	0.233	382	0.072	0.283	9,644.3	643	0.067	0.261
	II. Second Year of Benefit Period—0:7-Day Elimination Only (Table 12—1971 Report)									
20–29								20	0.00105	0.0099
30–39								73	0.00113	0.0110
40–49								137	0.00183	0.0164
50–59								214	0.00439	0.0429
60–69								114	0.00877	0.0897

* Per $1 monthly.

TABLE 1A—BASIC VALUES USED TO CONSTRUCT 1971 MODIFICATION OF 1964 COMMISSIONERS DISABILITY TABLE (MALE LIVES)

A. NUMBER DISABLED AT VARIOUS DURATIONS, PER 100,000 LIVES EXPOSED AT EACH AGE

(Durations up to 12 Months Derived by Interpolation from Table 1 Elimination Period Claim Rates; Durations after 12 Months Modified, for Continuity, from 1964 Table)

AGE AT DISABLEMENT	DURATION (MONTHS)									
	0	0.233 (7 Days)	0.467 (14 Days)	1	12.1	24	36	60	120	180
22	18,900	7,300	3,200	840	103	70	53	36	21	16
27	18,000	7,500	3,400	960	105	73	55	40	26	19
32	16,200	7,800	3,600	1,090	107	75	58	45	30	22
37	15,300	8,200	4,100	1,340	122	89	71	55	38	29
42	15,400	8,800	5,000	1,700	151	113	94	76	53	41
47	16,200	9,900	6,100	2,370	226	178	150	122	87	65
52	17,500	11,400	7,600	3,330	346	282	246	203	141	100
57	19,100	13,200	9,200	4,800	489	417	364	300	197	129
62	20,400	15,000	10,800	6,700	877	759	667	546	335	195
67	22,300	17,600	13,400	9,380	1,660	1,448	1,300	1,036	597	290
72	24,100	20,500	16,800	12,600	3,510	3,111	2,797	2,225	1,090	377

B. ANNUAL CLAIM COST PER EACH $1 MONTHLY BENEFIT

(Derived by Interpolation from Table 1 Annual Claim Costs)

AGE AT DISABLEMENT	ELIMINATION/MAXIMUM IN MONTHS				
	0/12	0.233/12	0.467/12	1/12	12.1/12 (Second Year of Benefit Period after 0.7-Day Elimination)
22	0.1550	0.0829	0.0529	0.0155	0.0097
27	0.1490	0.0902	0.0542	0.0183	0.0101
32	0.1400	0.1010	0.0548	0.0216	0.0104
37	0.1430	0.1170	0.0665	0.0296	0.0116
42	0.1570	0.1380	0.0892	0.0424	0.0135
47	0.1920	0.1710	0.1230	0.0619	0.0209
52	0.2480	0.2150	0.1690	0.0881	0.0338
57	0.3130	0.2770	0.2330	0.1500	0.0538
62	0.4000	0.3650	0.3150	0.2610	0.0897
67	0.4750	0.4460	0.4080	0.3540	0.1170
72	0.5750	0.5450	0.5140	0.4700	0.1630

The manner of extrapolating the number of lives disabled, using the 1964 Table, was to determine the ratio of the numbers disabled at 12.1 months[1] as determined from the "annual claim rate" for the second year of the benefit period in Table 1 to corresponding numbers disabled according to the 1964 Table, and then to extrapolate these ratios. The male 12.1-month ratios and their extrapolations for longer durations were as shown in the accompanying tabulation, the ratios being expressed as percentages.

ASSUMED RATIOS (PER CENT) OF NUMBER DISABLED ACCORDING TO 1971 TABLE (MALE LIVES) TO NUMBER DISABLED ACCORDING TO 1964 TABLE

Age at Disablement	Duration (Months)					
	12.1	24	36	60	120	180
22	137	137	136	135	134	133
27	142	140	138	137	136	135
32	118	115	115	115	116	116
37	103	102	101	100	100	100
42	88	88	88	89	89	89
47	80	81	81	82	83	84
52	75	76	77	78	79	80
57	58	59	59	60	60	60
62	59	59	59	60	60	60
67	58	58	59	59	60	61
72	61	61	62	63	65	66

This extrapolation is purely a matter of rather arbitrary judgment on the part of the author, and only the development of actual credible industry long-term experience will tell how well this judgment has been exercised. Meanwhile, it appears prudent to maintain a measure of consistency with the 1964 Table on some basis such as this.

Table 1A, as thus developed, was then used to construct the 1971 Table for male lives, using the methods described in the Appendix and shown, in basic functional form, in Table A8 of the Appendix. It should be emphasized that Table 1A does not give values from the 1971 Table but is rather the set of values to which the mathematically graduated table is made to conform to the extent reasonably possible and practical. Table A10 of the Appendix gives actual 1971 Table values for males.

Since that portion of the 1971 Table extending beyond 24 months de-

[1] This is intended to approximate the fact that the data in the reports for the second year of the benefit period are based on data from the 0-day accident, 7-day sickness elimination period.

pends on the 1964 Table, it is of course a "hybrid" table, somewhat similar in this respect to the Conference Modification of the 1926 Class (3) Disability Table. Accordingly, it seems appropriate to identify it as a "modification" of the 1964 Table.

The very first trial attempts to construct continuance tables from the data in Table 1A disclosed the fact that it was completely impossible to fit a single continuance, even remotely, to all the data for one given age at disablement. The problem lies with the data for each successive elimination period, and the differences are absolutely startling. For example, if at age 27 a trial continuance table is constructed that reproduces the 7-day elimination period rate of claim and claim costs for the first and second years of the benefit period, it will be found that the 30-day elimination period rate of claim calculated from such a table will range in excess of 500 per cent of the actual Table 1A value, while the 30-day elimination–first-year benefit period claim cost will exceed 200 per cent of the Table 1A value. No amount of manipulation of trial functions appears to be sufficient to bring these disparate results into correspondence, and one is forced very rapidly to the conclusion that variable tables are required, the variation being by elimination period. The necessity for a variable continuance, however, is most pronounced at the youngest ages, and the need for varying tables in fact disappears entirely at the highest ages of 67 and 72.

Accordingly, the 1971 Table is a variable table, but the method adopted to accomplish this is a very convenient and simple one. The precise technique is described in the Appendix. In effect, the 1971 Table is a different table for each elimination period from 0 day up to 37 days, at which point it becomes (rather arbitrarily, because of the lack of experience data for longer elimination periods) a fixed table for longer elimination periods.

II. CLAIM COST VALUES CALCULATED FROM THE 1971 TABLE

Table 2 shows annual claim costs for various elimination period–benefit period combinations as calculated from the 1971 Table (male lives), using rates of interest of 3 and 5 per cent. In order to show the startling degree of variation in the table by elimination period, several comparative values are shown for the 14-, 30-, and 90-day elimination periods, calculated with the function constants "frozen" at the values appropriate for the 7-day elimination period.

Table 3 provides comparisons between claim costs calculated from the 1971 Table functions and the original Table 1 costs obtained from data in the 1969 and 1971 reports. The comparison is very close, of course, for the 7-day and 30-day values, but inspection of the comparative 0-day elimina-

TABLE 2

1971 EXPERIENCE MODIFICATION OF 1964 COMMISSIONERS DISABILITY TABLE (MALES)

(Values of $S_x^{t/T}$ for Selected Elimination Periods [t] and Maximum Periods [T] at 3 and 5 Per Cent Interest; t and T in Months; 0.233 = 7 Days, 0.467 = 14 Days; Benefit = $10 Monthly)

Age	0/3	0/6	0/12	0/15	0/24	0/60	0.233/3	0.233/6	0.233/12	0.233/15	0.233/24	0.233/60	0.233/120	0.233/ Age 60	0.233/ Age 65	0.233/ Lifetime
	a) 3% Interest															
17	1.497	1.706	1.834	1.869	1.940	2.091	0.625	0.709	0.783	0.809	0.871	1.017	1.141	1.403	1.423	1.517
22	1.366	1.559	1.675	1.707	1.776	1.930	0.661	0.753	0.830	0.857	0.920	1.072	1.205	1.482	1.509	1.638
27	1.374	1.566	1.677	1.708	1.778	1.940	0.723	0.824	0.905	0.933	0.999	1.160	1.308	1.610	1.651	1.848
32	1.525	1.752	1.871	1.903	1.973	2.140	0.821	0.941	1.028	1.057	1.124	1.290	1.452	1.759	1.820	2.118
37	1.411	1.650	1.786	1.822	1.903	2.109	0.914	1.068	1.169	1.201	1.278	1.482	1.692	2.000	2.088	2.491
42	1.521	1.801	1.954	1.994	2.090	2.363	1.065	1.259	1.377	1.413	1.505	1.777	2.071	2.350	2.484	2.986
47	1.745	2.102	2.311	2.371	2.518	2.958	1.273	1.531	1.701	1.757	1.900	2.339	2.815	2.985	3.249	4.036
52	2.029	2.499	2.819	2.916	3.155	3.874	1.518	1.872	2.139	2.229	2.461	3.176	3.965	3.614	4.246	5.770
57	2.336	2.915	3.339	3.483	3.859	5.009	1.887	2.366	2.751	2.891	3.264	4.410	5.569	3.480	5.073	7.171
62	2.619	3.393	4.069	4.309	4.935	6.916	2.284	2.990	3.637	3.874	4.496	6.472	8.549	0.000	4.859	10.178
67	3.032	3.932	4.827	5.193	6.216	9.567	2.699	3.540	4.418	4.783	5.803	9.147	12.643	0.000	0.000	15.076
72	3.016	4.063	5.848	6.697	9.098	16.724	2.584	3.606	5.385	6.232	8.628	16.234	23.393	0.000	0.000	26.754
	b) 5% Interest															
17	1.496	1.705	1.832	1.866	1.934	2.072	0.625	0.710*	0.783	0.809	0.868	1.001	1.106	1.308	1.322	1.387
22	1.366	1.558	1.673	1.705	1.771	1.912	0.661	0.754*	0.830	0.856	0.917	1.055	1.168	1.383	1.402	1.492
27	1.375*	1.568*	1.678*	1.709*	1.775	1.922	0.725*	0.827*	0.907*	0.934*	0.997	1.143	1.269	1.505	1.535	1.676
32	1.536*	1.765*	1.884*	1.915*	1.981*	2.131	0.831*	0.953*	1.040*	1.068*	1.132*	1.281	1.418	1.662	1.708	1.926
37	1.410	1.649	1.783	1.819	1.896	2.084	0.914	1.067	1.168	1.199	1.273	1.458	1.636	1.881	1.948	2.236
42	1.518	1.798	1.948	1.988	2.080	2.332	1.064	1.256	1.373	1.408	1.497	1.747	1.999	2.221	2.321	2.665
47	1.743	2.097	2.304	2.362	2.505	2.913	1.271	1.527	1.695	1.749	1.888	2.294	2.704	2.842	3.047	3.583
52	2.026	2.493	2.809	2.904	3.136	3.804	1.515	1.867	2.131	2.219	2.443	3.107	3.788	3.492	4.015	5.084
57	2.332	2.907	3.326	3.467	3.831	4.905	1.883	2.359	2.738	2.875	3.236	4.307	5.312	3.443	4.893	6.471
62	2.614	3.382	4.048	4.283	4.892	6.757	2.278	2.979	3.617	3.848	4.452	6.312	8.129	0.000	4.802	9.323
67	3.026	3.918	4.800	5.159	6.152	9.309	2.691	3.526	4.391	4.748	5.739	8.888	11.950	0.000	0.000	13.746
72	3.008	4.045	5.802	6.633	8.967	16.165	2.575	3.587	5.338	6.167	8.495	15.672	21.965	0.000	0.000	24.499

* These values, which should of course be slightly *less* than the corresponding 3 per cent values, reflect the approximate method of interest discounting.

TABLE 2—*Continued*

Age	0.467/6	0.467/12	0.467/12 (7 Day)	0.467/24	0.467/60	0.467/120	0.467/Age 60	0.467/Age 65	0.467/Life-time	1/6	1/12	1/12 (7 Day)	1/24	1/60	1/120	1/Age 60	1/Age 65	1/Life-time
	a) 3% Interest																	
17	0.272	0.334	0.636	0.420	0.565	0.688	0.950	0.970	1.064	0.084	0.143	0.431	0.227	0.370	0.493	0.754	0.774	0.867
22	0.343	0.408	0.684	0.496	0.646	0.779	1.056	1.083	1.211	0.097	0.157	0.471	0.243	0.392	0.524	0.799	0.827	0.955
27	0.415	0.484	0.753	0.577	0.737	0.884	1.186	1.227	1.424	0.122	0.187	0.522	0.277	0.435	0.582	0.883	0.924	1.121
32	0.488	0.563	0.865	0.658	0.823	0.985	1.292	1.353	1.651	0.158	0.228	0.609	0.321	0.484	0.645	0.951	1.012	1.310
37	0.671	0.754	0.999	0.859	1.062	1.271	1.579	1.667	2.069	0.229	0.297	0.724	0.398	0.599	0.807	1.114	1.202	1.605
42	0.860	0.957	1.192	1.081	1.352	1.645	1.924	2.057	2.560	0.346	0.421	0.881	0.541	0.809	1.102	1.378	1.512	2.014
47	1.097	1.241	1.493	1.435	1.872	2.348	2.516	2.780	3.567	0.498	0.614	1.133	0.803	1.237	1.710	1.875	2.139	2.927
52	1.386	1.616	1.901	1.928	2.640	3.428	3.074	3.706	5.231	0.687	0.873	1.486	1.175	1.882	2.667	2.307	2.939	4.464
57	1.912	2.267	2.475	2.774	3.918	5.074	2.982	4.575	6.673	1.177	1.488	1.980	1.986	3.122	4.272	2.173	3.766	5.864
62	2.642	3.264	3.327	4.116	6.087	8.158	0.000	4.464	9.782	2.020	2.595	2.764	3.432	5.392	7.452	0.000	3.745	9.063
67	3.198	4.062	4.062	5.443	8.780	12.266	0.000	0.000	14.690	2.578	3.412	3.412	4.785	8.105	11.572	0.000	0.000	13.974
72	3.245	5.018	5.018	8.254	15.841	22.977	0.000	0.000	26.321	2.681	4.442	4.442	7.661	15.204	22.289	0.000	0.000	25.593
	b) 5% Interest																	
17	0.274	0.336	0.636	0.418	0.550	0.654	0.856	0.870	0.934	0.086	0.144	0.431	0.225	0.355	0.459	0.660	0.674	0.738
22	0.345	0.409	0.684	0.493	0.630	0.743	0.957	0.977	1.067	0.099	0.158	0.471	0.241	0.376	0.488	0.701	0.721	0.811
27	0.418	0.487	0.755	0.576	0.720	0.846	1.082	1.112	1.253	0.125	0.189	0.524	0.276	0.419	0.543	0.778	0.809	0.950
32	0.499	0.575	0.875	0.665	0.813	0.950	1.193	1.239	1.458	0.167	0.237	0.616	0.325	0.472	0.608	0.850	0.896	1.114
37	0.671	0.754	0.998	0.854	1.039	1.216	1.460	1.527	1.816	0.231	0.297	0.722	0.394	0.577	0.754	0.997	1.063	1.352
42	0.858	0.954	1.188	1.074	1.323	1.575	1.796	1.896	2.239	0.345	0.419	0.877	0.535	0.782	1.032	1.252	1.352	1.695
47	1.094	1.236	1.487	1.424	1.829	2.238	2.374	2.579	3.116	0.496	0.611	1.127	0.793	1.195	1.602	1.736	1.940	2.477
52	1.381	1.609	1.893	1.911	2.572	3.252	2.954	3.477	4.546	0.685	0.868	1.478	1.160	1.816	2.492	2.189	2.713	3.781
57	1.906	2.256	2.462	2.748	3.815	4.817	2.946	4.395	5.974	1.172	1.478	1.968	1.961	3.020	4.016	2.139	3.588	5.167
62	2.631	3.244	3.307	4.072	5.927	7.738	0.000	4.406	8.927	2.009	2.575	2.743	3.389	5.231	7.031	0.000	3.689	8.209
67	3.184	4.034	4.034	5.378	8.519	11.572	0.000	0.000	13.360	2.564	3.384	3.384	4.719	7.843	10.876	0.000	0.000	12.646
72	3.225	4.971	4.971	8.119	15.276	21.546	0.000	0.000	24.066	2.661	4.393	4.393	7.523	14.633	20.853	0.000	0.000	23.340

TABLE 2—*Continued*

Age	3/12	3/12 (7 Day)	3/24	3/60	3/120	3/ Age 60	3/ Age 65	3/ Lifetime	6/60	6/120	6/ Age 60	6/ Age 65	6/ Lifetime	12/120	12/ Age 60	12/ Age 65	12/ Lifetime
	a) 3% Interest																
17.....	0.126	0.194	0.204	0.342	0.462	0.720	0.740	0.833	0.311	0.427	0.681	0.701	0.794	0.374	0.619	0.639	0.733
22.....	0.129	0.207	0.209	0.353	0.482	0.754	0.781	0.910	0.321	0.447	0.714	0.741	0.870	0.393	0.651	0.678	0.807
27.....	0.141	0.223	0.226	0.378	0.523	0.819	0.860	1.057	0.342	0.482	0.773	0.814	1.012	0.425	0.705	0.746	0.943
32.....	0.160	0.251	0.247	0.405	0.563	0.865	0.926	1.224	0.358	0.512	0.808	0.868	1.167	0.450	0.733	0.793	1.091
37.....	0.150	0.307	0.247	0.442	0.647	0.948	1.036	1.439	0.402	0.603	0.896	0.984	1.386	0.550	0.827	0.915	1.317
42.....	0.180	0.374	0.296	0.559	0.847	1.116	1.249	1.752	0.504	0.786	1.043	1.177	1.679	0.733	0.968	1.101	1.604
47.....	0.282	0.517	0.466	0.891	1.357	1.510	1.774	2.561	0.806	1.261	1.395	1.659	2.446	1.179	1.278	1.542	2.329
52.....	0.443	0.753	0.737	1.431	2.203	1.823	2.455	3.980	1.304	2.058	1.648	2.280	3.804	1.929	1.460	2.092	3.617
57.....	0.794	1.058	1.278	2.389	3.516	1.389	2.981	5.079	2.128	3.221	1.052	2.645	4.743	2.975	0.729	2.321	4.420
62.....	1.544	1.660	2.354	4.278	6.295	0.000	2.540	7.857	3.724	5.678	0.000	1.853	7.170	5.186	0.000	1.227	6.545
67.....	2.160	2.160	3.505	6.766	10.158	0.000	0.000	12.481	6.091	9.375	0.000	0.000	11.581	8.700	0.000	0.000	10.686
72.....	3.680	3.680	6.835	14.214	21.110	0.000	0.000	24.267	13.657	20.273	0.000	0.000	23.220	18.878	0.000	0.000	21.436
	b) 5% Interest																
17.....	0.125	0.193	0.200	0.325	0.426	0.625	0.639	0.703	0.292	0.390	0.585	0.599	0.664	0.336	0.524	0.538	0.602
22.....	0.128	0.206	0.205	0.335	0.444	0.655	0.675	0.764	0.301	0.408	0.614	0.634	0.723	0.352	0.551	0.571	0.661
27.....	0.141	0.222	0.222	0.359	0.481	0.713	0.743	0.884	0.320	0.439	0.666	0.696	0.837	0.379	0.598	0.628	0.769
32.....	0.163	0.253	0.245	0.386	0.519	0.758	0.804	1.022	0.334	0.465	0.698	0.744	0.962	0.399	0.623	0.669	0.887
37.....	0.150	0.306	0.242	0.418	0.592	0.831	0.897	1.186	0.376	0.545	0.777	0.843	1.132	0.490	0.709	0.775	1.064
42.....	0.178	0.371	0.290	0.531	0.777	0.990	1.090	1.433	0.474	0.714	0.917	1.018	1.361	0.658	0.843	0.943	1.286
47.....	0.279	0.512	0.456	0.848	1.247	1.371	1.576	2.113	0.760	1.148	1.257	1.462	1.999	1.061	1.141	1.346	1.883
52.....	0.438	0.746	0.721	1.362	2.026	1.706	2.230	3.298	1.231	1.876	1.532	2.055	3.124	1.739	1.347	1.870	2.939
57.....	0.784	1.047	1.252	2.285	3.257	1.358	2.807	4.385	2.017	2.957	1.024	2.473	4.051	2.700	0.704	2.153	3.732
62.....	1.525	1.640	2.310	4.113	5.870	0.000	2.489	7.009	3.552	5.245	0.000	1.807	6.327	4.737	0.000	1.190	5.710
67.....	2.133	2.133	3.436	6.495	9.453	0.000	0.000	11.157	5.807	8.655	0.000	0.000	10.265	7.951	0.000	0.000	9.383
72.....	3.625	3.625	6.685	13.621	19.654	0.000	0.000	22.021	13.030	18.788	0.000	0.000	20.984	17.347	0.000	0.000	19.226

TABLE 3

COMPARISON OF 0 PER CENT COSTS FROM 1971 TABLE (MALES) (TABLE A8[*a*], APPENDIX) WITH COMBINED 1969–71 COSTS SHOWN IN TABLE 1

0-DAY ELIMINATION/12-MONTH MAXIMUM					7-DAY ELIMINATION/12-MONTH MAXIMUM					30-DAY ELIMINATION/12-MONTH MAXIMUM					SECOND YEAR OF BENEFIT PERIOD				
Age	Table A8(*a*)	Age Group	Table 1	Ratio*	Age	Table A8(*a*)	Age Group	Table 1	Ratio*	Age	Table A8(*a*)	Age Group	Table 1	Ratio*	Age	Table A8(*a*)	Age Group	Table 1	Ratio*
22	0.1677				22	0.0829				22	0.0155				22	0.0102			
		20–29	0.155	1.08			20–29	0.086	1.01			20–29	0.017	0.99			20–29	0.0099	1.04
27	0.1676				27	0.0902				27	0.0183				27	0.0104			
32	0.1855				32	0.1012				32	0.0216				32	0.0106			
		30–39	0.140	1.30			30–39	0.109	1.00			30–39	0.025	1.02			30–39	0.0110	1.02
37	0.1789				37	0.1171				37	0.0296				37	0.0118			
42	0.1962				42	0.1383				42	0.0424				42	0.0137			
		40–49	0.171	1.25			40–49	0.153	1.01			40–49	0.052	1.00			40–49	0.0164	1.06
47	0.2322				47	0.1710				47	0.0619				47	0.0211			
52	0.2834				52	0.2152				52	0.0881				52	0.0340			
		50–59	0.280	1.11			50–59	0.243	1.01			50–59	0.113	1.05			50–59	0.0429	1.02
57	0.3359				57	0.2770				57	0.1503				57	0.0538			
62	0.4101				62	0.3669				62	0.2625				62	0.0896			
		60–69	0.380	1.08			60–69	0.386	0.95			60–69	0.261	1.01			60–69	0.0897	1.00
67	0.4869				67	0.4461				67	0.3455				67	0.1445			

*"Ratio" is the average of the two quinquennial values from Table A8(*a*) to the decennial age group value from Table 1, except for ages 60–69. For ages 60–69, since most of the actual data in the 1969 and 1971 reports are for ages 60–64, the ratio shown is the Table A8(*a*) value for age 62 divided by the Table 1 value for ages 60–69.

tion period values shows that the variability built into the 1971 Table overcorrects for the shift in the continuance pattern that develops under a 0-day elimination period: that is, the 1971 Table values *overstate* 0-day claim costs.

III. ACCIDENT DISABILITY

Table 4 summarizes the ratios of accident to total disability as given in Table 6 in the 1969 and 1971 reports. The table also shows the constant ratios of accident to total disability used in the 1964 Table.

TABLE 4

RATIO (PER CENT) OF ACCIDENT DISABILITY TO TOTAL DISABILITY (MALES)
ANNUAL CLAIM COSTS
MALE OCCUPATIONAL GROUP I—FIRST YEAR OF BENEFIT PERIOD
(From Table 6 of 1969 and 1971 Reports)

ATTAINED AGE	1966–67 ELIM. PERIOD (DAYS)			1968–69 ELIM. PERIOD (DAYS)			ATTAINED AGE	1964 TABLE RATIOS	1971 TABLE RATIOS
	0	7	30	0	7	30			
							17		52.0
							22	51.5	50.0
20–29	46	47	53	31*	45	38	27	46.1	44.0
							32	40.6	40.0
30–39	37	36	26	45	40	29	37	35.7	36.0
							42	31.3	30.0
40–49	26	26	20	28	28	23	47	26.9	24.0
							52	22.5	18.0
50–59	16	18	13	17	14	11	57	18.1	15.0
							62	15.4	13.5
60–69	12	10	8	14	13	6	67	13.7	12.0
							72	13.0	11.0

* Only four sickness claims are included in the total experience in this cell.

The 1966–69 experience indicates some tendency for the accident ratios to decrease with increasing elimination period except in the 20–29 age group, and the 1968–69 experience in particular shows a strong tendency toward decreasing ratios at ages over 50. However, since use of a constant ratio is extremely simple and convenient, and since it is also conservative, in general, to use a higher accident ratio—because rarely, if ever, does a plan involve sickness benefits greater than those provided for accident—it seemed best to retain constant ratios for the 1971 Table, adopting constant values close to the 1966–69 experience values for the 0-day elimination period. Suggested constant 1971 Table accident ratios are shown in the right-hand column of Table 4.

IV. MALE OCCUPATION GROUP II AND FEMALE OCCUPATION GROUP I

Tables 5 and 6 summarize the 1966–69 experience with respect to Male Occupation Group II and Female Occupation Group I, respectively, again combining the data from the 1969 and 1971 reports. These tables then show the ratios of the costs for each of these classes to the costs for Male Occupation Group I.

As is clearly indicated in the separate 1969 and 1971 reports, the Male II costs show ratios that decrease fairly consistently with increasing age. The same is true in general with the Female I costs, except that the 20–29 age group shows ratios consistently lower than those of the 30–39 age group.

It would be entirely possible to construct continuance tables for each of these classifications, in the same way that the 1971 Table was constructed using the Male I data. However, it would be extremely convenient to avoid the multiple basic continuance tables that would result. Moreover, most insurers break down their occupational classes into more groups than the broad Classes I and II used in the reports, so that some question would arise as to how best to apply the several basic tables under other classification schemes.

It seems desirable, therefore, to develop fairly simple methods of approximating the experience of classes other than Male I in terms of the same basic table. One such method is the obvious one of simply using auxiliary ratio tables built directly from ratios such as those shown in Tables 5 and 6, employing these directly to modify the basic Male I claim costs for any desired plan.

The generally decreasing ratios suggest the possibility of an even simpler scheme developed in the form of a percentage plus a constant. Thus one might try the device of using a constant percentage of the attained age cost plus a constant percentage of the age 22 cost. Table 7 provides a test of such an approach, in which the total claim cost for Male II or Female I is expressed as r per cent of the Male I attained age cost plus s per cent of the age 22 cost.

The method works reasonably well for Male II and suggests the underlying rationale that the extra morbidity takes the form of a fairly uniform percentage excess of the accident and sickness attained age costs, increased by a constant excess accident exposure that is most readily related to the age 22 costs, where accident disability is a large fraction of the total.

For Female I, as would be expected on account of the bulge in extra morbidity always occurring in the 30–49 age groups, this simple system

TABLE 5

RATIO (PER CENT) OF MALE OCCUPATION GROUP II TO MALE OCCUPATION GROUP I (COMPOSITE 1966–69 EXPERIENCE)
ANNUAL CLAIM COSTS—FIRST YEAR OF BENEFIT PERIOD

(From Table 5 of 1969 and 1971 Reports and Table 1 of This Paper)

AGE GROUP	1969 REPORT—MALE II			1971 REPORT—MALE II			COMPOSITE EXPOSURE	COMBINED 1969–71 MALE II			MALE I CLAIM COSTS (TABLE 1)	RATIO (%) MALE II/ MALE I
	No. Claims	Annual Claim Rate	Annual Claim Cost*	No. Claims	Annual Claim Rate	Annual Claim Cost*		No. Claims	Annual Claim Rate	Annual Claim Cost*		
	0-Day Elimination											
20–29	3,053	0.219	0.177	3,076	0.331	0.223	23,233.7	6,129	0.264	0.200	0.155	129
30–39	6,370	0.238	0.237	5,837	0.235	0.257	51,603.0	12,207	0.237	0.247	0.140	176
40–49	7,129	0.232	0.291	6,522	0.230	0.298	59,085.0	13,651	0.231	0.294	0.171	172
50–59	5,529	0.245	0.415	5,370	0.233	0.410	45,614.6	10,899	0.239	0.413	0.280	148
60–69	1,506	0.232	0.536	1,738	0.244	0.552	7,123.0	3,244	0.455	0.545	0.380	143
	7-Day Elimination											
20–29	2,103	0.127	0.171	2,725	0.128	0.188	37,848.1	4,828	0.128	0.181	0.086	211
30–39	5,184	0.125	0.192	5,501	0.120	0.189	87,313.7	10,685	0.122	0.190	0.109	174
40–49	8,143	0.133	0.236	7,487	0.122	0.217	122,594.4	15,630	0.127	0.227	0.153	148
50–59	8,302	0.160	0.350	8,602	0.149	0.326	109,619.0	16,904	0.154	0.338	0.243	139
60–69	2,209	0.186	0.527	2,794	0.173	0.472	28,026.6	5,003	0.179	0.496	0.386	129

*Per $1 monthly.

TABLE 5—*Continued*

Age Group	1969 Report—Male II			1971 Report—Male II			Composite Exposure	Combined 1969–71 Male II			Male I Claim Costs (Table 1)	Ratio (%) Male II/ Male I
	No. Claims	Annual Claim Rate	Annual Claim Cost*	No. Claims	Annual Claim Rate	Annual Claim Cost*		No. Claims	Annual Claim Rate	Annual Claim Cost*		
	14-Day Elimination											
20–29	249	0.062	0.108	313	0.056	0.097	9,605.4	562	0.059	0.102	0.054	189
30–39	695	0.075	0.137	692	0.067	0.134	19,595.0	1,387	0.071	0.136	0.059	231
40–49	1,003	0.096	0.187	818	0.084	0.182	10,811.0	1,821	0.168	0.185	0.105	176
50–59	762	0.124	0.319	663	0.099	0.245	12,842.1	1,425	0.111	0.285	0.198	144
60–69	154	0.175	0.561	207	0.155	0.403	2,215.5	361	0.163	0.470	0.315	149
	30-Day Elimination											
20–29	152	0.025	0.059	251	0.028	0.057	15,044.3	403	0.027	0.058	0.017	341
30–39	457	0.031	0.071	647	0.035	0.085	33,227.6	1,104	0.033	0.079	0.025	316
40–49	626	0.041	0.117	769	0.042	0.112	33,577.8	1,395	0.042	0.114	0.052	219
50–59	485	0.063	0.208	583	0.055	0.176	18,298.4	1,068	0.058	0.191	0.113	169
60–69	81	0.095	0.435	144	0.094	0.454	2,384.5	225	0.094	0.447	0.261	171

* Per $1 monthly.

TABLE 6

RATIO (PER CENT) OF FEMALE OCCUPATION GROUP I TO MALE OCCUPATION GROUP I (COMPOSITE 1966-69 EXPERIENCE)
ANNUAL CLAIM COSTS—FIRST YEAR OF BENEFIT PERIOD

(From Table 5 of 1969 and 1971 Reports and Table 1 of This Paper)

AGE GROUP	1969 REPORT—FEMALE I			1971 REPORT—FEMALE I			COMPOSITE EXPOSURE	COMBINED 1969-71 FEMALE I			MALE I CLAIM COSTS (TABLE 1)	RATIO (%) FEMALE I/ MALE I
	No. Claims	Annual Claim Rate	Annual Claim Cost*	No. Claims	Annual Claim Rate	Annual Claim Cost*		No. Claims	Annual Claim Rate	Annual Claim Cost*		
	0-Day Elimination											
20–29	99	0.380	0.129	92	0.152	0.152	865.8	191	0.221	0.140	0.155	90
30–39	140	0.244	0.238	112	0.262	0.256	1,001.3	252	0.252	0.246	0.140	176
40–49	442	0.251	0.353	387	0.262	0.342	3,238.1	829	0.256	0.348	0.171	204
50–59	726	0.238	0.338	655	0.264	0.336	5,531.5	1,381	0.250	0.337	0.280	120
60–69	347	0.262	0.462	357	0.229	0.344	2,883.4	704	0.244	0.402	0.380	106
	7-Day Elimination											
20–29	272	0.099	0.120	385	0.101	0.118	6,559.4	657	0.100	0.119	0.086	138
30–39	564	0.123	0.203	666	0.128	0.183	9,788.5	1,230	0.126	0.192	0.109	176
40–49	1,242	0.146	0.267	1,348	0.148	0.249	17,615.0	2,590	0.147	0.258	0.153	169
50–59	1,180	0.159	0.299	1,362	0.160	0.291	15,933.9	2,542	0.160	0.295	0.243	121
60–69	89	0.168	0.340	109	0.150	0.293	1,256.4	198	0.158	0.314	0.386	81

* Per $1 monthly.

TABLE 6—*Continued*

Age Group	1969 Report—Female I			1971 Report—Female I			Composite Exposure	Combined 1969–71 Female I			Male I Claim Costs (Table 1)	Ratio (%) Female I/ Male I
	No. Claims	Annual Claim Rate	Annual Claim Cost*	No. Claims	Annual Claim Rate	Annual Claim Cost*		No. Claims	Annual Claim Rate	Annual Claim Cost*		
	14-Day Elimination											
20–29	31	0.043	0.080	52	0.065	0.077	1,520.9	83	0.055	0.078	0.054	144
30–39	83	0.094	0.175	83	0.074	0.169	2,004.6	166	0.083	0.172	0.059	292
40–49	143	0.083	0.214	141	0.087	0.213	3,343.6	284	0.085	0.214	0.105	204
50–59	157	0.114	0.232	107	0.096	0.195	2,491.8	264	0.106	0.217	0.198	110
60–69	25	0.096	0.205	18	0.109	0.180	425.6	43	0.101	0.195	0.315	62
	30-Day Elimination											
20–29	25	0.019	0.044	32	0.021	0.040	2,840.0	57	0.020	0.042	0.017	247
30–39	105	0.041	0.105	89	0.034	0.074	5,178.6	194	0.037	0.091	0.025	364
40–49	171	0.040	0.075	195	0.046	0.114	8,514.1	366	0.043	0.096	0.052	185
50–59	140	0.051	0.173	121	0.043	0.138	5,559.1	261	0.047	0.157	0.113	139
60–69	6	0.033	0.026	12	0.058	0.256	388.7	18	0.046	0.179	0.261	69

* Per $1 monthly.

TABLE 7

TEST OF ONE METHOD OF APPROXIMATING MALE II AND FEMALE I COSTS* FROM MALE I COSTS AS r PER CENT OF ATTAINED AGE COST PLUS s PER CENT OF AGE 22 COST

(Male I Costs from Table 2: Annual Claim Costs per $1 Monthly)

Age	Male I Cost	Derived Male II Cost	Ratio (%) of Decennial Averages to Table 5 Costs	Derived Female I Cost	Ratio (%) of Decennial Averages to Table 6 Costs
	0-Day Elimination				
		$r=125, s=30$		$r=30, s=150$	
22....	0.1677	0.2599	130	0.3019	216
27....	0.1676	0.2598		0.3018	
32....	0.1855	0.2822	113	0.3072	124
37....	0.1789	0.2739		0.3052	
42....	0.1962	0.2956	108	0.3104	91
47....	0.2322	0.3406		0.3212	
52....	0.2834	0.4046	106	0.3366	102
57....	0.3359	0.4702		0.3523	
62....	0.4101	0.5629	103	0.3746	93
	14-Day Elimination				
		$r=120, s=120$		$r=60, s=240$	
22....	0.0408	0.0979	101	0.1224	160
27....	0.0485	0.1072		0.1270	
32....	0.0564	0.1166	94	0.1318	80
37....	0.0754	0.1394		0.1432	
42....	0.0958	0.1639	98	0.1554	77
47....	0.1242	0.1980		0.1724	
52....	0.1616	0.2429	99	0.1949	99
57....	0.2268	0.3211		0.2340	
62....	0.3265	0.4408	94	0.2938	151

Age	Male I Cost	Derived Male II Cost	Ratio (%) of Decennial Averages to Table 5 Costs	Derived Female I Cost	Ratio (%) of Decennial Averages to Table 6 Costs
	7-Day Elimination				
		$r=110, s=90$		$r=50, s=160$	
22...	0.0829	0.1658	94	0.1741	148
27...	0.0902	0.1738		0.1777	
32...	0.1012	0.1859	102	0.1832	98
37...	0.1171	0.2034		0.1912	
42...	0.1383	0.2267	108	0.2018	81
47...	0.1710	0.2627		0.2181	
52...	0.2152	0.3113	102	0.2402	87
57...	0.2770	0.3793		0.2711	
62...	0.3669	0.4782	96	0.3160	101
	30-Day Elimination				
		$r=160, s=180$		$r=100, s=220$	
22...	0.0155	0.0527	95	0.0496	121
27...	0.0183	0.0572		0.0524	
32...	0.0216	0.0625	87	0.0557	66
37...	0.0296	0.0753		0.0637	
42...	0.0424	0.0957	98	0.0765	90
47...	0.0619	0.1269		0.0960	
52...	0.0881	0.1689	114	0.1222	98
57...	0.1503	0.2684		0.1844	
62...	0.2625	0.4479	100	0.2966	166

* First year of benefit period: annual claim cost per $1 monthly.

works rather poorly, but might nevertheless be resorted to as a roughly approximate technique. Further inspection of Table 6 reveals the interesting characteristic that, in general, under the longer elimination periods the ratios become very high in the 30–39 age group but become very low in the 60-and-over age group. This indicates that an essentially different pattern of basic disability morbidity exists among female risks, so that what are really needed are two basic continuance tables, a male table and an entirely separate female table. From either of these, relatively simple ratios can probably be developed to measure the morbidity of occupational classes other than "standard," for each sex separately. Accordingly, Table 8 shows the basic values (derived from Table 6 and extrapolated in relation to the 1964 Table in a manner similar to that used for the male table) used to construct the 1971 Table for female lives, and Table 9 shows claim costs for females corresponding to the male costs given in Table 2. Table 9A gives the accident ratios for females.

V. DISABLED LIFE RESERVES

There has been increasing evidence during the past several years that the 1964 Table may be an inadequate standard for the valuation of disabled life reserves. This concern has been voiced particularly by actuaries working with group long term-disability benefits, where claims arise, almost entirely, following long elimination periods such as 90 or 180 days.

Attention has already been given in this paper to the fact that disability continuance constructed from data arising from very short elimination periods cannot be used to value costs associated with long elimination periods. A short-period table will grossly overstate the incidence of disability arising from long elimination periods.

The 1964 Table is essentially a short-period table, so that the question naturally arises as to whether it is a satisfactory basis for dealing with long elimination period benefits. In addition, the very fact that the 1964 Table was deliberately constructed as a conservative valuation standard for active life reserves raises doubt as to whether the table will be adequate for valuing disabled life reserves. The reason for this is that such a table will naturally incorporate conservative assumptions as to the number of persons remaining disabled over the intermediate durations of disability, and, since this latter quantity enters the denominator in the calculation of the claim reserve, there is a "built-in" tendency for such a table to produce an understated disabled life reserve. Adequacy for active life purposes may therefore tend automatically to produce inadequacy for disabled life purposes.

Construction of an experience modification table such as the 1971 Table provides a specific quantitative means of testing this hypothesis.

TABLE 8—BASIC VALUES USED TO CONSTRUCT 1971 MODIFICATION OF 1964 COMMISSIONERS DISABILITY TABLE (FEMALE LIVES)

A. NUMBER DISABLED AT VARIOUS DURATIONS, PER 100,000 LIVES EXPOSED AT EACH AGE

(Durations up to 12 Months Derived by Interpolation from Table 6 Elimination Period Claim Rates; Durations after 12 Months Modified, for Continuity, from 1964 Table)

Age at Disablement	Duration (Months)									
	0	0.233 (7 Days)	0.467 (14 Days)	1	12.1	24	36	60	120	180
22	21,300	9,400	5,000	1,700	226	140	101	59	37	27
27	22,900	10,600	6,200	2,400	283	182	129	79	55	38
32	24,600	12,000	7,800	3,300	353	232	168	105	78	55
37	25,500	13,200	8,500	3,900	390	267	199	138	97	70
42	25,600	14,200	8,400	4,200	423	294	228	169	108	78
47	25,500	15,100	9,000	4,400	497	356	274	204	141	97
52	25,200	15,800	10,200	4,600	554	423	340	237	175	120
57	24,700	16,000	10,600	4,700	476	415	357	272	180	128
62	24,400	15,800	10,100	4,600	588	531	472	397	251	149
67	24,400	16,400	10,700	5,000	930	810	765	629	374	184
72	25,800	18,000	12,300	5,900	1,755	1,707	1,622	1,335	655	230

B. ANNUAL CLAIM COST PER EACH $1 MONTHLY BENEFIT

(Derived by Interpolation from Table 6 Annual Claim Costs)

Age at Disablement	Elimination/Maximum in Months			
	0/12	0.233/12	0.467/12	1/12
22	0.121	0.102	0.064	0.035
27	0.163	0.136	0.099	0.053
32	0.219	0.174	0.151	0.081
37	0.274	0.210	0.187	0.094
42	0.331	0.244	0.207	0.092
47	0.351	0.269	0.217	0.108
52	0.336	0.287	0.216	0.142
57	0.349	0.299	0.217	0.164
62	0.402	0.314	0.230	0.180
67	0.459	0.361	0.279	0.232
72	0.557	0.465	0.392	0.344

TABLE 9

1971 Experience Modification of 1964 Commissioners Disability Table (Females)

(Values of $S_t^{/T}$ for Selected Elimination Periods [t] and Maximum Periods [T] at 3 and 5 Per Cent Interest; t and T in Months; 0.233 = 7 Days, 0.467 = 14 Days; Benefit = $10 Monthly)

Age	0/3	0/6	0/12	0/15	0/24	0/60	0.233/3	0.233/6	0.233/12	0.233/15	0.233/24	0.233/60	0.233/120	0.233/ Age 60	0.233/ Age 65	0.233/ Lifetime
	a) 3% Interest															
17	1.028	1.168	1.313	1.362	1.470	1.683	0.510	0.616	0.742	0.787	0.889	1.095	1.242	1.491	1.507	1.577
22	1.280	1.496	1.701	1.767	1.911	2.203	0.709	0.867	1.038	1.098	1.230	1.510	1.737	2.190	2.234	2.442
27	1.515	1.801	2.061	2.144	2.322	2.701	0.955	1.173	1.395	1.469	1.636	2.003	2.324	2.965	3.051	3.468
32	1.712	2.058	2.369	2.470	2.694	3.195	1.228	1.513	1.792	1.888	2.103	2.597	3.043	3.811	3.953	4.608
37	1.972	2.443	2.875	3.013	3.313	3.962	1.419	1.793	2.160	2.282	2.557	3.178	3.735	4.482	4.683	5.557
42	2.321	2.886	3.370	3.520	3.843	4.545	1.632	2.053	2.448	2.578	2.873	3.549	4.154	4.695	4.953	5.969
47	2.481	3.112	3.666	3.840	4.218	5.066	1.782	2.263	2.720	2.872	3.219	4.037	4.802	5.075	5.515	7.148
52	2.509	3.119	3.644	3.818	4.227	5.261	1.927	2.424	2.888	3.051	3.446	4.467	5.431	5.013	5.759	7.734
57	2.550	3.141	3.600	3.750	4.124	5.249	2.062	2.564	2.982	3.126	3.492	4.610	5.745	3.701	5.266	6.634
62	2.568	3.214	3.768	3.960	4.447	5.940	2.079	2.632	3.140	3.324	3.802	5.287	6.832	0.000	4.077	8.034
67	2.666	3.417	4.204	4.506	5.295	7.718	2.181	2.849	3.591	3.884	4.660	7.071	9.502	0.000	0.000	11.094
72	2.900	3.854	5.154	5.731	7.334	12.365	2.427	3.316	4.590	5.163	6.760	11.777	16.447	0.000	0.000	18.588
	b) 5% Interest															
17	1.031*	1.172*	1.317*	1.365*	1.468	1.662	0.514*	0.621*	0.746*	0.790*	0.887	1.075	1.200	1.393	1.404	1.453
22	1.290*	1.508*	1.713*	1.778*	1.915*	2.181	0.718*	0.879*	1.050*	1.108*	1.233*	1.488	1.680	2.034	2.066	2.214
27	1.536*	1.828*	2.087*	2.168*	2.338*	2.681	0.974*	1.197*	1.418*	1.491*	1.649*	1.981	2.253	2.757	2.822	3.123
32	1.725*	2.076*	2.386*	2.484*	2.698*	3.152	1.241*	1.530*	1.808*	1.901*	2.106*	2.553	2.931	3.538	3.645	4.120
37	1.977*	2.450*	2.879*	3.014*	3.302	3.896	1.424*	1.800*	2.164*	2.284*	2.547	3.113	3.588	4.182	4.335	4.968
42	2.326*	2.892*	3.373*	3.520*	3.830	4.470	1.637*	2.060*	2.452*	2.579*	2.861	3.476	3.991	4.426	4.626	5.369
47	2.487*	3.119*	3.670*	3.840*	4.203	4.977	1.788*	2.271*	2.724*	2.874*	3.206	3.949	4.600	4.823	5.174	6.389
52	2.508	3.116	3.636	3.807	4.201	5.150	1.926	2.422	2.882	3.041	3.420	4.358	5.182	4.831	5.450	6.915
57	2.545	3.132	3.585	3.732	4.096	5.154	2.056	2.556	2.967	3.108	3.464	4.516	5.509	3.665	5.102	6.161
62	2.562	3.204	3.751	3.939	4.412	5.818	2.074	2.623	3.123	3.304	3.768	5.165	6.518	0.000	4.032	7.399
67	2.660	3.405	4.182	4.477	5.244	7.530	2.175	2.837	3.569	3.856	4.611	6.882	9.013	0.000	0.000	10.193
72	2.892	3.837	5.118	5.683	7.241	11.990	2.419	3.300	4.555	5.116	6.667	11.402	15.506	0.000	0.000	17.123

* These values, which should of course be slightly *less* than the corresponding 3 per cent values, reflect the approximate method of interest discounting.

TABLE 9—*Continued*

Age	0.467/6	0.467/12	0.467/12 (7 Day)	0.467/24	0.467/60	0.467/120	0.467/Age 60	0.467/Age 65	0.467/Lifetime	1/6	1/12	1/12 (7 Day)	1/24	1/60	1/120	1/Age 60	1/Age 65	1/Lifetime
	a) 3% Interest																	
17	0.362	0.478	0.598	0.620	0.823	0.969	1.217	1.233	1.303	0.188	0.295	0.444	0.432	0.632	0.777	1.024	1.040	1.110
22	0.536	0.689	0.866	0.872	1.147	1.373	1.825	1.869	2.076	0.274	0.413	0.655	0.588	0.858	1.082	1.533	1.577	1.784
27	0.791	0.989	1.190	1.219	1.580	1.899	2.538	2.625	3.042	0.410	0.585	0.910	0.803	1.158	1.475	2.112	2.199	2.616
32	1.129	1.385	1.554	1.685	2.174	2.618	3.385	3.526	4.182	0.633	0.857	1.199	1.142	1.623	2.064	2.828	2.969	3.625
37	1.325	1.643	1.904	2.012	2.615	3.165	3.908	4.109	4.981	0.704	0.958	1.511	1.291	1.872	2.414	3.151	3.352	4.224
42	1.454	1.788	2.167	2.185	2.846	3.447	3.985	4.243	5.258	0.700	0.968	1.717	1.334	1.980	2.576	3.110	3.368	4.383
47	1.639	2.029	2.421	2.495	3.295	4.055	4.325	4.765	6.397	0.823	1.135	1.937	1.564	2.345	3.099	3.363	3.803	5.435
52	1.882	2.300	2.573	2.838	3.850	4.811	4.390	5.136	7.111	1.078	1.431	2.050	1.942	2.939	3.894	3.467	4.213	6.188
57	2.094	2.477	2.652	2.976	4.089	5.221	3.175	4.739	6.106	1.333	1.659	2.089	2.139	3.242	4.367	2.317	3.878	5.245
62	2.158	2.628	2.817	3.275	4.753	6.295	0.000	3.538	7.492	1.393	1.799	2.265	2.424	3.889	5.421	0.000	2.658	6.608
67	2.390	3.094	3.259	4.146	6.545	8.968	0.000	0.000	10.553	1.654	2.292	2.704	3.313	5.689	8.096	0.000	0.000	9.665
72	2.884	4.137	4.252	6.297	11.301	15.955	0.000	0.000	18.085	2.198	3.413	3.692	5.554	10.527	15.147	0.000	0.000	17.252
	b) 5% Interest																	
17	0.367	0.482	0.601	0.618	0.803	0.927	1.119	1.131	1.179	0.192	0.299	0.446	0.430	0.611	0.734	0.926	0.937	0.985
22	0.547	0.700	0.877	0.875	1.124	1.315	1.668	1.700	1.848	0.284	0.422	0.663	0.589	0.833	1.023	1.374	1.407	1.555
27	0.813	1.010	1.211	1.230	1.556	1.826	2.329	2.394	2.695	0.428	0.602	0.925	0.810	1.129	1.398	1.898	1.963	2.265
32	1.145	1.399	1.568	1.687	2.128	2.505	3.111	3.217	3.693	0.647	0.869	1.209	1.141	1.575	1.949	2.552	2.659	3.134
37	1.331	1.648	1.907	2.002	2.551	3.019	3.609	3.762	4.394	0.711	0.963	1.512	1.282	1.808	2.269	2.854	3.006	3.638
42	1.461	1.793	2.170	2.174	2.774	3.285	3.718	3.918	4.661	0.707	0.973	1.718	1.324	1.909	2.416	2.845	3.044	3.787
47	1.648	2.035	2.425	2.482	3.208	3.855	4.075	4.425	5.640	0.832	1.141	1.939	1.552	2.259	2.899	3.115	3.465	4.680
52	1.880	2.294	2.566	2.814	3.742	4.563	4.210	4.828	6.293	1.078	1.426	2.042	1.919	2.832	3.648	3.290	3.908	5.373
57	2.086	2.464	2.637	2.949	3.995	4.985	3.140	4.576	5.634	1.326	1.648	2.075	2.114	3.150	4.132	2.285	3.717	4.776
62	2.149	2.612	2.800	3.243	4.633	5.981	0.000	3.495	6.858	1.385	1.786	2.249	2.393	3.770	5.108	0.000	2.618	5.978
67	2.379	3.073	3.237	4.097	6.357	8.480	0.000	0.000	9.654	1.644	2.272	2.682	3.265	5.501	7.608	0.000	0.000	8.769
72	2.868	4.102	4.216	6.204	10.924	15.014	0.000	0.000	16.621	2.183	3.378	3.655	5.460	10.148	14.204	0.000	0.000	15.790

TABLE 9—*Continued*

Age	3/12	3/12 (7 Day)	3/24	3/60	3/120	3/ Age 60	3/ Age 65	3/ Lifetime	6/60	6/120	6/ Age 60	6/ Age 65	6/ Lifetime	12/120	12/ Age 60	12/ Age 65	12/ Lifetime
	a) 3% Interest																
17	0.238	0.285	0.363	0.553	0.694	0.938	0.954	1.024	0.484	0.619	0.858	0.874	0.944	0.514	0.743	0.759	0.829
22	0.315	0.402	0.475	0.734	0.953	1.398	1.442	1.650	0.638	0.851	1.287	1.331	1.539	0.717	1.139	1.182	1.390
27	0.404	0.535	0.606	0.947	1.258	1.886	1.973	2.390	0.818	1.121	1.738	1.824	2.241	0.957	1.551	1.637	2.054
32	0.524	0.687	0.788	1.251	1.684	2.436	2.578	3.233	1.078	1.500	2.236	2.377	3.033	1.296	1.999	2.141	2.796
37	0.577	0.899	0.883	1.440	1.972	2.695	2.896	3.768	1.257	1.776	2.477	2.678	3.550	1.555	2.217	2.418	3.290
42	0.599	0.989	0.939	1.561	2.147	2.666	2.923	3.939	1.385	1.955	2.451	2.709	3.724	1.723	2.175	2.433	3.448
47	0.698	1.138	1.098	1.852	2.593	2.837	3.277	4.909	1.646	2.369	2.585	3.024	4.657	2.106	2.265	2.705	4.337
52	0.824	1.175	1.307	2.273	3.211	2.759	3.505	5.480	2.017	2.929	2.442	3.188	5.163	2.636	2.080	2.827	4.801
57	0.857	1.120	1.319	2.399	3.499	1.424	2.985	4.352	2.089	3.154	1.041	2.601	3.969	2.882	0.698	2.258	3.625
62	1.012	1.302	1.614	3.051	4.551	0.000	1.753	5.703	2.730	4.183	0.000	1.333	5.282	3.859	0.000	0.910	4.860
67	1.486	1.759	2.474	4.800	7.153	0.000	0.000	8.667	4.406	6.678	0.000	0.000	8.115	6.169	0.000	0.000	7.457
72	2.633	2.786	4.727	9.589	14.083	0.000	0.000	16.094	9.086	13.395	0.000	0.000	15.269	12.405	0.000	0.000	14.029
	b) 5% Interest																
17	0.238	0.285	0.357	0.529	0.648	0.837	0.848	0.897	0.456	0.571	0.756	0.767	0.815	0.464	0.641	0.653	0.701
22	0.317	0.403	0.469	0.702	0.887	1.234	1.266	1.414	0.600	0.779	1.120	1.152	1.300	0.643	0.971	1.003	1.151
27	0.409	0.539	0.599	0.905	1.168	1.661	1.726	2.028	0.768	1.023	1.507	1.572	1.873	0.854	1.319	1.384	1.686
32	0.527	0.689	0.777	1.192	1.559	2.153	2.259	2.734	1.011	1.367	1.947	2.054	2.529	1.157	1.711	1.817	2.292
37	0.576	0.896	0.867	1.370	1.821	2.394	2.547	3.178	1.179	1.617	2.174	2.326	2.958	1.391	1.915	2.067	2.698
42	0.598	0.985	0.922	1.483	1.979	2.396	2.596	3.339	1.299	1.780	2.178	2.378	3.121	1.541	1.904	2.103	2.847
47	0.698	1.134	1.077	1.757	2.385	2.585	2.935	4.150	1.542	2.153	2.328	2.678	3.893	1.881	2.010	2.360	3.575
52	0.818	1.166	1.280	2.161	2.960	2.582	3.200	4.665	1.898	2.672	2.265	2.883	4.347	2.370	1.907	2.524	3.989
57	0.847	1.107	1.294	2.306	3.264	1.395	2.827	3.886	1.992	2.914	1.015	2.447	3.505	2.633	0.676	2.108	3.167
62	0.999	1.287	1.583	2.929	4.236	0.000	1.717	5.076	2.602	3.861	0.000	1.300	4.659	3.524	0.000	0.883	4.242
67	1.467	1.737	2.424	4.607	6.659	0.000	0.000	7.776	4.203	6.175	0.000	0.000	7.227	5.646	0.000	0.000	6.578
72	2.595	2.747	4.626	9.197	13.129	0.000	0.000	14.637	8.672	12.423	0.000	0.000	13.820	11.404	0.000	0.000	12.599

It must be recognized at the very outset, of course, that it falls far short of a completely satisfactory medium, because that portion of the table extending beyond two years is derived from the 1964 Table, and, since the numbers remaining disabled after two years are fairly stable percentages of the 1964 values, for any given age, reserves based on the 1971 Table will tend to approach values, after two years of disability, very close to those of the 1964 Table.

TABLE 9A

RATIO (PER CENT) OF ACCIDENT DISABILITY TO TOTAL DISABILITY (FEMALES)
ANNUAL CLAIM COSTS
FEMALE OCCUPATIONAL GROUP I—FIRST YEAR OF BENEFIT PERIOD
(From Table 6 of 1969 and 1971 Reports)

Attained Age	1966–67 Elim. Period (Days)			1968–69 Elim. Period (Days)			Attained Age	1964 Table Ratios	1971 Table Ratios
	0	7	30	0	7	30			
							17	.....	26
							22	51.5	23
20–29	26	20	9*	22	22	15*	27	46.1	21
							32	40.6	19
30–39	20	13	29	20	21	16	37	35.7	17
							42	31.3	15
40–49	18	15	13	18	16	13	47	26.9	16
							52	22.5	18
50–59	18	21	31	20	21	14	57	18.1	18
							62	15.4	17
60–69	13	18	*	18	16	*	67	13.7	16
							72	13.0	15

*Five or fewer accident claims are included in the total experience in each of these cells.

During the first two years, however, values in the table are based on actual recent experience, and reserves calculated from the 1971 Table for durations within the first year of disability particularly should provide a meaningful test of the adequacy of corresponding 1964 Table reserves. Reserve comparisons between the two tables will therefore be provided, with emphasis again placed on the fact that after two years the 1971 Table becomes dependent on the very table it is being used to test.

Since the 1971 Table is variable by elimination period, testing must also be conducted for specified elimination period plans, even though the duration at which the claim is being valued may be well beyond the elimination period. Table 10 provides sample values of disabled life reserves on the 1971 Table (male lives), at 3 per cent, for 7-day elimination period continuance. Table 11 provides corresponding values for 30-day elimination

TABLE 10

1971 TABLE: DISABLED LIFE RESERVES PER $100 MONTHLY INCOME
7-DAY ELIMINATION PERIOD VALUES—MALES
(3 Per Cent Interest; Duration from Date of Disablement Shown in Months)

AGE	12-MONTH LIMIT				24-MONTH LIMIT				
	0.50	1.50	4.00	9	0.50	1.50	4.00	9	18
17	119	186	372	266	136	239	638	1,009	542
22	126	184	354	265	144	233	599	1,000	543
27	131	181	341	264	148	226	571	996	544
32	139	180	318	260	155	219	515	961	542
37	152	191	303	254	169	230	476	938	551
42	164	196	287	252	182	234	447	950	565
47	179	211	303	256	204	259	490	1,003	570
52	197	236	335	259	231	301	560	1,019	570
57	216	251	349	266	262	333	615	1,102	575
62	251	295	392	266	318	409	702	1,090	574
67	261	307	427	279	352	461	849	1,253	583
72	296	462	684	295	496	869	1,594	1,392	582

AGE	60-MONTH LIMIT							120-MONTH LIMIT							
	1.50	4.00	9.00	18	30	42	54	1.50	4.00	9.00	18	42	66	90	114
17	326	1,075	2,225	2,549	2,233	1,542	573	399	1,443	3,252	4,243	4,711	4,041	2,609	585
22	315	1,008	2,226	2,588	2,261	1,554	574	387	1,366	3,299	4,378	4,832	4,108	2,632	586
27	303	961	2,237	2,623	2,292	1,568	576	373	1,319	3,377	4,535	5,008	4,212	2,667	588
32	286	851	2,157	2,645	2,328	1,586	578	352	1,178	3,321	4,691	5,224	4,337	2,708	589
37	302	797	2,210	2,846	2,415	1,609	580	376	1,127	3,511	5,193	5,393	4,377	2,714	589
42	314	784	2,421	3,154	2,536	1,641	583	401	1,147	4,012	5,956	5,592	4,396	2,704	589
47	365	900	2,641	3,254	2,565	1,647	583	481	1,345	4,421	6,170	5,598	4,365	2,686	588
52	446	1,057	2,701	3,281	2,589	1,655	584	606	1,606	4,557	6,273	5,666	4,381	2,686	587
57	516	1,207	2,969	3,287	2,547	1,633	581	702	1,805	4,856	6,029	5,301	4,143	2,592	583
62	669	1,414	2,981	3,376	2,617	1,658	583	942	2,162	4,968	6,320	5,459	4,149	2,563	580
67	831	1,869	3,601	3,495	2,629	1,658	583	1,219	2,935	6,056	6,539	5,434	4,119	2,547	579
72	1,823	3,729	3,964	3,399	2,562	1,630	580	2,722	5,739	6,387	6,051	5,034	3,862	2,437	572

TABLE 10—*Continued*

Age	Age 65 Limit																
	1.50	4.00	9.00	18	42	66	90	114	138	162	186	210	234	258	282	306	330
17.....	567	2,290	5,610	8,134	11,992	14,762	16,849	18,409	19,536	20,293	20,728	20,877	20,768	20,425	19,866	19,108	18,165
22.....	552	2,188	5,766	8,494	12,372	14,992	16,848	18,128	18,947	19,379	19,478	19,285	18,833	18,146	17,246	16,150	14,873
27.....	539	2,158	6,045	9,008	13,053	15,520	17,074	17,979	18,384	18,384	18,045	17,415	16,531	15,423	14,114	12,622	10,964
32.....	503	1,934	6,012	9,422	13,633	15,793	16,890	17,286	17,169	16,652	15,810	14,697	13,353	11,808	10,087	8,208	6,187
37.....	520	1,764	6,029	9,735	12,715	14,046	14,557	14,491	13,982	13,115	11,950	10,532	8,895	7,063	5,058	2,898	596
42.....	526	1,673	6,310	10,001	11,296	11,633	11,508	10,991	10,131	8,965	7,521	5,824	3,893	1,745			
47.....	592	1,772	6,125	8,963	9,385	9,140	8,526	7,567	6,280	4,680	2,781	591					
52.....	673	1,837	5,339	7,533	7,356	6,486	5,249	3,653	1,700								
57.....	641	1,609	4,235	5,127	4,094	2,576	582										
62.....	505	966	1,792	1,615													
67																	

Age	Lifetime Limit																
	1.50	4.00	9.00	18	42	66	90	114	138	162	186	210	234	258	282	306	330
17.....	623	2,567	6,381	9,408	14,375	18,270	21,509	24,241	26,557	28,520	30,173	31,551	32,683	33,589	34,289	34,798	35,130
22.....	620	2,530	6,792	10,205	15,505	19,514	22,754	25,417	27,616	29,427	30,904	32,087	33,010	33,697	34,170	34,447	34,543
27.....	632	2,631	7,549	11,529	17,588	21,894	25,195	27,783	29,821	31,412	32,631	33,530	34,150	34,523	34,675	34,626	34,394
32.....	623	2,530	8,137	13,158	20,274	24,839	28,090	30,472	32,218	33,468	34,317	34,831	35,058	35,037	34,796	34,360	33,749
37.....	660	2,390	8,506	14,204	19,917	23,556	26,208	28,166	29,592	30,590	31,231	31,568	31,641	31,482	31,116	30,562	29,840
42.....	671	2,285	8,985	14,711	17,938	20,060	21,758	23,103	24,137	24,896	25,403	25,682	25,750	25,622	25,310	24,827	24,182
47.....	778	2,492	9,001	13,675	15,772	17,192	18,374	19,336	20,091	20,648	21,014	21,197	21,202	21,036	20,703	20,208	19,556
52.....	973	2,867	8,823	13,148	14,883	15,863	16,667	17,310	17,792	18,115	18,279	18,284	18,130	17,818	17,347	16,718	15,931
57.....	959	2,635	7,470	9,828	10,385	10,743	11,061	11,336	11,558	11,721	11,816	11,831	11,756	11,579	11,287	10,864	10,295
62.....	1,157	2,750	6,530	8,633	8,446	7,893	7,331	6,767	6,203	5,639	5,075	4,511	3,947	3,384	2,820	2,256	1,692
67.....	1,489	3,679	7,768	8,662	8,066	7,421	6,775	6,130	5,485	4,840	4,194	3,549	2,904	2,258	1,613	968	323
72.....	3,145	6,685	7,527	7,299	6,636	5,972	5,308	4,645	3,981	3,318	2,654	1,991	1,327	664	1,345	1,050	.....

TABLE 11—1971 TABLE: DISABLED LIFE RESERVES PER $100 MONTHLY INCOME
30-DAY ELIMINATION PERIOD VALUES—MALES
(3 Per Cent Interest; Duration from Date of Disablement Shown in Months)

AGE	12-MONTH LIMIT			24-MONTH LIMIT			
	1.50	4.00	9	1.50	4.00	9	18
17	685	650	280	1,163	1,298	1,130	546
22	517	636	280	863	1,269	1,131	547
27	411	600	278	661	1,173	1,107	546
32	364	538	273	552	1,005	1,056	544
37	224	468	281	328	924	1,180	560
42	199	384	281	277	751	1,236	574
47	216	389	281	304	766	1,250	577
52	243	412	280	353	817	1,245	579
57	256	395	278	366	765	1,226	578
62	295	399	269	415	730	1,121	576
67	307	427	279	461	849	1,253	583
72	462	684	295	869	1,594	1,392	582

AGE	60-MONTH LIMIT						120-MONTH LIMIT				
	1.50	4.00	9.00	18	30	42	1.50	4.00	9.00	18	42
17	1,966	2,389	2,559	2,591	2,239	1,543	2,647	3,313	3,769	4,322	4,716
22	1,456	2,353	2,588	2,629	2,266	1,554	1,976	3,304	3,866	4,455	4,836
27	1,092	2,159	2,536	2,647	2,294	1,569	1,488	3,067	3,851	4,581	5,009
32	876	1,811	2,409	2,659	2,329	1,586	1,192	2,596	3,726	4,719	5,225
37	533	1,819	2,944	2,939	2,424	1,610	743	2,737	4,755	5,380	5,399
42	450	1,568	3,364	3,263	2,544	1,641	638	2,454	5,673	6,179	5,596
47	508	1,628	3,468	3,337	2,571	1,647	729	2,565	5,881	6,338	5,601
52	608	1,760	3,494	3,394	2,600	1,656	892	2,804	5,983	6,511	5,672
57	616	1,608	3,381	3,323	2,548	1,633	869	2,460	5,560	6,097	5,302
62	692	1,497	3,097	3,401	2,620	1,658	984	2,304	5,176	6,372	5,461
67	831	1,869	3,601	3,495	2,629	1,658	1,219	2,935	6,056	6,539	5,434
72	1,823	3,729	3,964	3,399	2,562	1,630	2,722	5,739	6,387	6,051	5,034

NOTE.—After 42 months' duration, the 30-day table values become virtually identical with the corresponding 7-day values shown in Table 10.

TABLE 11—*Continued*

Age	Age 65 Limit					Lifetime Limit				
	1.50	4.00	9.00	18	42	1.50	4.00	9.00	18	42
17	4,210	5,434	6,548	8,299	12,008	4,721	6,129	7,457	9,600	14,394
22	3,171	5,491	6,803	8,654	12,383	3,668	6,399	8,024	10,399	15,520
27	2,414	5,191	6,927	9,103	13,056	2,937	6,388	8,661	11,652	17,592
32	1,922	4,410	6,771	9,479	13,634	2,499	5,843	9,175	13,239	20,275
37	1,150	4,514	8,260	10,106	12,731	1,550	6,262	11,708	14,754	19,943
42	909	3,734	9,007	10,390	11,306	1,225	5,224	12,888	15,292	17,954
47	941	3,463	8,192	9,214	9,390	1,298	4,979	12,091	14,064	15,779
52	1,011	3,243	7,032	7,824	7,365	1,542	5,203	11,704	13,674	14,903
57	785	2,179	4,843	5,184	4,095	1,219	3,640	8,580	9,943	10,386
62	518	1,014	1,854	1,624		1,213	2,938	6,809	8,706	8,450
67						1,489	3,679	7,768	8,662	8,066
72						3,145	6,685	7,527	7,299	6,636

Note.—After 42 months' duration, the 30-day table values become virtually identical with the corresponding 7-day values shown in Ta' le 10.

period continuance, and Table 12 provides sample 3 per cent reserve values on the 1964 Table. Table 12 was calculated using a functional approximation to the 1964 Table, so that the functional construction and approximate method of interest discounting would be consistent with those of the 1971 Table, eliminating any possible distortion that might be traceable, at certain durations and terminal durations, to these factors. The functionally calculated reserves approximate actual 1964 Table values reasonably well, tending toward modest overstatement at most points.

Table 13 provides comparisons at durations within the first year of disablement. The 1964 Table reserves hold up fairly well against the 7-day 1971 Table values, tending toward some inadequacy at the younger ages but remaining conservative at the older ages. When compared with the 30-day reserves, however, a different picture takes shape. At a duration of 1.5 months the 30-day 1971 Table reserve ranges to upwards of 600 per cent of the 1964 Table reserve at age 22, and the 1964 Table reserve remains inadequate at all ages shown below 60. At 4 months the 1971 Table reserves below age 40 are still over 200 per cent of the 1964 Table reserves. By 9 months the 30-day 1971 Table reserves are beginning to converge toward the 1964 Table values, and for longer claim durations the differences cease to be significant.

For the 12- and 24-month terminal durations, the 1971 Table values are not affected by the dependence of the table on the 1964 Table values beyond two years. Even for these shorter benefit limits, the 30-day 1971 Table reserve values range far in excess of 1964 Table reserve values for all but the oldest ages. These comparisons therefore at least serve as a strong indication that in the early months of disability continuance the 1964 Table may well be a seriously deficient reserve standard. If more were known of current experience beyond the second year of disablement, it is also entirely possible that the 1964 Table would prove to be inadequate at longer durations as well. As mentioned before, there is a built-in tendency for a table designed as a conservative standard for active life reserves to be inadequate for disabled life reserves. These considerations raise the question whether the same disability table should be established as a valuation standard for both purposes.

The sample reserve values in Tables 10 and 11 also show rather clearly that the "rule of thumb" practice of setting up, in the first few months of a claim, reserves equal to a multiple, such as 3 times, of the amount already accrued under the claim is of dubious adequacy. The reserve liability depends too much on *both* the elimination period and the maximum period and, for the same age at disablement, can vary more than tenfold

TABLE 12

1964 TABLE: DISABLED LIFE RESERVES PER $100 MONTHLY INCOME

(3 Per Cent Interest; Duration from Date of Disablement Shown in Months)

AGE	12 MONTHS				24 MONTHS				
	0.50	1.50	4.00	9	0.50	1.50	4.00	9	18
17	101	158	321	264	111	194	541	1,033	558
22	100	152	299	258	108	181	481	980	557
27	103	156	297	256	112	186	473	963	558
32	109	165	295	249	118	194	451	891	556
37	115	172	306	253	127	207	484	942	562
42	125	185	325	257	140	229	531	983	565
47	143	201	338	261	165	255	571	1,031	570
52	163	226	371	267	195	302	661	1,092	573
57	198	276	423	271	253	393	789	1,127	572
62	243	331	474	277	333	505	932	1,187	575
67	333	442	544	280	492	716	1,096	1,191	570
72	452	562	614	286	730	983	1,307	1,259	573

AGE	60 MONTHS							120 MONTHS							
	1.50	4.00	9.00	18	30	42	54	1.50	4.00	9.00	18	42	66	90	114
17	263	959	2,491	2,875	2,360	1,570	574	323	1,319	3,749	4,873	4,746	3,916	2,535	581
22	238	828	2,355	2,894	2,387	1,582	576	287	1,137	3,581	4,978	4,858	3,974	2,553	582
27	244	817	2,346	2,965	2,439	1,602	578	299	1,142	3,652	5,238	5,063	4,076	2,586	583
32	253	767	2,200	3,091	2,566	1,652	583	315	1,102	3,583	5,771	5,506	4,229	2,606	583
37	281	865	2,422	3,217	2,610	1,665	585	363	1,285	4,051	6,140	5,667	4,309	2,634	584
42	324	982	2,567	3,255	2,616	1,666	585	429	1,479	4,313	6,219	5,670	4,306	2,631	584
47	379	1,105	2,793	3,375	2,658	1,679	586	522	1,716	4,808	6,584	5,825	4,382	2,657	585
52	478	1,331	3,000	3,398	2,649	1,674	586	675	2,082	5,136	6,559	5,728	4,321	2,633	584
57	660	1,621	3,073	3,343	2,618	1,662	584	949	2,517	5,171	6,332	5,573	4,233	2,599	582
62	908	1,992	3,293	3,382	2,620	1,661	584	1,338	3,125	5,545	6,384	5,535	4,200	2,584	581
67	1,315	2,299	3,179	3,216	2,542	1,634	581	1,904	3,481	5,131	5,814	5,205	4,017	2,512	577
72	1,901	2,819	3,381	3,205	2,498	1,611	578	2,718	4,163	5,268	5,546	4,843	3,765	2,400	571

TABLE 13

COMPARISON OF DISABLED LIFE RESERVES FOR MALES IN TABLES 10 (1971 TABLE 7-DAY), 11 (1971 TABLE 30-DAY), AND 12 (1964 TABLE FUNCTIONAL)
(Reserves per $100 Monthly, 3 Per Cent Interest)

Age	Duration* 1.5 Months					Duration* 4.0 Months					Duration* 9.0 Months				
	1971 7-Day (1)	1971 30-Day (2)	1964 Table (3)	Ratios (%) (1)/(3) (4)	Ratios (%) (2)/(3) (5)	1971 7-Day (6)	1971 30-Day (7)	1964 Table (8)	Ratios (%) (6)/(8) (9)	Ratios (%) (7)/(8) (10)	1971 7-Day (11)	1971 30-Day (12)	1964 Table (13)	Ratios (%) (11)/(13) (14)	Ratios (%) (12)/(13) (15)
	12-Month Limit														
22	184	517	152	121	340	354	636	299	118	213	265	280	258	103	109
32	180	364	165	109	221	318	538	295	108	182	260	273	249	104	110
42	196	199	185	106	108	287	384	325	88	118	252	281	257	98	109
52	236	243	226	104	108	335	412	371	90	111	259	280	267	97	105
62	295	295	331	89	89	392	399	474	83	84	266	269	277	96	97
	24-Month Limit														
22	233	863	181	129	477	599	1,269	481	125	264	1,000	1,131	980	102	115
32	219	552	194	113	285	515	1,005	451	114	223	961	1,056	891	108	119
42	234	277	229	102	121	447	751	531	84	141	950	1,236	983	97	126
52	301	353	302	100	117	560	817	661	85	124	1,019	1,245	1,092	93	114
62	409	415	505	81	82	702	730	932	75	78	1,090	1,121	1,187	92	94

* Duration from date of disablement in months.

TABLE 13—*Continued*

Age	Duration* 1.5 Months					Duration* 4.0 Months					Duration* 9.0 Months				
	1971 7-Day	1971 30-Day	1964 Table	Ratios (%)		1971 7-Day	1971 30-Day	1964 Table	Ratios (%)		1971 7-Day	1971 30-Day	1964 Table	Ratios (%)	
				(1)/(3)	(2)/(3)				(6)/(8)	(7)/(8)				(11)/(13)	(12)/(13)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	60-Month Limit														
22.....	315	1,456	238	132	612	1,008	2,353	828	122	284	2,226	2,588	2,355	95	110
32.....	286	876	253	113	346	851	1,811	767	111	236	2,157	2,409	2,200	98	110
42.....	314	450	324	97	139	784	1,568	982	80	160	2,421	3,364	2,567	94	131
52.....	446	608	478	93	127	1,057	1,760	1,331	79	132	2,701	3,494	3,000	90	116
62.....	669	692	908	74	76	1,414	1,497	1,992	71	75	2,981	3,097	3,293	91	94
	120-Month Limit														
22.....	387	1,976	287	135	688	1,366	3,304	1,137	120	291	3,299	3,866	3,581	92	108
32.....	352	1,192	315	112	378	1,178	2,596	1,102	107	236	3,321	3,726	3,583	93	104
42.....	401	638	429	93	149	1,147	2,454	1,479	78	166	4,012	5,673	4,313	93	132
52.....	606	892	675	90	132	1,606	2,804	2,082	77	135	4,557	5,983	5,136	89	116
62.....	942	984	1,338	70	74	2,162	2,304	3,125	69	74	4,968	5,176	5,545	90	93

* Duration from date of disablement in months.

TABLE 14

1971 TABLE: DISABLED LIFE RESERVES PER $100 MONTHLY INCOME

(3 Per Cent Interest; Duration from Date of Disablement Shown in Months)

7-DAY ELIMINATION PERIOD VALUES—FEMALES

AGE	12-MONTH LIMIT				24-MONTH LIMIT				
	0.50	1.50	4.00	9	0.50	1.50	4.00	9	18
17	130	301	493	268	163	427	870	982	527
22	147	286	456	264	180	392	779	949	528
27	160	272	429	262	194	365	719	933	530
32	171	263	416	262	207	350	700	949	534
37	192	284	418	261	234	378	696	929	532
42	195	272	401	260	245	357	663	928	534
47	203	281	407	260	247	372	677	937	536
52	203	268	398	264	248	361	686	1,008	551
57	199	249	362	261	238	327	616	1,025	568
62	213	270	391	266	264	370	695	1,075	570
67	235	317	457	275	315	472	878	1,159	573
72	282	395	567	288	431	677	1,237	1,320	580

AGE	60-MONTH LIMIT							120-MONTH LIMIT							
	1.50	4.00	9.00	18	30	42	54	1.50	4.00	9.00	18	42	66	90	114
17	604	1,397	1,977	2,246	2,070	1,483	566	730	1,770	2,682	3,465	4,199	3,786	2,529	582
22	547	1,251	1,948	2,331	2,153	1,521	571	673	1,631	2,754	3,785	4,589	4,020	2,609	585
27	504	1,158	1,949	2,404	2,212	1,546	574	626	1,540	2,834	4,037	4,843	4,158	2,654	587
32	488	1,149	2,033	2,488	2,251	1,559	575	612	1,553	3,009	4,245	4,946	4,199	2,665	588
37	524	1,128	1,968	2,458	2,243	1,557	575	655	1,513	2,896	4,178	4,924	4,187	2,661	588
42	492	1,076	1,982	2,490	2,254	1,558	575	613	1,444	2,923	4,236	4,918	4,172	2,654	587
47	520	1,116	2,037	2,550	2,292	1,573	577	658	1,526	3,064	4,430	5,073	4,253	2,680	588
52	529	1,211	2,363	2,789	2,366	1,586	577	688	1,705	3,640	4,897	5,075	4,182	2,644	586
57	496	1,173	2,693	3,245	2,575	1,645	582	668	1,738	4,387	5,963	5,330	4,089	2,544	579
62	592	1,377	2,883	3,303	2,599	1,654	583	824	2,086	4,766	6,149	5,428	4,138	2,560	580
67	820	1,825	3,145	3,305	2,581	1,646	582	1,171	2,780	5,149	6,062	5,304	4,055	2,524	578
72	1,328	2,783	3,706	3,364	2,552	1,627	579	1,935	4,224	5,928	5,955	4,995	3,839	2,428	572

TABLE 14—*Continued*

7-DAY ELIMINATION PERIOD VALUES—FEMALES—*Continued*

Age	Age 65 Limit																
	1.50	4.00	9.00	18	42	66	90	114	138	162	186	210	234	258	282	306	330
17.....	957	2,445	3,959	5,670	9,114	11,778	13,890	15,555	16,836	17,781	18,422	18,788	18,901	18,777	18,432	17,880	17,132
22.....	948	2,469	4,529	6,990	11,351	14,262	16,304	17,714	18,628	19,131	19,286	19,137	18,719	18,059	17,180	16,110	14,838
27.....	904	2,416	4,859	7,774	12,389	15,106	16,797	17,788	18,251	18,290	17,979	17,369	16,500	15,403	14,100	12,614	10,959
32.....	869	2,389	5,028	7,881	11,954	14,177	15,425	16,004	16,077	15,745	15,077	14,122	12,918	11,493	9,873	8,075	6,116
37.....	882	2,182	4,507	7,164	10,769	12,539	13,369	13,558	13,261	12,572	11,556	10,260	8,719	6,962	5,011	2,883	595
42.....	776	1,944	4,201	6,608	9,480	10,684	11,032	10,778	10,059	8,960	7,541	5,845	3,905	1,748			
47.....	794	1,928	4,073	6,277	8,513	9,042	8,724	7,828	6,494	4,807	2,826	593					
52.....	752	1,905	4,155	5,749	6,485	6,122	5,130	3,631	1,700								
57.....	612	1,555	3,840	5,085	4,140	2,569	581										
62.....	453	950	1,750	1,591													
67.....																	

Age	Lifetime Limit																
	1.50	4.00	9.00	18	42	66	90	114	138	162	186	210	234	258	282	306	330
17.....	1,016	2,621	4,291	6,243	10,392	13,857	16,846	19,449	21,724	23,710	25,435	26,924	28,195	29,264	30,143	30,844	31,377
22.....	1,062	2,813	5,258	8,306	14,128	18,467	21,926	24,746	27,065	28,970	30,522	31,767	32,741	33,471	33,980	34,288	34,409
27.....	1,061	2,908	5,997	9,873	16,628	21,256	24,743	27,452	29,574	31,228	32,494	33,429	34,077	34,471	34,640	34,604	34,382
32.....	1,050	2,976	6,447	10,437	16,881	21,192	24,395	26,842	28,717	30,136	31,175	31,891	32,327	32,514	32,480	32,247	31,831
37.....	1,085	2,780	5,944	9,830	15,988	19,994	22,929	25,138	26,800	28,023	28,879	29,422	29,691	29,718	29,529	29,143	28,577
42.....	975	2,554	5,758	9,497	15,036	18,616	21,235	23,190	24,634	25,663	26,341	26,717	26,827	26,699	26,358	25,823	25,110
47.....	1,085	2,789	6,230	10,226	15,867	19,282	21,647	23,308	24,347	25,141	25,491	25,539	25,324	24,878	24,223	23,381	22,368
52.....	1,069	2,894	6,709	9,966	13,462	15,727	17,430	18,698	19,598	20,176	20,468	20,501	20,296	19,871	19,244	18,426	17,429
57.....	802	2,180	5,713	8,092	8,216	7,776	7,310	6,840	6,369	5,897	5,425	4,954	4,482	4,010	3,539	3,067	2,596
62.....	1,004	2,638	6,231	8,363	8,365	7,839	7,284	6,725	6,166	5,605	5,045	4,485	3,924	3,364	2,804	2,244	1,685
67.....	1,402	3,406	6,463	7,869	7,701	7,120	6,508	5,891	5,272	4,653	4,034	3,415	2,796	2,179	1,568	986	1,049
72.....	2,214	4,886	6,948	7,146	6,542	5,889	5,235	4,581	3,926	3,272	2,618	1,963	1,309	655	3,083	1,581	.....

TABLE 14—*Continued*

30-DAY ELIMINATION PERIOD VALUES—FEMALES

Age	12-Month Limit				24-Month Limit				
	0.50	1.50	4.00	9	0.50	1.50	4.00	9	18
17	215	535	590	274	308	838	1,098	1,031	531
22	219	466	554	271	304	710	1,013	1,016	533
27	194	374	515	270	258	552	929	1,010	536
32	176	301	479	270	226	431	865	1,025	540
37	187	310	479	271	243	448	875	1,046	544
42	195	316	499	274	258	470	938	1,083	547
47	200	317	493	274	266	470	927	1,088	549
52	195	281	456	276	254	411	867	1,135	559
57	190	247	384	270	234	340	704	1,131	575
62	205	272	420	275	264	393	803	1,178	577
67	232	325	487	280	322	507	982	1,227	577
72	290	420	600	291	457	741	1,335	1,344	581

Age	60-Month Limit							120-Month Limit							
	1.50	4.00	9.00	18	30	42	54	1.50	4.00	9.00	18	42	66	90	114
17	1,273	1,825	2,114	2,286	2,081	1,486	567	1,583	2,345	2,888	3,540	4,218	3,792	2,530	582
22	1,080	1,709	2,146	2,397	2,173	1,527	572	1,382	2,278	3,069	3,920	4,623	4,030	2,612	586
27	833	1,587	2,185	2,487	2,236	1,552	575	1,081	2,168	3,223	4,209	4,881	4,169	2,657	587
32	646	1,500	2,271	2,564	2,270	1,563	576	841	2,077	3,402	4,402	4,973	4,206	2,667	588
37	685	1,552	2,373	2,641	2,302	1,572	577	905	2,179	3,601	4,583	5,034	4,221	2,669	588
42	736	1,698	2,486	2,666	2,300	1,569	576	980	2,395	3,770	4,605	4,987	4,190	2,658	587
47	744	1,703	2,545	2,736	2,341	1,584	578	1,007	2,448	3,942	4,831	5,151	4,272	2,684	588
52	661	1,661	2,793	2,904	2,388	1,591	578	899	2,417	4,371	5,136	5,102	4,187	2,645	586
57	551	1,433	3,094	3,349	2,591	1,647	582	767	2,177	5,099	6,180	5,344	4,091	2,545	579
62	674	1,695	3,281	3,404	2,615	1,656	583	968	2,629	5,484	6,362	5,443	4,140	2,560	580
67	926	2,129	3,417	3,378	2,595	1,648	582	1,352	3,292	5,639	6,219	5,320	4,059	2,524	578
72	1,487	3,041	3,789	3,373	2,553	1,627	579	2,182	4,630	6,067	5,974	4,995	3,839	2,428	572

TABLE 14—*Continued*

30-DAY ELIMINATION PERIOD VALUES—FEMALES—*Continued*

Age	Age 65 Limit																
	1.50	4.00	9.00	18	42	66	90	114	138	162	186	210	234	258	282	306	330
17	2,147	3,287	4,292	5,815	9,173	11,816	13,918	15,576	16,853	17,795	18,434	18,798	18,908	18,783	18,437	17,884	17,135
22	2,051	3,536	5,112	7,290	11,476	14,337	16,354	17,750	18,655	19,152	19,302	19,149	18,728	18,066	17,186	16,105	14,841
27	1,652	3,502	5,607	8,167	12,531	15,181	16,843	17,819	18,271	18,305	17,989	17,377	16,506	15,406	14,103	12,615	10,960
32	1,246	3,275	5,748	8,215	12,045	14,217	15,446	16,016	16,085	15,750	15,080	14,124	12,919	11,494	9,873	8,075	6,116
37	1,292	3,281	5,761	7,996	11,120	12,733	13,489	13,636	13,312	12,606	11,578	10,273	8,727	6,966	5,012	2,884	595
42	1,313	3,346	5,524	7,253	9,654	10,760	11,070	10,799	10,071	8,967	7,544	5,846	3,905	1,748			
47	1,267	3,183	5,322	6,901	8,674	9,106	8,753	7,842	6,500	4,809	2,826	593					
52	995	2,722	5,009	6,039	6,523	6,132	5,133	3,631	1,700								
57	697	1,937	4,451	5,266	4,150	2,570	581										
62	497	1,134	1,959	1,627													
67																	

Age	Lifetime Limit																
	1.50	4.00	9.00	18	42	66	90	114	138	162	186	210	234	258	282	306	330
17	2,293	3,532	4,658	6,407	10,464	13,906	16,883	19,480	21,750	23,732	25,455	26,941	28,210	29,277	30,155	30,854	31,386
22	2,326	4,054	5,952	8,675	14,293	18,573	22,002	24,805	27,112	29,008	30,553	31,794	32,763	33,490	33,997	34,302	34,421
27	1,973	4,252	6,947	10,393	16,832	21,372	24,819	27,506	29,615	31,260	32,519	33,449	34,093	34,485	34,651	34,613	34,390
32	1,531	4,116	7,398	10,896	17,018	21,258	24,434	26,867	28,735	30,148	31,185	31,898	32,332	32,518	32,484	32,249	31,833
37	1,638	4,269	7,697	11,055	16,575	20,363	23,189	25,333	26,952	28,143	28,976	29,501	29,756	29,772	29,573	29,180	28,608
42	1,719	4,505	7,662	10,483	15,346	18,772	21,329	23,253	24,679	25,696	26,366	26,736	26,841	26,711	26,368	25,831	25,116
47	1,823	4,757	8,278	11,335	16,220	19,458	21,752	23,377	24,485	25,175	25,517	25,558	25,339	24,889	24,232	23,388	22,373
52	1,473	4,236	8,169	10,509	13,555	15,762	17,447	18,708	19,604	20,181	20,471	20,503	20,297	19,873	19,244	18,426	17,429
57	936	2,761	6,669	8,399	8,240	7,781	7,312	6,840	6,369	5,897	5,425	4,954	4,482	4,010	3,538	3,067	2,595
62	1,197	3,356	7,198	8,666	8,392	7,845	7,286	6,726	6,166	5,605	5,045	4,484	3,924	3,363	2,803	2,242	1,682
67	1,631	4,055	7,097	8,083	7,728	7,127	6,510	5,891	5,272	4,652	4,032	3,412	2,792	2,173	1,555	946	545
72	2,502	5,361	7,113	7,169	6,543	5,890	5,235	4,581	3,926	3,272	2,618	1,963	1,309	654	3,024	1,568	.....

even at 1.5 months' duration since disablement. It seems clear, therefore, that current prevailing disability claim reserve valuation standards are badly in need of updating and refinement.

Table 14, finally, provides sample disabled life reserve values for female lives. These again depart significantly from the 1964 Table disabled life reserve values but follow a pattern that differs distinctly from that of the male reserves.

APPENDIX

This Appendix provides reference details concerning the construction of the 1971 Experience Modification of the 1964 Commissioners Disability Table (herein called the "1971 Table") and also of the exponential approximation of the 1964 Commissioners Disability Table (herein called the "1964 Table") itself which is used in the paper for reserve comparisons. In addition, various tables are included which compare values computed from the exponential approximation with actual 1964 Table values, in order to provide an indication of the accuracy of the exponential reconstruction of the 1964 Table as well as to provide an indirect indication of the over-all accuracy of the type of exponential graduation used, including the method of approximating present value discount of the claim annuities implicit in the functions.

For the reader's convenience, a summary of the basic formulas required for computations using the exponential functions is provided.

I. COMPUTATION OF VALUES USING THE FUNCTIONAL TABLES

A two-element exponential graduation is employed, following the general methodology developed in the paper "Continuance Functions" in *TSA*, XI, 649. This general technique provides the most powerful, flexible, and at the same time concise method of operating with continuance data of which the author is aware. The two basic types of exponential functions developed in that paper have in this paper been combined into a single general function, by introducing a constant, y, indicating sign, which always takes on either of the values $+1$ or -1. The value $y = +1$ is the equivalent of the lambda function, and $y = -1$ is the equivalent of the alpha function. The alpha notation is then used in the generalized formulas, and in the tables the function constants are always identified by the sequence (a, a', α, y). The values r and ρ are not separately defined, being intrinsically incorporated in the above four function constants.

From any single element, continuance values are then obtained by the following formulas.

1. The elemental probability that an active life entering age x will become disabled during the year of age x and remain disabled for at least t months is given by

$$ {}^{d}p_x^t = \left(\frac{a' - yt}{a}\right)_x^{ya} \qquad [p_x^t = 0 \quad \text{if} \quad (a' - yt) \leq 0]\,. \tag{1} $$

Then the total probability of continuance of disability to duration t, for a two-element function, is the sum

$$ {}^{\sigma}p_x^t = {}^{d_1}p_x^t + {}^{d_2}p_x^t\,. \tag{1a} $$

2. The present value at date of disablement of a benefit paying an income of \$1 monthly during total disability following an elimination period of t months and to a maximum period of T months, approximately discounted at a rate of interest i, is given, for one element, by

$$ {}^{(i)d}S_x^{t/T} = {}^{(i)}\left\{\frac{a}{a+y}\left[\left(\frac{a' - yt}{a}\right)^{y(a+y)} - \left(\frac{a' - yt - yT}{a}\right)^{y(a+y)}\right]\right\}_x, \tag{2} $$

in which, again, the terms in parentheses take on the value zero if the numerators are zero or negative.

Then the total annual claim cost, for a two-element function, discounted to date of disablement at interest rate i, is the sum

$$ {}^{(i)\sigma}S_x^{t/T} = {}^{(i)d_1}S_x^{t/T} + {}^{(i)d_2}S_x^{t/T}\,. \tag{2a} $$

Thus the value of ${}^{(0.03)\sigma}S_{37}^{3/60}$, from Table A1($c$) of this Appendix, rounding the values, is

$$ \frac{1.0638}{2.119}\left[\left(\frac{1.0638}{1.800+3}\right)^{2.119} - \left(\frac{1.0638}{1.800+63}\right)^{2.119}\right] $$

$$ + \frac{2655}{6.323}\left[\left(\frac{702-3}{2{,}655}\right)^{6.323} - \left(\frac{702-63}{2{,}655}\right)^{6.323}\right] $$

$$ = 0.02053 + 0.03935 = 0.05988 \text{ per \$1 monthly}\,. $$

The disabled life reserve, representing the present value at duration t, per each \$1 of monthly benefit, of future benefits to be expected under a continuing claim with a benefit period expiring as of duration T (from the date of disablement) is given for a two-element function by

$$ \frac{{}^{(i)d_1}S_x^{t/T-t} + {}^{(i)d_2}S_x^{t/T-t}}{{}^{(i)d_1}p_x^t + {}^{(i)d_2}p_x^t} = \frac{{}^{(i)\sigma}S^{t/T-t}}{{}^{(i)\sigma}p_x^t}\,. \tag{3} $$

Note that this formula as stated does not take into account the elimination period or maximum period directly; t is the duration since date of

disablement, as of the date of valuation, and T is the date of expiration of the benefit period as measured *from the date of disablement.*

Small desk-top computer equipment is available nowadays that permits very efficient computation of values using this type of exponential function. The calculations are readily programmable on any modern larger-scale equipment.

In the case of the 1971 Table (Tables A8 and A9 of this Appendix), an additional constant, b, is introduced, to provide the adjustment in the basic function required to fit the continuance to various elimination periods. The necessity for this is described in the paper.

The basic function in each case is constructed to fit the continuance for a 7-day accident and sickness elimination period, and the constant b is then employed to alter the exponent to fit any other elimination period. The constant b is always a positive fraction, and, since y is always $+1$ or -1, Table A8 uses a condensed notation that combines y and b into a single input value, with the sign indicating the value of y and the decimal quantity indicating the positive value of b. Thus, in Table A8(a), the entry for the age 17 d_1 function gives y, $b = -1.61661$, indicating that $y = -1$ and $b = 0.61661$.

The constant b is then used to alter the exponent a to an ${}^e a$ for any desired elimination period:

$$\begin{aligned} {}^e a &= a^{1+b(e-0.233)} \quad \text{for} \quad e < 1.233 \\ &= a^{1+b} \quad \text{for} \quad e \geq 1.233 , \end{aligned} \tag{4}$$

where e is the elimination period in months and the constant 0.233 is used as the equivalent of 7 days. Hence, when $e = 0.233$ (7 days), we have ${}^{0.233}a = a^1 = a$.

Adjustment of the exponent a for elimination period precedes adjustment for interest discount. Also, if the accident and sickness elimination periods differ, separate adjustment and discounting must be carried out for the accident and sickness components.

Thus Table A8(a) is actually an entire set of continuance tables, varying for all elimination periods from zero on up to 1 month and 7 days or longer. The introduction of the constant b into the functions greatly expands their flexibility and generality and makes it practical to value claim costs and disabled life reserves when the basic continuance itself varies by elimination period.

II. CONSTRUCTION OF THE FUNCTIONAL TABLES

Both the functional approximation of the 1964 Table (Table A1) and the 1971 Table (Tables A8 and A9) were constructed by a computer tech-

nique of successive trial-and-error solution, in which progressively more accurate trial constants were tested against selected values of p^t and/or $S^{t/T}$, until what was deemed a satisfactory over-all pattern of fit was achieved.

In the case of the 1964 Table, the selected test values of p^t are shown in Table A2, together with the results of the final accepted test. Further testing of $S^{t/T}$ values was performed, using interest rates of $2\frac{1}{2}$ and 3 per cent, with the results shown in Tables A5 and A7. To obtain the interest-discounted modifications of Table A1(a) used in Tables A5 and A7 and shown in Tables A1(b) and A1(c), modified values of a and a and of ${}^{(i)}a$ and ${}^{(i)}a$ were obtained by solving the following equations at durations u and v, holding a' constant:

$$ {}^{(i)}p_x^u = \left(\frac{a' - ul}{{}^{(i)}a}\right)^{v({}^{(i)}a)} = \left(\frac{1}{1+i}\right)^{u/12}\left(\frac{a' - ul}{a}\right)^{va}; \qquad (5) $$

$$ {}^{(i)}p_x^v = \left(\frac{a' - vl}{{}^{(i)}a}\right)^{v({}^{(i)}a)} = \left(\frac{1}{1+i}\right)^{v/12}\left(\frac{a' - vl}{a}\right)^{va}. \qquad (6) $$

The values used for u and v in the d_1 function were 0.267 and 4 and in the d_2 function 12 and 120, these values being expressed in months. The same values of u and v were also employed in the interest-discounted versions of the 1971 Table given in Tables A8 and A9.

The selected test values used in construction of the 1971 Table were the values of both p and s shown in Tables 1A and 8 of the paper, and a similar method of progressive trial and error was used. A test of the final results for male lives is shown in Table 3 of the paper. It was necessary to use both p and s values in the basic trial-and-error procedure, since, as indicated in the paper, no single continuance table can be constructed which even remotely fits all elimination periods. Accordingly, the task was one of constructing a *series* of continuance tables, one for each elimination period, and the only data available for this purpose were those shown in Tables 1A and 8. The method finally adopted was to construct a basic table, starting with the p values, but forcing it into a fit with $S^{0.233/12}$ and $S^{12.1/12}$, considering the result to be the "7-day table." Next, solutions of constant b were obtained for each age, so that the altered functions would reproduce each $S^{1/12}$, and these are the b values shown in Tables A8 and A9. Table 3 of the paper shows, for males, tests of the accuracy, included testing of the 0-day elimination period, where it will be seen that the 1971 Table overstates the values of $S^{0/12}$ by 8–30 per cent, indicating that constant b overcorrects for the 0-day elimination

when solved for by using 7- and 30-day elimination period values. (It should be noted here that the S values in Tables 1 and 1A are at zero rate of interest discount.)

III. APPENDIX TABLES

Table A1 gives the functional approximation of the 1964 Table, at interest rates of 0, $2\frac{1}{2}$, 3, and $3\frac{1}{2}$ per cent. Tables A2–A7, as already indicated, give various measures of the accuracy of the functional approximations as compared to actual 1964 Table values, together with certain auxiliary information.

Table A8 gives the function values for the 1971 Table (male lives). Table A8(a) is the basic variable table. Table A8(b) is the 7-day 3 per cent table used to generate Table 10 in the paper. Table A8(c) is the 30-day 3 per cent table used to generate Table 11. Tables A9(a)–A9(c) are the corresponding tables for female lives.

Table A10 shows actual numbers of lives disabled, by age and duration, for male lives, as derived from Table A8 using a 7-day elimination period.

TABLE A1

1964 COMMISSIONERS DISABILITY TABLE APPROXIMATED IN FUNCTIONAL FORM

(Unit: One Month [Valuing a Benefit of $1 per Month])

AGE	d_1 FUNCTION				d_2 FUNCTION			
	a	a'	α	y, b	a	a'	α	y, b
	a) 0% Interest							
17	1.120000	1.91000	3.64999	−1.00000	2.950000	110.00000	1.99999	−1.00000
22	1.170000	1.90000	3.59999	−1.00000	3.030000	120.40000	1.97999	−1.00000
27	1.130000	1.89000	3.47999	−1.00000	3.500000	144.54000	1.96999	−1.00000
32	0.907000	1.59000	2.99999	−1.00000	3,817.000000	762.00000	4.62000	1.00000
37	1.062000	1.80000	3.10999	−1.00000	4,612.000000	702.00000	3.76000	1.00000
42	1.134000	1.90000	3.06999	−1.00000	4,532.000000	642.00000	3.41000	1.00000
47	1.630000	2.60000	3.39999	−1.00000	5,680.000000	582.00000	2.70999	1.00000
52	1.870000	2.91000	3.43999	−1.00000	4,390.000000	522.00000	2.62999	1.00000
57	1.650000	2.68000	2.96999	−1.00000	3,153.000000	462.00000	2.57000	1.00000
62	1.850000	3.00000	2.93999	−1.00000	2,710.000000	402.00000	2.26000	1.00000
67	0.900000	1.87000	1.85999	−1.00000	1,722.000000	342.00000	2.25999	1.00000
72	0.950000	2.04000	1.79999	−1.00000	971.600000	282.00000	2.29000	1.00000
	b) 2½% Interest							
17	1.121398	1.91000	3.65769	−1.00000	5.085219	110.00000	2.35049	−1.00000
22	1.171356	1.90000	3.60766	−1.00000	5.453574	120.40000	2.35257	−1.00000
27	1.131425	1.89000	3.48764	−1.00000	6.786830	144.54000	2.39355	−1.00000
32	0.908342	1.59000	3.00697	−1.00000	2,609.330068	762.00000	6.04929	1.00000
37	1.063503	1.80000	3.11744	−1.00000	2,840.317177	702.00000	5.06555	1.00000
42	1.135629	1.90000	3.07766	−1.00000	2,742.051474	642.00000	4.59176	1.00000
47	1.632226	2.60000	3.40921	−1.00000	2,998.179053	582.00000	3.76789	1.00000
52	1.872544	2.91000	3.44988	−1.00000	2,514.701883	522.00000	3.56391	1.00000
57	1.652713	2.68000	2.97938	−1.00000	1,992.123080	462.00000	3.37978	1.00000
62	1.853253	3.00000	2.95008	−1.00000	1,740.594670	402.00000	2.94539	1.00000
67	0.902908	1.87000	1.86760	−1.00000	1,250.907256	342.00000	2.82060	1.00000
72	0.953438	2.04000	1.80798	−1.00000	799.169504	282.00000	2.72504	1.00000
	c) 3% Interest							
17	1.121673	1.91000	3.65920	−1.00000	5.556904	110.00000	2.41956	−1.00000
22	1.171622	1.90000	3.60918	−1.00000	5.994239	120.40000	2.42600	−1.00000
27	1.131705	1.89000	3.48915	−1.00000	7.529096	144.54000	2.47703	−1.00000
32	0.908606	1.59000	3.00834	−1.00000	2,470.428685	762.00000	6.33096	1.00000
37	1.063798	1.80000	3.11891	−1.00000	2,654.974201	702.00000	5.32284	1.00000
42	1.135949	1.90000	3.07918	−1.00000	2,556.708576	642.00000	4.82465	1.00000
47	1.632664	2.60000	3.41102	−1.00000	2,751.618094	582.00000	3.97637	1.00000
52	1.873044	2.91000	3.45183	−1.00000	2,328.220022	522.00000	3.74796	1.00000
57	1.653246	2.68000	2.98123	−1.00000	1,865.441146	462.00000	3.53936	1.00000
62	1.853892	3.00000	2.95206	−1.00000	1,632.671040	402.00000	3.08047	1.00000
67	0.903479	1.87000	1.86910	−1.00000	1,191.607377	342.00000	2.93108	1.00000
72	0.954114	2.04000	1.80955	−1.00000	774.490040	282.00000	2.81078	1.00000
	d) 3½% Interest							
17	1.121946	1.91000	3.66071	−1.00000	6.040131	110.00000	2.48830	−1.00000
22	1.171887	1.90000	3.61068	−1.00000	6.549274	120.40000	2.49906	−1.00000
27	1.131984	1.89000	3.49065	−1.00000	8.292441	144.54000	2.56009	−1.00000
32	0.908868	1.59000	3.00971	−1.00000	2,350.391922	762.00000	6.61127	1.00000
37	1.064092	1.80000	3.12037	−1.00000	2,497.923914	702.00000	5.57888	1.00000
42	1.136267	1.90000	3.08068	−1.00000	2,400.012904	642.00000	5.05641	1.00000
47	1.633099	2.60000	3.41283	−1.00000	2,547.924443	582.00000	4.18384	1.00000
52	1.873541	2.91000	3.45377	−1.00000	2,171.871645	522.00000	3.93112	1.00000
57	1.653776	2.68000	2.98307	−1.00000	1,757.235283	462.00000	3.69817	1.00000
62	1.854528	3.00000	2.95404	−1.00000	1,540.115632	402.00000	3.21488	1.00000
67	0.904047	1.87000	1.87059	−1.00000	1,139.370057	342.00000	3.04103	1.00000
72	0.954785	2.04000	1.81111	−1.00000	752.072098	282.00000	2.89610	1.00000

TABLE A2

RATIO OF LIVES DISABLED AS CALCULATED BY TABLE A1(*a*) FUNCTIONS TO LIVES DISABLED IN ACTUAL 1964 TABLE: 0 PER CENT INTEREST DISCOUNT*

DURATION	AGE AT BEGINNING OF POLICY YEAR IN WHICH DISABLEMENT OCCURS										
	22	27	32	37	42	47	52	57	62	67	72
8 days	1.010	0.989	1.009	1.005	1.007	0.995	1.011	1.024	1.000	1.003	1.007
10 days	1.001	0.987	0.997	0.994	0.994	0.992	1.009	1.019	0.998	0.995	1.000
1 month	0.989	0.999	0.995	0.993	1.073	1.010	1.017	1.038	0.995	0.995	1.025
3 months	0.971	1.023	1.066	1.022	0.990	1.016	1.018	1.053	1.005	1.086	1.113
6 months	1.025	1.093	1.184	1.171	1.114	1.068	1.033	1.074	0.998	1.057	1.002
12 months	0.947	0.986	0.927	0.941	0.953	0.894	0.927	0.983	0.977	1.007	1.056
24 months	0.941	0.923	0.838	0.874	0.899	0.877	0.909	0.917	0.932	0.951	0.992
60 months	1.148	1.138	1.026	1.091	1.082	1.040	1.031	0.998	1.033	0.961	0.978
120 months	1.125	1.052	1.019	1.105	1.067	1.067	1.045	1.021	1.075	0.996	0.999
180 months	0.917	0.950	0.884	0.966	0.913	1.000	0.976	0.940	1.074	1.011	1.018

* 1964 Table actual values are from *1964 Commissioners Disability Table* (Health Insurance Association of America, 1965), III, 12–14, Table B1.

TABLE A3

NUMBER DISABLED FOR ONE DAY, AS EXTRAPOLATED BY FUNCTIONS SHOWN IN TABLE A1(*a*)

(Number Disabled on Eighth Day Shown for Comparison; 100,000 Active Lives Exposed at Each Age)

AGE	NUMBER DISABLED		AGE	NUMBER DISABLED	
	1st Day	8th Day		1st Day	8th Day
22	17,528	10,918	52	22,219	16,560
27	16,766	10,566	57	24,384	18,550
32	18,621	11,709	62	25,475	20,160
37	19,474	12,685	67	27,660	22,780
42	20,663	13,817	72	30,910	26,210
47	20,654	14,875			

TABLE A4

BASIC CONTINUANCE TABLE DISCOUNTED AT 2½ PER CENT INTEREST
RATIO OF VALUES COMPUTED FROM TABLE A1(*b*) FUNCTIONS
TO ACTUAL VALUES FROM 1964 TABLE*

(Ratios Shown for Selected Ages Only)

DURATION	AGE AT BEGINNING OF POLICY YEAR IN WHICH DISABLEMENT OCCURS					
	27	32	37	47	57	62
8 days	0.990	1.007	1.021	0.993	1.019	0.998
10 days	0.983	0.994	1.014	0.991	1.014	0.995
1 month	0.995	0.997	1.009	1.003	1.008	0.996
3 months	1.023	1.067	1.035	1.017	1.037	1.012
6 months	1.094	1.210	1.174	1.024	1.055	0.991
12 months	1.000	0.987	0.957	0.895	0.970	0.975
24 months	0.980	0.926	0.916	0.881	0.914	0.930
60 months	1.077	1.126	1.102	1.064	1.016	1.036
120 months	1.100	1.085	1.100	1.110	1.025	1.097
180 months	0.910	0.908	0.960	1.057	0.946	1.067

* 1964 Table actual values from *1964 Commissioners Disability Table*, III, 17–19, Table D.

TABLE A5

NET ANNUAL CLAIM COSTS AT 2½ PER CENT INTEREST: RATIO OF VALUES
COMPUTED BY TABLE A1(*b*) FUNCTIONS TO ACTUAL
VALUES FROM 1964 TABLE*

(7-Day Elimination Period)

DURATION	AGE AT BEGINNING OF POLICY YEAR IN WHICH DISABLEMENT OCCURS										
	22	27	32	37	42	47	52	57	62	67	72
15 days	1.024	1.023	1.015	1.039	1.018	1.034	1.005	1.032	1.014	0.999	1.002
1 month	1.016	1.016	1.009	1.027	1.002	1.020	1.015	1.024	1.007	1.000	1.006
3 months	1.014	1.016	1.020	1.030	0.996	1.034	1.025	1.034	1.018	1.028	1.051
6 months	1.004	1.023	0.994	1.038	0.998	1.018	1.020	1.034	1.010	1.037	1.044
12 months	1.009	1.017	1.033	1.038	1.002	1.012	1.014	1.032	0.994	1.025	1.026
24 months	1.024	1.017	1.025	1.029	0.994	0.995	0.988	1.019	0.986	1.015	1.031
60 months	1.004	1.021	1.029	1.028	0.998	0.989	0.989	0.993	0.988	1.000	1.002
120 months	1.009	1.024	1.040	1.038	1.013	1.009	1.003	1.004	1.008	1.000	1.004
180 months	1.009	1.024	1.013	1.039	1.003	1.014	1.004	1.002	1.019	1.001	1.006
To age 65	1.008	1.020	1.001	1.016	1.000	1.017	1.005	0.997	0.987	.....	.....
Lifetime	1.019	1.037	0.985	0.995	0.962	0.997	0.980	0.980	1.018	0.999	1.001

* 1964 Table actual values from *1964 Commissioners Disability Table*, III, 25–27, Table H.

TABLE A6

BASIC CONTINUANCE TABLE DISCOUNTED AT 3 PER CENT INTEREST: RATIO OF VALUES COMPUTED FROM TABLE A1(*c*) FUNCTIONS TO ACTUAL VALUES FROM 1964 TABLE*

(Ratios Shown for Selected Ages Only)

DURATION	AGE AT BEGINNING OF POLICY YEAR IN WHICH DISABLEMENT OCCURS			
	27	37	47	57
8 days	0.992	1.021	0.991	1.021
10 days	0.988	1.011	0.988	1.018
1 month	0.998	1.007	1.004	1.008
3 months	1.025	1.033	1.020	1.040
6 months	1.094	1.178	1.073	1.060
12 months	0.986	0.957	0.902	0.965
24 months	0.959	0.927	0.890	0.916
60 months	1.120	1.149	1.062	1.016
120 months	1.000	1.143	1.089	1.029
180 months	0.889	0.947	1.000	0.934

* 1964 Table actual values from *1964 Commissioners Disability Table*, III, 104–6, Table D.

TABLE A7

NET ANNUAL CLAIM COSTS AT 3 PER CENT INTEREST: RATIO OF VALUES COMPUTED BY TABLE A1(*c*) FUNCTIONS TO ACTUAL VALUES FROM 1964 TABLE*

(7-Day Elimination Period; Ratios Shown for Selected Ages Only)

DURATION	AGE AT BEGINNING OF POLICY YEAR IN WHICH DISABLEMENT OCCURS				
	27	37	47	57	67
15 days	1.006	1.038	1.012	1.028	0.990
1 month	1.009	1.026	1.011	1.024	0.989
3 months	1.016	1.031	1.016	1.035	1.023
6 months	1.017	1.035	1.022	1.035	1.034
12 months	1.019	1.038	1.019	1.031	1.034
24 months	1.013	1.024	1.008	1.007	1.004
60 months	1.015	1.025	1.000	0.999	1.003
120 months	1.022	1.039	1.013	1.003	1.006
180 months	1.021	1.039	1.017	1.007	1.008
To age 65	1.021	1.017	1.015	1.002	.....
Lifetime	1.037	0.997	0.991	0.980	1.006

* 1964 Table actual values from *1964 Commissioners Disability Table*, III, 112–14, Table H.

TABLE A8

1971 MODIFICATION OF THE 1964 COMMISSIONERS DISABILITY TABLE (MALE LIVES)

(Unit: One Month [Valuing a Benefit of $1 per Month])

AGE	d_1 FUNCTION				d_2 FUNCTION			
	a	a'	a	y, b	a	a'	a	y, b
	a) Basic Table: 0% Interest							
17	1.561110	2.64511	4.27558	−1.61661	0.012716	13.84664	0.91747	−1.00000
22	2.077940	3.38423	4.76311	−1.44864	0.005815	11.83062	0.83778	−1.00000
27	3.278960	4.83882	6.00135	−1.34104	0.001119	6.71371	0.71021	−1.00000
32	5.425160	7.30702	7.91180	−1.30816	0.000093	1.04024	0.57822	−1.00000
37	3.518890	5.38337	5.38949	−1.21433	0.000300	13.10386	0.60595	−1.00000
42	4.976410	7.17301	6.15085	−1.15457	0.021945	60.68463	0.83675	−1.00000
47	6.538300	8.92147	6.93133	−1.13134	0.469800	108.08778	1.14408	−1.00000
52	5.057670	7.27800	5.55994	−1.14079	2.829340	163.93217	1.42585	−1.00000
57	10.909110	13.51792	8.91795	−1.06764	137.808930	464.86841	4.33513	−1.00000
62	6.298300	8.70459	5.53004	−1.02040	2,939.389000	402.00000	2.43545	1.00000
67	18.084720	20.66701	12.57717	−1.00000	2,815.599000	342.00000	2.04822	1.00000
72	19.644270	21.04309	22.01120	−1.00000	1,448.210000	282.00000	2.09611	1.00000
	b) 7-Day, 3% Interest							
17	1.563403	2.64511	4.28672	−1.00000	0.038752	13.84664	1.07924	−1.00000
22	2.080858	3.38423	4.77616	−1.00000	0.020761	11.83062	0.99331	−1.00000
27	3.282647	4.83882	6.01810	−1.00000	0.005413	6.71371	0.84929	−1.00000
32	5.429948	7.30702	7.93474	−1.00000	0.000676	1.04024	0.69762	−1.00000
37	3.524053	5.38337	5.40761	−1.00000	0.003062	13.10386	0.76543	−1.00000
42	4.983215	7.17301	6.17346	−1.00000	0.174147	60.68463	1.12888	−1.00000
47	6.546310	8.92147	6.95830	−1.00000	2.014577	108.08778	1.55878	−1.00000
52	5.065369	7.27800	5.58281	−1.00000	8.877381	163.93217	1.98165	−1.00000
57	10.919249	13.51792	8.95631	−1.00000	182.643203	464.86841	5.63827	−1.00000
62	6.297196	8.70459	5.55648	−1.00000	1,783.009521	402.00000	3.25593	1.00000
67	18.095491	20.66071	12.63320	−1.00000	1,676.951535	342.00000	2.71931	1.00000
72	19.647812	21.04309	22.06816	−1.00000	1,048.496719	282.00000	2.61689	1.00000
	c) 30-Day, 3% Interest							
17	1.562264	2.64511	8.51112	−1.00000	0.038752	13.84664	1.07924	−1.00000
22	2.079647	3.38423	8.16305	−1.00000	0.020761	11.83062	0.99331	−1.00000
27	3.281269	4.83882	9.60682	−1.00000	0.005313	6.71371	0.84929	−1.00000
32	5.428099	7.30702	12.92297	−1.00000	0.000676	1.04024	0.69762	−1.00000
37	3.522806	5.38337	7.12711	−1.00000	0.003062	13.10386	0.76543	−1.00000
42	4.981900	7.17301	7.65161	−1.00000	0.174147	60.68463	1.12888	−1.00000
47	6.544895	8.92147	8.45097	−1.00000	2.014577	108.08778	1.55878	−1.00000
52	5.064071	7.27800	6.71443	−1.00000	8.877381	163.93217	1.98165	−1.00000
57	10.918164	13.51792	10.02835	−1.00000	182.643203	464.86841	5.63827	−1.00000
62	6.296936	8.70459	5.70645	−1.00000	1,783.009521	402.00000	3.25593	1.00000
67	18.095491	20.66071	12.63320	−1.00000	1,676.951535	342.00000	2.71931	1.00000
72	19.647812	21.04309	22.06816	−1.00000	1,048.496719	282.00000	2.61689	1.00000

TABLE A9

1971 MODIFICATION OF THE 1964 COMMISSIONERS DISABILITY TABLE (FEMALE LIVES)

(Unit: One Month [Valuing a Benefit of $1 per Month])

AGE	d_1 FUNCTION				d_2 FUNCTION			
	a	a'	$\bar{a}$	y, b	a	a'	$\bar{a}$	y, b
	a) Basic Table: 0% Interest							
17	0.294477	0.59402	2.44190	−1.48338	0.081093	11.00171	1.13736	−1.00000
22	0.383706	0.81459	2.41745	−1.50375	0.011911	4.78295	0.85255	−1.00000
27	0.581088	1.20154	2.57918	−1.38021	0.003491	2.33747	0.71725	−1.00000
32	1.055585	1.96407	2.98351	−1.19043	0.004436	4.37617	0.69973	−1.00000
37	0.714772	1.56763	2.26587	−1.29116	0.007590	9.32908	0.71416	−1.00000
42	1.276429	2.39271	2.80402	−1.31597	0.014223	10.42506	0.75315	−1.00000
47	1.283110	2.40287	2.72721	−1.30551	0.007398	9.75748	0.67697	−1.00000
52	2.153445	3.52090	3.43430	−1.15848	0.152562	34.58764	0.92617	−1.00000
57	3.074178	4.66606	3.99435	−1.08030	2,604.596000	462.00000	3.11789	1.00000
62	2.792498	4.38607	3.74177	−1.09033	3,238.744000	402.00000	2.46111	1.00000
67	1.819689	3.12806	3.01103	−1.09215	2,820.079000	342.00000	2.19866	1.00000
72	3.423985	4.85539	4.64952	−1.05484	1,685.791000	282.00000	2.14664	1.00000
	b) 7-Day, 3% Interest							
17	0.295107	0.59402	2.44739	−1.00000	0.154786	11.00171	1.29028	−1.00000
22	0.384613	0.81459	2.42360	−1.00000	0.030673	4.78295	0.98516	−1.00000
27	0.582456	1.20154	2.58646	−1.00000	0.011498	2.33747	0.84134	−1.00000
32	1.057824	1.96407	2.99287	−1.00000	0.015661	4.37617	0.83095	−1.00000
37	0.717023	1.56763	2.27416	−1.00000	0.028579	9.32908	0.86177	−1.00000
42	1.279626	2.39271	2.81451	−1.00000	0.047112	10.42506	0.90425	−1.00000
47	1.286416	2.40287	2.73773	−1.00000	0.030143	9.75748	0.82594	−1.00000
52	2.157768	3.52090	3.44770	−1.00000	0.449106	34.58764	1.14797	−1.00000
57	3.079594	4.66606	4.01067	−1.00000	1,729.952953	462.00000	4.08725	1.00000
62	2.797938	4.38607	3.75739	−1.00000	1,925.041090	402.00000	3.28159	1.00000
67	1.823952	3.12806	3.02343	−1.00000	1,725.230904	342.00000	2.86975	1.00000
72	3.428470	4.85539	4.66631	−1.00000	1,192.110793	282.00000	2.66743	1.00000
	c) 30-Day, 3% Interest							
17	0.294930	0.59402	3.40549	−1.00000	0.154786	11.00171	1.29028	−1.00000
22	0.384351	0.81459	3.40614	−1.00000	0.030673	4.78295	0.98516	−1.00000
27	0.582126	1.20154	3.40728	−1.00000	0.011498	2.33747	0.84134	−1.00000
32	1.057494	1.96407	3.50934	−1.00000	0.015661	4.37617	0.83095	−1.00000
37	0.716648	1.56763	2.72827	−1.00000	0.028579	9.32908	0.86177	−1.00000
42	1.278920	2.39271	3.61048	−1.00000	0.047112	10.42506	0.90425	−1.00000
47	1.285725	2.40287	3.46052	−1.00000	0.030143	9.75748	0.82594	−1.00000
52	2.157167	3.52090	4.00339	−1.00000	0.449106	34.58764	1.14797	−1.00000
57	3.079153	4.66606	4.36633	−1.00000	1,729.952953	462.00000	4.08725	1.00000
62	2.797464	4.38607	4.11560	−1.00000	1,925.041090	402.00000	3.28159	1.00000
67	1.823633	3.12806	3.26740	−1.00000	1,725.230904	342.00000	2.86975	1.00000
72	3.428190	4.85539	4.97678	−1.00000	1,192.110793	282.00000	2.66743	1.00000

TABLE A10

1971 EXPERIENCE MODIFICATION OF THE 1964 COMMISSIONERS DISABILITY TABLE

(Number Disabled at Each Duration per 1,000,000 Lives Exposed at Age of Disablement; Male Lives—7-Day Elimination Period Table)

DURATION (DAYS)	AGE AT DISABLEMENT											
	17	22	27	32	37	42	47	52	57	62	67	72
7	74,703	72,969	74,970	77,973	81,975	87,975	98,975	113,972	131,972	150,795	175,967	204,939
8	71,188	69,917	72,151	75,378	79,448	85,613	96,561	111,273	129,261	147,881	172,736	199,085
9	67,880	67,021	69,458	72,883	77,014	83,326	94,216	108,652	126,614	145,037	169,573	193,438
10	64,762	64,272	66,885	70,483	74,669	81,111	91,937	106,106	124,030	142,261	166,478	187,990
11	61,824	61,662	64,424	68,174	72,410	78,965	89,722	103,631	121,506	139,551	163,450	182,734
12	59,052	59,182	62,071	65,954	70,234	76,886	87,570	101,227	119,042	136,904	160,485	177,662
13	56,435	56,824	59,821	63,817	68,136	74,871	85,477	98,889	116,636	134,321	157,584	172,768
14	53,963	54,582	57,667	61,760	66,113	72,918	83,443	96,617	114,286	131,798	154,744	168,046
15	51,627	52,449	55,606	59,780	64,162	71,026	81,465	94,409	111,991	129,334	151,964	163,488
16	49,418	50,418	53,633	57,874	62,281	69,191	79,542	92,261	109,750	126,928	149,243	159,090
17	47,328	48,485	51,744	56,039	60,466	67,412	77,672	90,173	107,560	124,578	146,580	154,845
18	45,349	46,643	49,934	54,272	58,715	65,687	75,854	88,142	105,422	122,282	143,972	150,748
19	43,474	44,888	48,200	52,569	57,025	64,014	74,085	86,167	103,332	120,040	141,420	146,794
20	41,697	43,214	46,539	50,929	55,394	62,391	72,364	84,246	101,291	117,849	138,921	142,976
21	40,011	41,618	44,946	49,348	53,819	60,817	70,690	82,376	99,297	115,708	136,474	139,291
22	38,412	40,095	43,418	47,825	52,298	59,290	69,062	80,557	97,349	113,616	134,079	135,733
23	36,894	38,642	41,953	46,357	50,830	57,808	67,478	78,788	95,446	111,572	131,734	132,298
24	35,452	37,254	40,548	44,942	49,411	56,370	65,936	77,065	93,585	109,574	129,437	128,982
25	34,081	35,928	39,199	43,577	48,040	54,974	64,435	75,389	91,768	107,622	127,189	125,780
26	32,778	34,661	37,905	42,261	46,715	53,619	62,975	73,757	89,991	105,713	124,987	122,688
27	31,538	33,450	36,662	40,991	45,435	52,304	61,553	72,168	88,255	103,848	122,832	119,701
28	30,359	32,292	35,468	39,767	44,197	51,027	60,169	70,622	86,559	102,024	120,721	116,818
29	29,235	31,184	34,322	38,585	43,000	49,787	58,822	69,115	84,900	100,241	118,653	114,032
30	28,165	30,123	33,220	37,445	41,843	48,583	57,511	67,649	83,280	98,497	116,628	111,342
31	27,146	29,109	32,162	36,344	40,723	47,413	56,234	66,220	81,695	96,792	114,646	108,744
32	26,173	28,137	31,145	35,282	39,640	46,277	54,990	64,829	80,146	95,125	112,704	106,234
33	25,246	27,206	30,167	34,257	38,592	45,173	53,779	63,473	78,632	93,495	110,802	103,810
34	24,361	26,314	29,226	33,267	37,578	44,101	52,599	62,153	77,151	91,900	108,939	101,467

TABLE A10—*Continued*

Duration (Months)	Age at Disablement											
	17	22	27	32	37	42	47	52	57	62	67	72
1.00	28,165	30,123	33,220	37,445	41,843	48,583	57,511	67,649	83,280	98,497	116,628	111,342
2.00	10,890	12,211	13,859	16,428	19,839	24,529	30,492	37,282	48,211	60,489	71,771	61,740
3.00	5,470	6,164	6,945	8,312	10,652	13,567	17,478	22,384	29,730	39,895	47,133	43,387
4.00	3,339	3,707	4,090	4,825	6,374	8,160	10,804	14,536	19,594	28,120	33,237	36,217
5.00	2,354	2,560	2,764	3,179	4,200	5,312	7,193	10,153	13,830	21,075	25,200	33,223
6.00	1,838	1,960	2,082	2,333	3,014	3,728	5,148	7,581	10,444	16,691	20,438	31,851
7.00	1,539	1,615	1,699	1,861	2,325	2,803	3,941	6,005	8,392	13,866	17,548	31,132
8.00	1,348	1,400	1,464	1,577	1,902	2,240	3,202	5,003	7,111	11,988	15,750	30,685
9.00	1,218	1,255	1,310	1,393	1,630	1,884	2,733	4,343	6,288	10,705	14,603	30,356
10.00	1,123	1,152	1,201	1,265	1,446	1,651	2,426	3,895	5,744	9,804	13,849	30,080
11.00	1,050	1,074	1,119	1,171	1,317	1,493	2,219	3,582	5,373	9,156	13,337	29,828
12.00	992	1,012	1,055	1,098	1,222	1,383	2,075	3,357	5,112	8,678	12,977	29,587
13.00	943	962	1,003	1,040	1,150	1,303	1,971	3,191	4,922	8,317	12,714	29,353
14.00	901	919	959	991	1,094	1,243	1,894	3,065	4,779	8,038	12,513	29,122
15.00	865	882	921	950	1,048	1,198	1,835	2,967	4,667	7,818	12,353	28,893
16.00	833	849	887	913	1,010	1,161	1,789	2,888	4,576	7,640	12,219	28,666
17.00	804	820	857	881	978	1,132	1,751	2,824	4,501	7,494	12,104	28,441
18.00	777	794	830	853	950	1,107	1,719	2,771	4,435	7,370	12,001	28,216
19.00	753	770	805	826	925	1,086	1,692	2,725	4,378	7,264	11,906	27,992
20.00	731	747	782	803	903	1,068	1,668	2,685	4,325	7,171	11,817	27,770
21.00	710	727	761	781	883	1,051	1,646	2,649	4,277	7,087	11,733	27,548
22.00	690	707	742	761	864	1,036	1,627	2,617	4,231	7,012	11,651	27,327
23.00	672	689	723	742	847	1,023	1,608	2,588	4,188	6,943	11,571	27,107
24.00	655	673	706	724	831	1,010	1,591	2,561	4,147	6,879	11,493	26,888
25.00	639	657	690	708	816	998	1,575	2,535	4,107	6,819	11,417	26,670
26.00	624	641	674	692	802	987	1,560	2,511	4,068	6,761	11,341	26,453
27.00	609	627	660	678	789	976	1,545	2,489	4,031	6,707	11,266	26,237
28.00	595	614	646	664	776	965	1,531	2,467	3,994	6,654	11,192	26,022
29.00	582	601	633	651	764	956	1,517	2,446	3,958	6,603	11,118	25,808
30.00	570	588	621	639	753	946	1,504	2,425	3,922	6,554	11,045	25,594

TABLE A10—*Continued*

Duration (Years)	Age at Disablement											
	17	22	27	32	37	42	47	52	57	62	67	72
3.00	506	525	557	577	694	894	1,430	2,315	3,720	6,277	10,613	24,333
4.00	414	435	467	490	607	810	1,304	2,126	3,356	5,775	9,777	21,912
5.00	352	373	405	432	544	741	1,197	1,964	3,035	5,307	8,977	19,622
6.00	306	327	360	389	496	685	1,107	1,823	2,752	4,864	8,212	17,465
7.00	271	293	326	356	458	637	1,028	1,698	2,500	4,444	7,482	15,438
8.00	244	265	298	330	427	596	959	1,587	2,277	4,046	6,786	13,542
9.00	222	243	276	309	400	560	898	1,488	2,077	3,670	6,126	11,775
10.00	204	224	257	291	378	529	844	1,399	1,898	3,316	5,499	10,137
11.00	188	208	241	275	359	501	796	1,319	1,738	2,983	4,908	8,627
12.00	175	195	227	262	342	476	753	1,247	1,595	2,670	4,350	7,243
13.00	163	183	215	250	327	454	714	1,180	1,465	2,378	3,827	5,986
14.00	154	173	204	239	314	434	678	1,120	1,348	2,105	3,339	4,853
15.00	145	163	195	230	302	416	646	1,065	1,243	1,852	2,884	3,844
16.00	137	155	186	222	291	399	617	1,014	1,147	1,617	2,463	2,957
17.00	130	148	179	214	281	384	590	967	1,061	1,401	2,077	2,190
18.00	124	141	172	207	272	370	565	924	982	1,203	1,723	1,543
19.00	118	135	166	201	264	357	542	884	910	1,023	1,404	1,013
20.00	113	130	160	195	256	345	520	846	845	859	1,118	598
21.00	108	125	155	189	249	334	501	812	785	712	865	295
22.00	104	120	150	184	242	324	482	779	731	581	645	101
23.00	100	116	145	180	236	314	465	749	681	466	458	10
24.00	96	112	141	175	230	305	449	721	635	365	303	.....
25.00	93	109	137	171	225	296	434	695	593	278	181	.....
26.00	90	105	133	167	220	288	420	670	554	205	91	.....
27.00	87	102	130	164	215	281	406	646	518	144	32	.....
28.00	84	99	126	160	211	274	394	624	486	96	3	.....
29.00	81	96	123	157	206	267	382	604	455	59	.....	.....
30.00	79	94	121	154	202	260	371	584	427	32	.....	.....
31.00	77	91	118	151	198	254	360	565	401	14	.....	.....
32.00	75	89	115	149	195	249	350	548	377	4	.....	.....
33.00	73	87	113	146	191	243	340	531	355	.....	.....	.....
34.00	71	85	110	143	188	238	331	515	334	.....	.....	.....
35.00	69	83	108	141	185	233	323	500	315	.....	.....	.....

DISCUSSION OF PRECEDING PAPER

JOHN B. CUMMING:

In his paper Mr. Barnhart has recognized the need for actuaries to question the use of the 1964 Commissioners Disability Table (1964 Table) for certain applications for which that table was not originally intended. Mr. Barnhart has given a great deal of thought to this problem and has done a vast amount of work to prepare alternative tables based on recent experience.

The subject of disability continuance is exceedingly complex, and the time available to consider the material set forth by Mr. Barnhart has been short. Therefore, these comments are preliminary thoughts which it is hoped will aid a discussion of the problems Mr. Barnhart has recognized and the solutions which he suggests. My purpose is to sound a note of caution and to raise some questions. Hopefully the discussion will provide answers.

Mr. Barnhart has based his work on data presented in the 1969 and 1971 reports of the Committee on Experience under Individual Health Insurance. In his paper he points out some of the limitations of these data. Experience during the years covered by the reports was unusually favorable. Hence gross premiums based on such data may prove inadequate unless substantial contingency margins are incorporated. Recent expected loss ratio constraints promulgated by some state insurance departments leave doubt whether insurers will be permitted to incorporate margins which prudently recognize the inherent risks of this business. A characteristic of disability income insurance is greater variance of the ratio of actual to expected morbidity when compared with the ratios typical of mortality, with which life actuaries are generally more familiar. I would be interested in any thoughts which Mr. Barnhart and other actuaries have concerning how this variance can be recognized in gross premium calculations to produce premiums with an acceptable confidence level of probable profit. One would expect intuitively that this variance would increase for longer elimination periods. This is of particular interest in working with multiple continuance tables for different elimination periods. Because of this variation of experience actuaries should proceed cautiously in using the experience of short observation periods, such as the 1969 and 1971 reports data, as the basis for calculations which project probable experience far into the future.

Another difficulty with the intercompany published data is its lack of homogeneity. Disability income experience is strongly affected by company practices with respect to underwriting, claim administration, and market concentration, among other factors. In advising a company on an appropriate basis to use for gross premiums, the actuary needs to consider these practices and to modify accordingly the premium assumptions. Thus we should avoid giving the impression that any single continuance table can serve as the appropriate basis for gross premiums for all, or even most, companies.

Mr. Barnhart has defined his tables in terms of the graduation operator rather than setting forth discrete values as is more traditional. This is a unique approach but a powerful one if it can be demonstrated that the values in the tables are not thereby unduly distorted. Mr. Barnhart has provided such a demonstration, within reasonable limits consistent with the reliability of the underlying data, for all points for which he has experience. Mr. Barnhart then uses this technique to extrapolate continuance patterns for which there are no experience data. This requires acceptance of the validity of the operator device for all levels of claim rate and continuance. I had a little difficulty with this, but, given the intent to develop a series of continuance tables for many different elimination periods, it seems the only practical device. This is an intriguing approach with many possible applications, and I hope that it will receive careful consideration by actuaries.

In Section V of this paper Mr. Barnhart states that the 1964 Table may understate disabled life reserves because of its construction as a conservative standard for active life reserves. This will be true only if the conservatism is not uniform throughout the table but is concentrated, as Mr. Barnhart suggests, at intermediate durations. Mr. Barnhart refers particularly to claims after long elimination periods such as 90 or 180 days. Without more data on continuance at these intermediate durations, it is difficult to draw definitive conclusions. It should be emphasized that the available experience data for these elimination periods are too sparse to permit reliable analysis.

Mr. Barnhart's paper opens many interesting possibilities. It should provoke wide discussion and consideration of these important questions by actuaries concerned with disability income insurance. Mr. Barnhart's proposal to define continuance tables in terms of operators is particularly interesting and points to the greater flexibility now available to actuaries in their analytical work through the use of new computational devices such as time-sharing computer services. We are in his debt for a stimulating and valuable contribution.

TIMOTHY A. HINCHLIFF:

The actuarial profession is deeply indebted to Mr. Barnhart for his invaluable contributions in the area of health insurance. This paper is the latest in a long series of papers in which Mr. Barnhart utilizes sound actuarial principles to develop practical information and techniques for the health insurance actuary. The results in this paper should be extremely helpful to the actuary in a stock company with limited disability experience.

This discussion will be directed to one area, the construction of basic continuance table values, particularly the number of lives disabled one year or longer. As Mr. Barnhart so aptly points out, the Society statistics show conclusively that during the first year of disability the number of lives disabled for a given duration varies greatly depending upon the elimination period of the underlying data. For example, the number of lives disabled for 30 days or longer based on experience with a 0-day elimination period greatly exceeds the number of lives disabled 30 days or longer based on experience with a 30-day elimination period. This fact led Mr. Barnhart to develop separate continuance tables for each elimination period up to 30 days.

In developing continuance tables, Mr. Barnhart used data for the first year of disability which was distinct by elimination period. However, for the second year of disability, he utilized data based solely on experience on policies with a 0-day elimination period for accident and a 7-day elimination period for sickness. For years beyond the second year, a ratio of the 1964 Commissioners Disability Table (1964 Table) was used. In other words, the assumption was made that the number of lives disabled for one year or longer was the same irrespective of elimination period.

This latter assumption seems questionable, given the wide divergence by elimination period in the number of lives disabled at durations less than one year. Assuming a homogeneous group of lives, it might seem logical that the number of lives would converge after, say, one year for each elimination period. However, as explained in the paper "Some Observations on the Nature of the Risk of Disability, Its Measurement and Control" by Miller and Courant (*TSA*, XXIV, 349), there is substantial evidence suggesting self-selection according to elimination period. In other words, groups of lives with policies of differing elimination periods do not form homogeneous groups. It is the opinion of this writer that Mr. Barnhart's assumptions of the convergence of basic continuance table values for each elimination period is not a valid one.

In his defense it should be noted that the Society reports provide no data for the second year of disability based on experience with either a 14-day or a 30-day elimination period. However, it does not seem appropriate to utilize this rather questionable assumption in deriving basic continuance tables and then draw conclusions about the inadequacy of the 1964 Table reserves using as criteria disabled life reserves based on these derived tables.

Mr. Barnhart is careful to note that disabled life reserves calculated from his 1971 Table will not provide a meaningful test of the adequacy of 1964 Table reserves for durations from disablement of two years or more. However, his findings of inadequacy of 1964 Table disabled life reserves at durations within the first year of disability are somewhat questionable. These inadequacies are forced results which automatically follow from the assumption of convergence of basic continuance table values for each elimination period.

An examination of the results in Table 13 supports this conclusion. The disabled life reserves calculated from the 1971 Table (7-day) for benefit periods of 12 months and 24 months are reasonably consistent with the corresponding 1964 Table reserves. The inadequacy of the 1964 Table reserves shows up on the comparison with the reserves on the 1971 Table (30-day).

The comparison using the 7-day table is meaningful, since, during the first two years of disability, the 7-day table was based solely on experience under policies with 0-day or 7-day elimination periods. However, the test of the 30-day table is artificial, since the 30-day table was based only on experience under policies with 30-day elimination period during the first year of disability. During the second year of disability, the 30-day table was based on experience under policies with 0-day or 7-day elimination periods. To make a valid test of the adequacy of the 1964 Table for disabled life reserves on policies with 30-day elimination periods, the reserves used as criteria must be based on a table derived solely from experience on policies with 30-day elimination periods.

JOHN H. MILLER:

Mr. Barnhart has again made an important contribution to the actuarial treatment of health insurance. It is somewhat anomalous that the concept of separate tables for different elimination periods, applied to group disability benefits since 1937, is only now being discussed with respect to individual disability benefits. While the tendency to malinger, together with some selection at the time of application, has influenced the group results to the point of requiring separate tables according to

elimination period, the scope for selection by the purchaser is obviously much greater in the case of individual policies. Mr. Barnhart has demonstrated the existence of such selection and revealed its extreme importance in the pricing of disability insurance.

In making allowance for elimination period selection, one should, however, bear in mind that the experience on individual loss-of-time policies, published by the Society, consists largely of business issued by insurers which offer optional elimination periods. Presumably, if a company were to allow no choice as to elimination period, its premium calculations should take into account that some applicants will be insured who would opt out for a longer or shorter elimination period if given an election. Specifically, if only a 30-day period were offered, the net annual costs might be expected to exceed the published amounts.

Lacking data on the prevalence of disability at the longer durations according to elimination period, the author has provided for eventual convergence of the continuance tables for the various elimination periods. An alternative would be to extend these separate continuance tables by assuming the same termination rates after the first year of disablement regardless of the length of elimination period. This would result in a series of continuance tables each of which is a constant multiple of any of the others after the first year of duration.

Mr. Barnhart's modification extends the two-dimensional 1964 Table into one of three dimensions—age, duration of disablement, and elimination period. Still to be considered is a fourth determinant, policy duration. What few data are available suggest that the effect of underwriting selection resembles that for life insurance only at the higher issue ages. Also, there is substantial evidence of a continuing secular trend in the disability rates at the upper ages. A practical means of dealing with this aspect of the disability risk is to load or project the basic table after age 40 or age 45 to reflect ultimate experience, as this may be determined statistically or by judgment. This margin over the observed experience, if established at an adequate level, will assure the sufficiency of the active life reserves and of the premiums at the younger issue ages.

To avoid redundant gross premiums, a "discount for selection," based on the assumed coefficients of selection, can be introduced in the premium formula for ages covered by the loading or projection factors underlying the ultimate rates.

Mr. Barnhart points out the apparent inadequacy of some of the disabled life annuities based on the 1964 Table standard. It can readily be seen how such inadequacies may result from ignoring the effect of elimination period selection. If, for any age at disability, we chart a

continuance table based on policies with a 3-month elimination period—for example, benefits 2 and 3, together with tables for shorter elimination periods, it will be found, using the author's method of analysis, that the continuance curve for each elimination period will occupy a position above that for the next longer elimination period. Then, if we draw in the 1964 Table continuance curve, it will start at an elevation above that for the 7-day elimination period and cut through the curves for the longer elimination periods, finally merging with that of the 3-month elimination. In general, this will create some overstatement of future benefits but a much greater overstatement of the number of disabled lives at the valuation date, thus causing an understatement of claim reserves. This reinforces the author's position that each elimination period requires its own table of disability and termination rates.

R. TERRY NELSON:

The health insurance industry is once again indebted to Mr. Barnhart for this major contribution toward a solution to a sticky problem for many health insurers. While everyone has known for some time how unsuitable the 1964 Table is for gross premium and allied purposes, it remained for Mr. Barnhart to come forward with a usable alternative.

It seems quite likely that Mr. Barnhart's work will be embraced by a good many companies seeking a more realistic basis for adjusting earnings. It is with this area, specifically active life reserves for guaranteed renewable and noncancelable business, that I wish to deal.

The Paul Revere is in the process of a morbidity study during which about 225,000 claims will be examined. Our objective will be to produce a series of continuance tables to reflect our experience by elimination period, occupation class, and sex. While our study is not complete, we have proceeded far enough to note some interesting similarities and some striking dissimilarities to Mr. Barnhart's work.

I have calculated some "statutory" active life reserves (no lapses, 1958 CSO mortality) using the Paul Revere table closest to the basic 1971 Table with respect to occupation class and elimination period. I compared these with reserves produced from the 1971 Table. The Paul Revere reserves were almost without exception higher than the 1971 Table values and ranged as high as 175 per cent of the 1971 Table reserves in some cases. This was true despite the fact that in over half the issue age and benefit combinations studied the Paul Revere net level issue age premium was lower than that from the 1971 Table. This result suggests that the tables in question differ sharply in slope by attained age, and this, in fact, turns out to be true. Very roughly, the curves of claim costs seem to cross

around age 40, with Paul Revere costs lower before that point and higher thereafter.

Our studies tend to verify Mr. Barnhart's conclusion that claim reserves at early durations based on the 1964 Table may be deficient, at least for Male Occupation Group I. In fact, our claim reserves are slightly larger than those from the 1971 Table in some cases.

JOHN S. THOMPSON, JR.:

Mr. Barnhart is to be congratulated on a very fine paper. It should be of great value to virtually all companies interested in noncancelable disability insurance.

It has now been almost twenty years since the Society's Committee on Experience initiated its collection and study of intercompany data on disability insurance. Consequently, a significant volume of data has now been assembled, and an experience table compiled from these data, appropriate for premium purposes, seems timely. A new experience table is timely also for the reserves required for generally accepted accounting principles (GAAP) accounting, since so many companies are in the process of introducing adjustment of earnings.

The 1964 Table is a single continuance table which was intended to be applied to all combinations of elimination period and maximum benefit period. There is ample evidence, however, that a separate continuance table should be developed for each elimination period and that a uniform percentage modification of the 1964 Table cannot represent current experience under all elimination periods with any degree of precision. On the other hand, there would be certain advantages in adopting a simple modification of the 1964 Table to represent the experience table. This approach will probably enable us to derive the special reserves for GAAP accounting, from statutory reserves, by approximate methods without elaborate revaluations. With this objective in mind, we have developed a table in which the annual claim cost is equal to the sum of 65 per cent of the claim cost based on the 1964 Table and a second element independent of age. The values of the second element were determined through a process of experimentation to produce the best possible agreement between the net level premiums according to our modification of the 1964 Table, when combined with the 1958 CSO and 3 per cent interest, and corresponding net level premiums according to the 1971 experience modification of the 1964 Table. Because of their uniformity by age, the constant elements of the formula have no effect on reserves, so that reserves on the modified table may be calculated as 65 per cent of statutory reserves.

The values to be added to the 65 per cent modification of the 1964 Table, in order to approximate the 1971 Table, are shown in Table 1 of this discussion. In order to test the closeness of fit between our modification of the 1964 Table and the 1971 Table, we have calculated the ratios of corresponding net level premiums on the two tables. The detailed results are set out in Table 2. The results in Table 2 indicate that the 65

TABLE 1

CONSTANT ELEMENT PER $100 MONTHLY INDEMNITY

ELIMINATION PERIOD (DAYS)	MAXIMUM BENEFIT PERIOD (YEARS)			
	1	2	5	To 65
7	$4.80	$5.00	$6.00	$6.00
30	− 0.20	0.00	1.00	1.00
90	− 0.35	− 0.30	0.80	0.50

TABLE 2

RATIOS OF NET LEVEL PREMIUM BASED ON 65 PER CENT MODIFICATION OF 1964 TABLE TO CORRESPONDING PREMIUMS BASED ON 1971 EXPERIENCE MODIFICATION TABLE WITH 1958 CSO, 3 PER CENT

(7-Day, 30-Day, and 90-Day Elimination Periods)

AGE AT ISSUE	MAXIMUM BENEFIT PERIOD											
	1 Year			2 Years			5 Years			To Age 65		
	7	30	90	7	30	90	7	30	90	7	30	90
25	105%	113%	96%	104%	106%	94%	104%	109%	100%	97%	95%	86%
35	100	106	103	101	104	103	101	106	103	98	100	95
45	96	99	104	97	101	104	98	102	103	99	102	103
55	93	90	100	97	97	104	97	97	101	103	105	112

per cent modification of the 1964 Table is a satisfactory representation of the 1971 Table.

Another question that seems to require further research arises from the classification of the Society's published data in only two occupation classes. For premium purposes it is important to have some objective measure of the variations in claim costs with respect to each of the occupation classes used for underwriting purposes. Typically four classes are used, although there are certain variations in this practice. In any event,

the two-way classification implicit in the Society's study is not producing all the information required for the various premium questions with which we are faced. A subdivision of the data, at least for Occupation Group I, would appear to be highly desirable.

EDUARD H. MINOR:

Observations on the Basic Considerations for Premium Calculations

Tables 1A and A10 include data for claims arising during the first 7 days of disability. Ninety-five per cent of the data submitted to the committee for 0-day elimination for sickness disability came from one large company which had not issued such coverage for ten years. All of these policies had been written to expire at age 60, and only the lives with good experience were extended to age 65. There is little basis for entries at ages 67 or 72, and, for practical purposes, it might be better to start these tables at the eighth day.

Mr. John H. Miller, in his paper "Some Observations on the Nature of the Risk of Disability, Its Measurement and Control" (*TSA*, XXIV, 349) refers to Dillner's work on determination of variation in disability rates by length of elimination periods.[1] Dillner found that the "intensity of disability" varied from 1.721 for a 7-day deferment to 1.308 for 30 days, as compared with a 3-month elimination period.

On the basis of the findings of Miller and Dillner, it would appear that the premiums calculated from a continuance table based on the heavy rates experienced under policies with a 7-day elimination period will be quite conservative with respect to expected claim costs after a 14-day, 30-day, or 1-month deferment. The financial experience of companies offering such policies twenty years ago, before these recent refinements came to light, has been very satisfactory—enabling more liberal underwriting, more widespread marketing, and, for participating policies, increased dividends for policies with longer elimination periods.

In 1968 Mr. E. L. Bartleson, in a Society textbook,[2] wrote that "the probability of being disabled on the t-th day measured from the date of disablement is usually smaller for persons who have a long elimination period . . . than a short period . . . a continuance table based on experience with a short period . . . will overstate the experience on policies with a longer elimination period. Usually it is impossible to develop a single continuation table that gives completely accurate values for every elimi-

[1] Carl-Gösta Dillner, "New Bases for Non-cancellable Sickness Insurance," *Skandinavisk Aktuarietidskrift*, 1969.

[2] *Health Insurance Provided through Individual Policies* (2d ed.).

nation period and benefit period combination, so that the result will have to be a composite that gives the best average results which can be conservatively obtained" (p. 194). Mr. Barnhart may be attempting the impossible in his efforts to "force a fit" with a basic 7-day table without making overstatements and overcorrections.

Reference has been made by Miller and by Hamilton-Jones[3] to the economic prosperity of the last twenty-five years as being helpful in reducing the rate of disability. Perhaps this is intended as a euphemism for the detested word "inflation." Shortly after World War II, companies venturing into the sickness disability field, after a careful scanning of their competitors' ratebooks in the absence of reliable tables, wrote policies for $100 of monthly benefit. Such policies, if still in force today, would be of so little value in relation to the cost of living that doubtful disabilities would not give rise to claims. The older the policyholder, the more the chance that he has this type of inflation-scorched coverage and rates at the upper ages are below the expected.

Inflation has reduced claim cost while it has made the expense loading a serious problem in computing gross premiums. Prosperity never caused this condition. Companies are concerned with their financial experience because of expenses, not disabilities. Hence they offer longer waiting periods and have had to double their average-sized policies in order to keep the premiums reasonable in relation to the benefits.

At ages below 45, applicants are aware of the substantial disability benefits available under OASDI to a family with dependents—significantly larger than those available for older lives who have had many years of contributions under lower maximum wages. Younger lives are not seeking long-term coverage with long elimination periods; they want large indemnities after short elimination periods. These they obtain through other coverages. Sales of individual coverage to lives under age 40 become a smaller proportion of the total each year, and self-selection more significant.

Continuance tables by size of benefit may be of greater practical value to health insurance actuaries than elimination period tables. In fact, the cost of claim investigation and the rate of lapsation by elimination period may be of greater concern than the disability rates. It is only the Male Occupational Group II morbidity rates that are a current problem, and the 1971 modification tables were not prepared for that occupational group.

Exclusion riders have a significant effect on the type of claims sub-

[3] J. Hamilton-Jones, "Actuarial Aspects of Long-Term Sickness Insurance" (paper presented to the Institute of Actuaries, November 22, 1971).

mitted. Many individual policies which would have been ridered if a short elimination period had been applied for are issued at standard rates with a 90-day elimination period. Sickness and disease have, for any specific cause, very much the same duration of disability regardless of age; the incidence, of course, differs. Good underwriting can exclude the lengthy disabilities that may be anticipated by poor medical history of applicants over age 45, reducing the claim costs expected on the basis of waiver-of-premium experience of forty years ago.

As Hamilton-Jones points out, "the rate of permanent total disablement in the past was much higher than the rate would be today. Permanent impairment is no longer necessarily a bar to useful employment . . . restrictions are now eased by modern aids and special vehicles." Many diseases are either disappearing or no longer causing disability. The 1952 study, upon which the 1964 Table was based, found tuberculosis, paresis, and other effects of syphilis, polio, and other infectious diseases to be important causes of the disability rates on which the tables were based. Today many of these diseases have become relatively unimportant. On the other hand, coronary artery and mental diseases "increase day by day."

Disabled Life Reserves: Reliability of Total Liability versus Small Cells

Mr. Barnhart states in the opening paragraph of Section V of his paper that "the 1964 Table may be an inadequate standard for the valuation of disabled life reserves." When he suggests that this may be particularly so for group long-term disability(LTD) benefits, he may be entirely correct. However, it might be more accurate to say that it is an inadequate standard for nonunderwritten business. None of these claims follows a period during which the claimant had no income, as might be surmised from the statement that the claims follow an elimination period of 90 or 180 days. Every one of them follows 26 weeks of temporary sickness benefits provided by the employer or by the state or perhaps by workmen's compensation payments. Even where there is not a basic, temporary disability benefit coverage in force with the group LTD carrier, there is frequently a salary continuance program in effect for the employees with sufficient length of service or salary to qualify for the coverage. In individual insurance there may be little other coverage for the dentist or lawyer who purchases a policy with a 180-day waiting period, although many association plans that are available may be quite adequate. Moreover, the tax savings on the $15,000 or more of professional income lost during the first 6 months of disability is equivalent to at least $5,000 of benefit.

From a practical viewpoint, disabled life reserve values at the youngest ages for policies with benefit periods of 12- or 24-month maximum and 30-day elimination period might well have been excluded from the 1971 Tables. For example, elimination periods of 30 days or longer are not generally offered with individual policies having a maximum benefit period of 12 months. Such policies in Occupational Group I would have an insufficient benefit to produce a claim return of more than 50 per cent of the gross premium unless the coverage was for at least $500 of monthly indemnity; even a two-year maximum would barely support the premium for a benefit of less than $400.

Examination of Table 13 points up some wide disparities in reserve values between the new modified table and the 1964 Table in cases (1) where the claim duration is less than 6 months and (2) at the very young ages for a 30-day elimination period policy with an 11-month maximum payment period. In the first type of case, such claims under individual policies are permitted to be valued on the basis of the individual insurer's experience as verified by the follow-up shown in Schedule O. Many companies still use three times the elapsed duration (or the time remaining to the end of 12 months of benefit at the year end, if less), although Mr. Barnhart states that such a practice is of "dubious adequacy" (p. 151). Table 11 indicates that this "rule of thumb" is *very conservative* for all claims under 12- or 24-month policies with less than 9 months' duration. The second type of case is of little or no importance to either the individual insurance or group actuary making a reserve valuation of open claims. As previously stated, there is almost no noncancelable insurance issued at these ages for this type of coverage because of lack of engagement in an insurable occupation on the part of applicants.

In Table 1A, which shows the basic values used to construct the 1971 modification of the 1964 Table, 840 claims are tabulated for age 22 as lasting 1 month out of 100,000 exposed; the 1964 Table for both occupational groups and sexes showed 3,923 claims. In order to produce the claim cost of 0.0155 shown for age 22 in Table 1B, there would have to be an average duration of 8 weeks of payment following the first 30 days of disability. The reserve value for claims open at age 22, in Table 11, with 1 month of duration of disability, may be interpolated as 3.7 months for only 11 months of payment possible under the maximum that was used for this table. Had all of the 840 claims been incurred at midyear, the reserve would have been far in excess of the total claim cost in Table 1B—using 4 months for each claim instead of the 8 weeks indicated by the 1969–71 data. It is not surprising, therefore, that the new table shows a reserve equal to 340 per cent of the 1964 Table at duration 1.5 months in Table 13, or 213 per cent at duration 4.0 months.

Since there are few if any claims at ages 17 and 22, since such claims would be valued by most individual companies at three times the elapsed duration without giving rise to any inadequacy, and since such values can be of no assistance to the group actuary concerned with LTD benefits, I would suggest that these ages be expunged from the 30-day elimination period tables along with the 0.5-month durations; also that the 9-month duration for the 12-month maximum be eliminated, since 4 months' reserve is used for claims with 8 months of payment at December 31. For 60-month, 120-month, and age 65 maximums, all values for 4 months or less of elapsed disability can be deleted, thus avoiding any need to explain the peculiar dip in reserve values shown at age 42.

Miscellaneous Questions

PREMIUM CALCULATION TABLES

Since the 1971 Table is not a modification of the composite values for all occupational groups and sexes shown in the 1964 Table, would it not be better to make this clear in all the table headings? For example, "Male O.G. I Adjustment 1971" might avoid the tendency for readers to expect some slight modification of the basic values of the *composite* 1964 Table.

In Table 1A the basic values for Male Occupational Group I, which were used to construct the 1971 Table, ran about 75 per cent of the composite 1964 Table. In view of the high rates assumed for females and Occupational Group II, there would be no quarrel with the use of 70–80 per cent of the composite. However, at the end of the first month of disability, the values range from 25 per cent of the claims at age 22 to 50 per cent at age 57 and to 70 per cent at age 67. Then, 11 months later, as shown in the tabulation on page 125, the persisting claims for age 22 are 137 per cent of the survivors in the composite table; at age 67 they are only 58 per cent. This appears to be more of a complete reconstruction than a "modification."

Comparison of the basic values underlying the 1971 Table and the composite 1964 Table produces differences of such magnitude as to lead to the conclusion that either one or the other of the two tables is unreliable.

RESERVE TABLES

The paper states that after two years of disability the survival rates of the 1964 Table are used, that is, the same disabled life annuities of the Class III table. It might be expected that even with some graduation the values should be the same after five years of disability—for any occupation and both sexes. However, comparison of disabled life annuities at duration 10.5 years, for lifetime coverage, shows much higher reserves on

the 1971 Table than on the 1964 Table. For the average-sized policy of $400 monthly indemnity, the increases range from $10,784 at age 57 to $72,880 at age 32. These are substantial differences.

The thesis that the elimination period makes some difference in the probability of survival at *all* durations seems to lose whatever validity it has by the forty-second month of disability. Since the reserves of the 7- and 30-day policies converge at the longer durations, it is suggested that the near-duplication of values in Tables 10 and 11 be eliminated by consolidation of portions of the tables.

(AUTHOR'S REVIEW OF DISCUSSION)

E. PAUL BARNHART:

The several discussions submitted have added some valuable thoughts to this complex subject of an experience-based disability continuance table and have also raised several notes of caution. These words of caution are much in order, and I would like not only to second them but also to amplify and summarize the most important reasons why the 1971 Table should indeed be approached and used with great caution and careful judgment.

First of all, to re-emphasize the introduction to the paper, this 1971 Table is at best only a modification of the 1964 Table, and the modification rests on the Society reports data, which are not only limited to the first two years of the benefit period (the first year only, except for the 0:7 elimination period data), but also provide only a limited number of continuance value points. There are enough claims, in my opinion, to render most of these data quite credible with respect to the period studied, but there are few value points reported from which to undertake the construction of an entire table. Hence there is admittedly a great deal of reliance on interpolation and extrapolation, and the modification is not able to proceed very far at all before it must fall back upon the 1964 Table all over again and, moreover, in a way that relies heavily on judgment, as indicated in the basic continuance values set out in Table 1A, the starting point of the graduation. Nevertheless, let me repeat that I believe the need for such a table is so great that its development is well justified in spite of these very substantial limitations.

The 1971 Table is based on the committee's reported experience for a very favorable period, 1966–69. Moreover, the table is constructed on a net experience basis. There are no margins of conservatism built into it, because I did not consider it my place to judge what the extent of such margins should be. Nevertheless, any actuary using the table must

certainly provide for reasonable margins of conservatism, appropriate to his own purposes, arising from a variety of considerations, not merely from the fact that the table is based on a favorable recent period of observation. I would have preferred that the experience data underlying the 1971 Table be based on a longer period of experience, particularly including some less favorable years, but the 1969 and 1971 reports appeared to me to be the only recent ones presenting enough data breakdown to be satisfactory for the purpose.

Among the reasons for caution and conservatism in using the 1971 Table, in addition to the fact that it is a net experience table based on a recent favorable period of experience, are these, some of them cited in oral discussion by other contributors attending the concurrent session, who unfortunately did not reduce their valuable remarks to writing:

1. The reports data, coming as they do from a number of companies, contain much heterogeneity, and, moreover, this heterogeneity may concentrate at various points in the data in ways that can distort the composite results used to construct the table.
2. Any company must, of course, prefer its own experience to the extent this is available. Wherever a company has such experience in any volume, the 1971 Table may perhaps best serve only as a point of reference or comparison, or else the actuary may quite possibly be able to use such experience to construct a company table that serves as a reasonable modification, in turn, of the 1971 modification. I would expect that there would be considerable opportunity for such modified usage.
3. The actuary using the table as a starting point for, say, expected costs or benefit reserves must consider carefully all variant policy provisions, definitions of disability, and so on, that he is working with, as well as the underwriting involved. These variables create, of course, part of the heterogeneity that comprises the reports data and will probably be a very major factor in the modifications and margins that the actuary must consider.

Such problems as all of these, however, have existed to begin with, and I will have to object to any implication or suggestion that any presentation of the 1971 Table has created any major new difficulties. All of these problems have surely confronted the disability actuary all along, and I am convinced that the publication of the 1971 Table gives him a valuable additional tool to help him cope with them more confidently and effectively, so long as he realizes that caution and good judgment remain just as important as they ever were.

One point of keen concern has to do with the degree of margin which should be loaded onto the table where it is to be used as a basis for long-term projections of expected costs, such as under a new noncancelable

disability program. This matter becomes particularly crucial where actuarial justification for rates must be submitted to insurance departments. I think it must be recognized that substantial margins of conservatism are in order here, whenever (*a*) guaranteed rates will have to apply over a considerable period of years into the future or (*b*) relatively long elimination periods or long benefit periods are involved, under which the relative degree of risk is increased and also where, obviously, the 1971 Table possesses the least reliability. On this score, I heartily second the comments made by John Cumming in the third paragraph of his valuable discussion. My own practice and judgment have usually been to incorporate contingency margins ranging from a minimum of around 15 per cent to as high as 40 per cent or so of the net values, where factors *a* and *b* above have been significant in the gross premium structure. (Attempts to go much beyond these levels usually result, I might mention, in uncompetitive rates!)

Let me now comment more specifically on the written discussions. I have already touched on the major points raised by John Cumming in his discussion, and I thank him again for his very pertinent observations. Three additional comments seem in order in response to his remarks.

First, John comments on my use of "graduation operators," that is, the particular graduating technique I have used, and suggests that distortion of table values or invalid extrapolations may result from this. I do not agree that such distortions or invalid projections are likely to arise from my particular graduating technique any more than under any other reasonable graduating technique. Any graduation is limited by the number and range of value points available, and the extensive supporting comparisons, provided in the Appendix to the paper, on my preliminary functional graduation of the 1964 Table, serve in my opinion to show that the two-element functional graduation used is capable of producing reasonably faithful results. Where the graduation must be accomplished using a very limited set of data value points, as was the case with the 1971 Table, it is my opinion that the automatic inherent mathematical consistency of functional graduation aids the task and at least helps to guard against undue distortion. As to whatever degree of distortion or invalid extrapolation may actually be present in the 1971 Table, this is the fault of the limited available data, in my judgment, rather than of the specific technique of graduation adopted.

Second, John says that I have used the technique "to extrapolate continuance patterns for which there are no experience data." While this is quite true, in the sense that the reports data are limited to the first 12 (or 24) months, this is where necessarily I have fallen back on the 1964

Table. Accordingly, I am not placing a sort of blind faith in the "validity of the operator device" but rather depending, as a frankly unfortunate necessity, on the 1964 Table. Any other graduating approach would have had to be based on some equivalent kind of decision. Whenever actual raw data are available, over a given range of continuance, then I feel satisfied that my functional technique is as valid a method as any—subject, of course, to testing against all data points actually available.

Third, John raises doubts about my conclusions that the 1964 Table may understate disabled life reserve values at intermediate durations. Tim Hinchliff, Ed Minor, and several others (in their verbal discussions) have voiced similar doubts about this.

John states that I referred "particularly to claims after long elimination periods such as 90 or 180 days." This is not the case. The reports do not provide any data for elimination periods in excess of 30 days. My quantitative analysis of this area is limited in the paper to claims following elimination periods of 7 days and 30 days only, and the apparent deficiencies within the 1964 Table emerge primarily in relation to claim continuance based on the 30-day 1971 Table values.

It is actually a simple matter to prove that disabled life reserve deficiencies occur for at least one duration within the 1964 Table, in relation to the 1966–69 reports data, and such proof rests purely on the raw reported data itself, not on any graduations, extrapolations, or "operators" whatever. This deficiency, moreover, remains evident over all ages of disablement. Consider the reports data for the 30-day elimination period, first year of benefit period. The average duration of claim may readily be determined from this information and compared with the corresponding average duration of claim arising under the 1964 Table. Such an average duration is, of course, the same thing exactly as the disabled life reserve, per unit amount, required at the moment the elimination period is satisfied, and at zero interest (Interest will have little effect on these values in any case, since the average duration of disability in no instance exceeds 4 months).

I presume that no one will quarrel with my use of the data in Table 1A of the paper for this purpose, if limited to these average claim values only, since Table 1A (at this point) merely serves to break down Table 1 into quinquennial age values instead of decennial age groups. On the basis of data from Table 1A, the accompanying tabulation shows a comparison with the 1964 Table. Thus, at every quinquennial age, the Table 1A data show an average duration significantly exceeding that obtained from the 1964 Table, the range varying from 147 per cent at age 22 to a high of 164 per cent at age 42 and finally back to 131 per cent at age 62.

COMPARISON OF AVERAGE DURATION OF CLAIM: 1964 COMMISSIONERS TABLE VERSUS DATA FROM TABLE 1A (DURATION IN MONTHS)

(30-Day Elimination Period; First Year of Benefit Period)

	Age at Disablement								
	22	27	32	37	42	47	52	57	62
(1) 1964 Table....	1.26	1.27	1.31	1.39	1.52	1.72	1.98	2.39	2.98
(2) Table 1A.....	1.85	1.91	1.98	2.21	2.49	2.61	2.65	3.13	3.90
Ratio (2)/(1).....	1.47	1.50	1.51	1.59	1.64	1.52	1.34	1.31	1.31

Obviously, at the 30-day duration and for a 30-day elimination period, the 1964 Table produces inadequate disabled life reserves. Moreover, it is in my opinion virtually impossible to construct any sort of reasonable continuance table that would reproduce the Table 1A number of lives disabled and one-year claim costs, for the 30-day elimination period, that does not lead to increasing relative deficiencies in the 1964 Table disabled life values over the next several months of claim continuance. Let me, accordingly, issue a friendly challenge to the doubters to try to construct such a table, consistent with the Table 1 or Table 1A data, which follows the basic continuance criterion of a rate of termination decreasing during the first year of disablement, and which will not also indicate that the required reserves, at intermediate durations between the end of the elimination period and about the fifth or sixth month, reach levels in excess of at least 200 per cent of the 1964 Table. I am willing to be shown, gentlemen, but I don't think you can do it!

If I am right, with respect to a one-year benefit period, it also seems unlikely that the 1964 Table will develop adequate disabled life reserves for benefit periods somewhat longer than one year as well. There is no way to be sure, of course, about longer periods in excess of two years or so.

I made one statement in the paper, however, which generalizes too far on this matter. This was my comment, in Section V, that "adequacy for active life purposes may therefore tend automatically to produce inadequacy for disabled life purposes." While this *may* be the effect (and I remain quite persuaded that this is definitely so, under the 1964 Table), it is certainly not a necessary or general principle. In fact, it is very easy to build conservatism into a continuance table that will assure conservatism for both active and disabled life values. All that must be done is to

build in the conservatism in such a way that the rate of termination is reduced at every point. If a functionally graduated table such as the 1971 Table is used as the starting point, this is very easy to accomplish, since one or more parameters can be modified readily so that the force of termination, $\pi^{(t)}$, is invariably lower. A slight decrease in the attenuation parameter, a, will produce this result.

For example, take male age 37, and reduce the value of a in each element by 1 per cent. The comparative effect on both active life claim costs and disabled life reserves is illustrated in the following tabulation:

	"100%a" Values	"99%a" Values
3% claim costs, $10 monthly benefit:		
7-day elim/24 mo. max.	$1.278	$1.335
30-day elim/120 mo. max.	0.807	0.866
3% disabled life reserves per $100 monthly:		
24-month max. (7-day elimination):		
At 1.5 months	$ 230	$ 234
At 4 months	476	481
At 9 months	938	939
120-month max. (7-day elimination):		
At 4 months	$1,127	$2,740
At 9 months	3,511	4,775
At 42 months	5,393	5,414

Note that the relative effect, under this adjustment, is much more pronounced for a long maximum period, especially the short duration reserves. The over-all effect can be kept more evenly distributed by adopting somewhat modified adjustments: for example, reducing the value of a in the first element, d_1, by 1 per cent but reducing the value of a in the second element, d_2, by only 0.5 per cent. In any case, it is a very simple matter to assure at least some conservatism in every table value, whether for active or for disabled life valuation.

Tim Hinchliff states that I made the assumption that "the number of lives disabled for one year or longer was the same irrespective of elimination period." While this comes close to the effect of the assumption I employed to modify the basic 7-day table to fit other elimination periods, this is not actually the assumption. The assumption actually made was that the d_1, or "short-term" function, could be modified in a simple way to approximate the variable fit needed, while d_2, which is essentially the "long-term" function, is left unchanged. The object was simplicity, and the rationale underlying this experimental approach was that really long-term disability, largely represented by the d_2 function, would not be

materially affected by the elimination period, whereas short-term disability, largely represented by d_1, would be heavily affected. Again, for simplicity, I hoped to achieve the necessary variation by modifying only a single parameter, and tests indicated that modification of the attenuation parameter, a, produced the most effective results, especially over a range of elimination periods. Accordingly, I solved for the value of b, the adjustment factor required to modify a sufficiently to reproduce the 30-day/1-year claim costs.

This does turn out to be a little too simple. As Ed Minor suggests in his discussion, I "may be attempting the impossible." What happens under the simple basis of variation I adopted is that, while the 30-day/12-month claim costs of the 1966–69 data are well reproduced, as well as the 14-day costs, the numbers of lives disabled at 30 days, that is, the 30-day elimination period claim rates, are not well reproduced. These are understated below age 37 and then become somewhat overstated at age 37 and over. In order to produce accurate first-year claim costs, this means that the reverse must hold true for the number of lives disabled at the end of the first year of benefit: that is, below age 37 the number is overstated. At age 37 and over, the number disabled becomes understated. Hence it becomes likely that the 1971 Table produces claim costs somewhat too flat by increasing age, for 30-day or longer elimination periods and for benefit periods in excess of 12 months. If sufficient data were available, therefore, to test this, I suspect the result would be that these costs should grade somewhat more steeply by age than is indicated by the 1971 Table.

As to the disabled life reserves, these would become a little lower below age 37 at disablement, but they would become higher at age 37 and over. The 1964 Table would still be shown to develop inadequate reserves at intermediate durations, but the inadequacy would not grade down as steeply by advancing age as indicated in Table 13 of the paper. The ratios in columns 5, 10, and 15 of Table 13 would be lower for age 22 but higher for ages 37 and older.

A more refined basis of variation is obviously necessary to correct for this. It is possible to reproduce accurately the 30-day claim rates, as well as the 30-day/12-month claim costs of Table 1A by introducing a "b factor" into the d_2 function as well as into the d_1 function. The d_1 b factors would then change to new values, but the two-variable basis which results is able not only to reproduce the first-year claim costs of the reports data also the 30-day claim rates, and certainly would reflect more accurately the number disabled at the end of the first year of benefit also.

To test the possible effect of such a refinement, I worked out the double b factor adjustment for age 22, which is the point at which the distortion appears to be the greatest in relation to the Table 1A data. Comparative results are shown in the table below, compared with the 1971 Table values:

MALE VALUES: 30-DAY TABLE

	1971 Table (Single b Factor)	Double b Factor Adjustment	
		Values	Ratio to 1964 Table
Value of b for d_1	0.44864	0.27054	.....
Value of b for d_2	0	−0.39441	.....
Number disabled, per 1,000,000 exposed, at 12 months	940	645	86%
Number disabled at 36 months	525	346	89
Disabled life reserve values (per $100 Monthly benefit):			
12-month maximum period:			
At 1.5 months	$ 517	$ 450	369%
At 4 months	636	625	209
24-month maximum period:			
At 1.5 months	863	739	408
At 4 months	1,269	1,234	256
At 9 months	1,131	1,117	114
120-month maximum period:			
At 1.5 months	1,976	1,631	568
At 4 months	3,304	3,118	274
At 9 months	3,866	3,705	103

Note that, while the reserve ratios to the 1964 Table, shown in the right-hand column, are reduced from those for the 1971 Table, they do not reduce very much, even for this most extreme case of age 22. Note also that with double b factors the factor signs may be either positive or negative, and both can take on either sign, moving on through the quinquennial ages. This means that display of such factors must be shown in a manner slightly modified from the form used in Tables A8 and A9. A negative b factor can be shown by displaying a value of y, b that has an absolute value less than unity, where this absolute value is the complement of the absolute value of the negative b factor itself. In this way, the condensed display used in Tables A8 and A9 can be preserved, and the same computed logic can still be applied to the condensed input data. The sign of y, b still indicates whether y is equal to $+1$ or -1. An absolute value greater than unity indicates that b is

positive and has the value of the decimal portion of the quantity. A value less than unity indicates that b is negative and has an absolute value equal to the complement of the decimal value shown (b always has an absolute value less than unity). Thus, for male age 22, the values of y, b are, for the d_1 function, -1.27054; for the d_2 function, -0.60559.

Shown below is the complete set of double y, b factors for both the male and the female tables. Also shown, for reference, are the numbers of lives disabled at 13 months' duration, the end of the first year of the benefit period. I hope that the individual morbidity committee will be able to publish data that will indicate whether or not these numbers disabled are "within the ball park" or not, because such a test would go far toward demonstrating the basic validity or invalidity of the graduation extrapolation implicit in these adjustments.

Age	Male Table			Female Table		
	$(y, b)_1$	$(y, b)_2$	Number Disabled at 13 Months (30-Day Table) per 100,000 Exposed	$(y, b)_1$	$(y, b)_2$	Number Disabled at 13 Months (30-Day Table) per 100,000 Exposed
17	−1.29050	−0.11785	59	−1.14673	−1.61041	108
22	−1.27054	−0.60559	62	−1.19840	−0.28939	119
27	−1.24030	−0.84690	73	−1.20935	−0.77292	180
32	−1.22021	−0.91352	79	−1.19892	−0.97783	308
37	−1.25236	−1.08718	128	−1.24358	−0.88867	322
42	−1.22708	−1.65583	202	−1.23061	−0.68815	284
47	−1.19796	−0.16878	296	−1.26728	−0.88819	390
52	−1.19422	−0.77180	398	−1.24490	−1.92750	665
57	−1.13736	−0.91730	743	−1.26981	0.82220	926
62	−1.12729	0.81740	1,330	−1.30015	0.79760	1,082
67	−1.00000	1.00000	1,640	−1.37661	0.80138	1,526
72	−1.00000	1.00000	2,740	−1.27374	0.89368	2,470

It is interesting to note here that the values of the b_1 factors are very much leveled out under this two-factor adjustment. Also, at most ages the number of males disabled at 13 months is closer to the 1964 Table value.

As a final comment on the 30-day table graduation in the paper, note that the number of lives disabled at 12 months is *not* the same as for the 7-day table (shown in Table A10 of the Appendix). The number in Table A10 is 1,012; here it is 940, or about 7 per cent less. At 24 months, however, the numbers are 673 and 668, respectively. This illustrates

further the point brought out above, that my assumption was that only the d_1 function varied with elimination period, not that the number disabled for one year or longer is independent of the elimination period, as indicated by Tim Hinchliff. Nevertheless, the values do converge eventually, as indicated by the 24-month values, when the d_2 function has essentially "taken over" the continuance. By 36 months the values are identical. It should be noted, however, that convergence does not occur if the more refined assumption of double b factors is employed. Under this assumption the values *never* converge, even ultimately, and this is in all likelihood a more valid outcome, as suggested by Tim. It is my hope that in the next individual committee report on disability experience, to be published next year, it will be possible for the report to include the number of lives remaining disabled at the end of the first year of benefit, for the 30-day elimination period, and if possible to include also some data on the second year of the benefit period. This would give us very valuable information for further testing and refinement of these theories.

Before I leave this subject, it may be of interest to display the numbers disabled at 12 months, under the 1971 Table (30-day) for all the data ages, in comparison with the numbers under the 7-day table shown in Table A10 of the Appendix:

COMPARISON OF NUMBER OF MALE LIVES DISABLED AT 12 MONTHS' DURATION SINCE DISABLEMENT

	Age at Disablement								
	22	27	32	37	42	47	52	57	62
7-day table	1,012	1,055	1,098	1,222	1,383	2,075	3,357	5,112	8,678
30-day table	940	1,001	1,055	1,051	1,167	1,815	2,899	4,806	8,453

Note.—The values at ages 67 and 72 are identical, since $b = 0$ for these ages.

John Miller has suggested a different approach for extension of the continuance to longer durations. This is to assume the same rates of termination, after the first year, regardless of elimination period, such rates to be applied to whatever numbers remain disabled at one year under each elimination period. This would be approximately the same thing as the use of a constant multiple of the d_2 function in the 1971 Table, differing for each elimination period. The alternative I have suggested above, of using b factors for both d_2 and d_1 is a different assumption that does not lead to converging rates of termination, but the over-

all effect on the continuance is rather similar to that produced by John Miller's suggested technique, and, as mentioned above, I suspect that a refinement of this general nature will turn out to be closer to reality. John Miller has had many years of experience with disability continuance problems, and I have very great respect for his views on this subject.

John also points out another important principle, in the second paragraph of his discussion. If there were no optional selection of elimination period by individual insurance applicants, then we should expect less variance by elimination period; in particular, if only the 30-day period were available, the resulting 30-day claim costs would surely increase. Some companies have been moving in the direction of withdrawing short elimination period plans from sale, so this principle becomes more than a matter of academic interest.

Mr. Miller also draws attention to the fourth dimension of *duration*, a dimension unfortunately missing from the committee reports. Here again, I hope very much that future reports can provide some data broken down by duration.

Terry Nelson's comments about the slope of Paul Revere Life's claim costs are extremely interesting, because they seem to reinforce my comments above about the age-graded distortion resulting from my too-simple adjustment of the 1971 Table (7-day) in order to adapt it to other elimination periods. As I mentioned above, the effect of a more refined adjustment, such as use of double b factors, would evidently be a steeper slope of costs, the values being lower below age 37 and higher at ages 37 and over. Terry mentions that the Paul Revere scale does in fact cross the 1971 Table values around age 40, a fact strikingly consistent with the above observations. This tends to confirm all the more strongly the conclusion that such a more refined method of adjustment should be used.

John Thompson has contributed yet another very interesting and evidently extremely practical approximate technique which, as he indicates, offers the immense practical advantage of permitting use of a constant multiple of the 1964 Table active life reserves.

I also found it of interest that his method is equivalent to that which I used in Table 7 of the paper to approximate the costs for Male Occupation Group II. John's technique extends this very practical approximate technique to the entire array of male active life claim costs.

Ed Minor questions my use and presentation of 0-day elimination period values. These have no effect on the values for the 7-day or longer elimination periods, and accordingly I see no harm in including them. However, they certainly do not belong in Table A10! This is specifically

a 7-day table and hence should *start* with the seventh day. Accordingly, the final published version of Table A10 will delete the values prior to the seventh day, as Ed suggests ought to be done.

Ed also comments, as did John Miller, on the evidence of a secular trend affecting the adequacy of costs at higher ages, and he gives some interesting and useful insight into possible underlying reasons for this. He also comments on yet a fifth dimension: continuance by size of benefit. Perhaps, as Ed suggests, this would be of even greater practical value than continuance table variation by elimination period. Unfortunately, we do not seem to have any data on the fifth dimension to work with. Perhaps, again, the Committee on Experience under Individual Health Policies could do something to begin to fill this gap also.

I cannot agree with Ed's comment that "it might be more accurate to say that [the 1964 Table] is an inadequate standard for nonunderwritten business." While this may well be the case so far as group LTD is concerned, the 1966–69 data in the reports, used in the paper, are derived from *underwritten* business, and I still say that the evidence points rather strongly to inadequacy of the 1964 reserve values at least within the first year of disability.

Ed offers various comments about the practical aspects of disabled life reserve valuation. While I agree with him that certain of the reserve values shown in Table 11 may have little occasion for actual use, I see nothing to be gained by deleting them purely on this score. However, I do agree that the 0.5-month duration values included in Table 11 are illogical, since this is a 30-day table, and these values are deleted from the final published version of this table. Also, at Ed's suggestion, the 30-day values beyond 42 months' duration have been deleted, since they become virtually identical with the corresponding 7-day values shown in Table 10.

Some comment needs to be made here concerning the use of the 1964 disabled life reserves for durations of disability of less than two years. The National Association of Insurance Commissioners reserve standards state that the "reserve should be established in accordance with the 1964 Commissioners Disability Table" but permit at the option of the insurer, for claims of less than two years' duration, use of the insurer's experience or other assumptions "designed to place a sound value on the liabilities." Many companies do in fact use the 1964 Table for claims of less than two years' duration, sometimes down to as short a duration as 3 months. One obvious reason for this is the desire to ensure that such reserves qualify as "life insurance reserves" for federal tax purposes. Hence my concern about the adequacy of the 1964 Table for short-duration claims

is, I think, considerably more than a merely academic concern, as Ed would seem to be inferring.

In conclusion, let me thank all those who contributed written discussion of the paper. Every one of the discussions has added valuable comments and additional insights, which I much appreciate and which I think will be of great value to those using any of this material as well as to others who may enter into further research in this very complex and important field.