DISABILITY CONTINUANCE STUDY

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ABSTRACT

The industry is reviewing the adequacy of the 1964 Commissioners Disability Table (1964 CDT) as a basis for reserving disability claims. This paper is intended to aid in this review by showing the results of a study of Mutual of Omaha's claim continuance experience and its relationship to the characteristics of the 1964 CDT for long-term individual disability business. This study was limited to the experience of totally disabled insureds in their second and subsequent years of claim continuance.

Another purpose of the paper is to provide individual insurers with information that might aid them in their deliberations concerning reserve adequacy and/or reserve table modifications.

INDEX OF GRAPHS

CATEGORY OF EXPERIENCE	AGES AT DISABLEMENT			
	All	18–39	40–59	60–99
Continuance rates	B	....	....	....
Actual-to-expected continance ratios	A	....	....	....
By sex	....	C	D	E
By cause of disability	....	F-1	G-1	H-1
Accident claims by sex	....	F-2	G-2	H-2
Sickness claims by sex	....	F-3	G-3	H-3
By occupational class	....	I	J	K
By elimination period	....	L	M	N
By amount of monthly benefit	....	O	P	Q
By sickness requirement	....	R	S	T

INTRODUCTION

THE original intent of this study was twofold: first, to determine the level of adequacy or inadequacy of the 1964 Commissioners Disability Table continuance probabilities as a basis for reserving our disabled lives, and, second, to examine the effect of various parameters on our continuance experience. Because of the reserving methods employed by our company and the use of readily accessible data files, the study was limited to claimants who had completed at least one year

of disablement. Thus, our exposure period began at the end of the first year of disablement and continued until disability termination or until the end of the benefit or exposure period. Because all tabulations were based on date of disablement, the duration of disablement was measured from the beginning of the elimination period.

In order to measure the appropriateness of the 1964 CDT and to simplify our analysis, both actual continuance probabilities and actual-to-expected continuance ratios were tabulated—with expected values based on the 1964 CDT. In this paper, actual-to-expected continuance characteristics are presented in all cases, and actual continuance rates are presented in one instance. Experience was tabulated by the parameters of sex, cause of loss, elimination period, amount of monthly benefit, and so forth, in order to determine the effects of these factors on experience. Because of the limited nature of these tabulations, the analysis of the tabulated parameters may have been affected by the distribution of the untabulated parameters.

The paper presents ungraduated results, since the intent is to disclose our findings rather than to suggest a table of continuance values. Also, only a limited attempt was made to determine the effect of the observed experience on disabled life annuities.

DATA BASE

The data for this study were obtained from our company's special inventory file used for determining claim reserves. They included both regular and franchise business and were limited to claims persisting at least one year after disablement. All claims that were closed between January 1, 1970, and December 31, 1977, or were still active as of December 31, 1977, were included. It should be noted that some of our older policies contain a house-confinement requirement for sickness benefits and that this business was not identified separately or excluded except as mentioned later in this report. On the basis of the volume and relative experience under the "confinement" claims, the results were not distorted materially by such claims. Since the adequacy of claim reserves was our primary concern, no exposure data on active lives were accumulated, and therefore no claim frequency rates were derived.

The claim volume in the study amounted to over 30,000 records, where each record reflected the claim activity under a single policy. However, if a claimant held more than one policy, there would have been more than one record. Initially, we reviewed the durational data by certain incurred-year groupings through 1977 and found no definitive secular trend in the continuance experience. Therefore, all incurred

years were combined for this study. While deterioration in disability continuance experience has taken place in recent years, we suspect that most of this has been limited to the first year of disablement.

An initial analysis of the effect of using claim count as opposed to amount of monthly indemnity as the exposure unit for studying continuance experience indicated no appreciable difference. The data base we used has a heavy concentration of claims with relatively low monthly indemnity amounts, where "low" is defined as $300 or less. We therefore decided to base the study on claim counts rather than amounts of monthly indemnity. It might be noted that the majority of our claimants are blue-collar workers with relatively large social security disability benefits. This explains our company's low monthly benefits under long-term policies.

We split the data into three age-at-disablement groups: 18–39, 40–59, and 60 and over.

As is often true when one is working with a data file of this size whose original purpose is other than actuarial analysis, we encountered accuracy problems when the data were split according to certain parameters. In these instances, only the claim records providing the necessary parameter identification were used. As a result, the exposure under certain splits of the data did not sum to the total exposure of the data file.

As stated, the basic approach was to tabulate annual rates of continuance and compare them with the rates in the 1964 Commissioners Disability Table. The results are shown in the accompanying graphs. Composite expected values for each of the three age-at-disablement groups were derived from the 1964 CDT by summations of the form $\Sigma\, l_{[x]+t}^{i}/\Sigma\, l_{[x]+t-1}^{i}$, where x assumed the appropriate quinquennial age values for the applicable age groups; for example, for age group 40–59, x took the values 42, 47, 52, and 57.

We identified and classified the various claims according to final disposition; that is, we identified terminations (death and recovery), benefit expirations, settlements, and active cases. Those cases whose benefits expired during a given duration of disability were not included in the exposure for that duration. Cases classified as settlements were treated as continuing claims for as many months as the settlement amount provided for (according to the monthly benefit at time of settlement), and then were counted as either normal terminations or benefit expirations. For both active and inactive claims, the exposure was terminated at the end of the observation period, that is, December 31, 1977.

FINDINGS

If the experience were to be tabulated for each of the combinations of the various parameters involved, the number of tabulations would be overwhelming. Also, the exposure base for any one combination would be so small as to produce results that lacked credibility. We therefore decided to study the characteristics of the entire data set first and then to examine several major subsets of the data, but without analyzing the effect of each studied subset on the results of the others.

It should be emphasized that the findings presented in this paper apply to the claim experience of one insurer only. The influence of underwriting selection, risk classification, market penetration, claim administration, and policy design may make the experience of another company markedly different from that presented here.

Total Experience

Graph A shows the annual actual-to-expected ratios of continuance for the entire data set supporting the study. Our exposure was quite heavily weighted by age-at-disablement groups 40–59 and 60–99. Nonetheless, the youngest age group contained enough exposure to produce reasonably reliable results, at least as far as fluctuation of data points is concerned.

For all three age-at-disablement groups represented in Graph A, the adequacy of the 1964 CDT continuance rates for claim reserving has vanished by the end of the fourth year of disablement. For age group 40–59, where our exposure was the heaviest, the actual-to-expected ratios exceeded unity in the third year. Age groups 18–39 and 60–99 exhibit quite similar results and also indicate that the inadequacy increases as duration of claim increases. The slope of the graph connecting the ratios of the actual-to-expected rates of continuance for age group 40–59 is quite different from that for the other two age-at-disablement groups. While all the ratios reach or exceed unity by the end of the fourth year, the level for age group 40–59 remains quite constant at about 101 percent, implying that the slope of the underlying continuance is consistent with the 1964 CDT although the level is different. The other age groups show increasing actual-to-expected ratios throughout the studied durations.

In summary, for the block of business represented in the study, the continuance probabilities of the 1964 CDT appear to be inadequate for disablements of four years or longer. Also, the relative adequacy or inadequacy differs by age at disablement.

Because 1964 CDT continuance rates are conservative at early durations and inadequate at later durations, it is possible that the distribution of a company's claims by duration would be such that 1964 CDT reserve factors applied to all claims would produce adequate reserves in the aggregate. However, deficiencies could develop as the average duration of existing claims advanced, as would occur under a closed block of business.

To estimate the effect of our findings on disabled life annuities, we extrapolated the data beyond the fourteenth year of disablement and calculated annuities for certain ages and durations from disablement. The extrapolation was based on ratios of the form $q^{1958 \text{ CSO}}/q^{\text{observed}}$ for approximately the last half of the observed durational termination rates for each age group (assuming central ages at disablement of 32, 52, and 67). An exponential curve was fitted to these ratios using the least-squares method. This produced a set of termination rates for the durations beyond the scope of our study that eventually duplicate 1958 CSO mortality at the extremely high ages. Using this approach, we produced the following results:

RATIO OF OBSERVED ANNUITY VALUES TO 1964 CDT
ANNUITY VALUES
INTEREST AT 3 PERCENT

AGE AT DIS-ABLE-MENT	DURATION (YEARS) SINCE DISABLE-MENT	BENEFIT PERIOD			
		5 Years	10 Years	To Age 65	Life
32.....	2	0.988	1.000	1.126	1.140
	5	....	1.027	1.199	1.213
	10	....	....	1.180	1.191
52.....	2	1.024	1.048	1.061	1.092
	5	....	1.020	1.033	1.064
	10	....	....	1.007	1.034
67.....	2	0.981	0.984	....	1.047
	5	....	1.016	....	1.119
	10	....	....	....	1.179

Graph B shows the observed rates of continuance. It appears that maximum continuance rates occurred at much earlier durations for the two higher age groups than for those insureds below age 40 at disablement. This probably is a result of the increasing impact of the mortality decrement with advancing attained age. The following table gives approximate maximum annual continuance values by age group.

Age at Disablement	Maximum Annual Continuance
18–39	97%–98%
40–59	93%–94%
60–99	89.5%–90.5%

The remainder of this paper shows the experience, by age-at-disablement group, relative to other characteristics potentially influencing claim continuance.

Sex

Graphs C, D, and E show the experience according to the sex of the claimant for the three age-at-disablement groups. For each of these groups, the actual-to-expected continuance ratio for females was below that for males for the second year of disablement. Except for the youngest age group, there was no appreciable difference in continuance rates by sex for the third through fifth years of disablement. After the fifth year (third year for the youngest age group), the female rate generally exceeded the male rate.

Accident versus Sickness

A comparison of continuance according to cause of loss is presented in Graphs F-1, G-1, and H-1. The early durations of sickness claims exhibited higher continuance, but this difference diminished with advancing age at disablement. Further, as the claims matured, sickness continuance eventually became less than accident continuance. The crossover point seemed to occur earlier for higher ages at disablement. This probably reflects higher mortality associated with long-term sickness claims than with accident claims, since recovery rates are no doubt relatively insignificant at the longer durations.

The 1964 CDT eventually does become deficient for reserving purposes for both accident and sickness claims. This deficiency appears earlier for sickness claims, and is more pronounced for the younger age-at-disablement groups.

We also studied accident versus sickness continuance according to the sex of the claimant. Graphs F-2, G-2, and H-2 pertain to accident claims, while Graphs F-3, G-3, and H-3 pertain to sickness claims. Sex did not appear to be a strong determinant of continuance for claims due to accident, but female continuance generally exceeded male continuance for the sickness claims, especially for the younger age-at-disablement groups.

Occupational Class

The data also were studied according to two broad occupational class groups. These occupational classes are not subject to precise definition, since they reflect changes in occupational classifications through the years. In general, the white-collar occupational class could be categorized as preferred risks, and the blue-collar occupational class could be categorized as all other risks excluding hazardous occupations. Because of occupational code problems, all franchise business was excluded. The sum of the exposures for the white-collar and blue-collar classes was thus less than the total exposure for all business included in the study.

Graphs I, J, and K display our findings by occupational class within each age-at-disablement group. As expected, for our company the exposure was heavier for blue-collar risks than for white-collar risks. In analyzing these graphs, we found that the general continuance characteristics did not differ greatly between white-collar and blue-collar risks. However, the blue-collar risks exhibited slightly lower claim continuance until approximately the seventh or eighth year of disablement.

Elimination Period

As with the separation of the data by occupational class, not all of the cases could be categorized properly by length of elimination period. In this instance, the elimination period could not be identified for cases closed prior to 1973. This produced an upward bias on continuance rates, since only terminated cases were excluded. We feel, however, that the relationships between elimination periods were not disturbed. For purposes of analysis, we defined "short" elimination periods as those of less than thirty days' duration; all other elimination periods were called "long." The short elimination periods contributed by far the greatest exposure.

Graphs L, M, and N show the results for each of the three age-at-disablement groups by elimination period. As mentioned previously, the greatest exposure was in the age group 40–59, and, within that group, by far the majority of the cases fell into the short elimination period category. In general, the continuance experience by elimination period was quite similar for each of the three age-at-disablement groups. This means that the elimination period mix has not had a major impact on the experience. Since only claim experience after the first year of disablement was included, one might expect that the impact of the elimination period would have worn off by that time.

Amount of Monthly Benefit

Continuance characteristics were also studied according to the size of monthly benefit the claimant was receiving. Based on the distribution of monthly benefits in the data base, $300 was chosen as the separation point. For convenience, we called those claims with a monthly benefit less than $300 the "small-amount cases," and all other claims were referred to as "large-amount cases."

Graphs O, P, and Q show the experience according to these monthly benefit groupings for each of the three age-at-disablement groups. For age group 18–39 and age group 40–59, the continuance for the small-amount cases almost always exceeded that for the large-amount cases. This was not as evident in the highest age group, where the continuance characteristics apparently were not influenced by the size of the monthly benefit. Although there were some differences in continuance according to the size of the monthly benefit, it is uncertain whether the level of monthly benefit was the real reason or whether some other underlying characteristic was the cause. For example, differences in underwriting criteria or occupational differences between those purchasing large and those purchasing small monthly benefit amounts might explain the difference in exhibited continuance levels.

Confining versus No Limitation

Some of our company's older disability business requires house confinement under sickness claims. Graphs R, S, and T show the comparison of actual-to-expected continuance ratios between regular and house-confinement policies for each of the age-at-disablement groups. For the two youngest age groups, the exposure was greatest on the cases without the confinement limitation, but for the highest age group there was slightly more exposure on the confinement cases.

For the two youngest age groups, sickness claims with a confinement requirement showed higher continuance than the other sickness cases through at least six to seven years of duration. This excess is greater for the youngest age group than for age group 40–59. For age group 60–99, the continuance by age for confining cases actually falls below the continuance for the other sickness claims.

In other words, the confinement requirement appears to have a diminishing impact on continuance in the first six to seven years of claim as the age at disablement advances.

Length of Benefit Period

Our original intentions included a study of continuance by length of benefit period. However, a problem in the data base (multiple use of

certain record fields) precluded a meaningful extraction of benefit period data from the file.
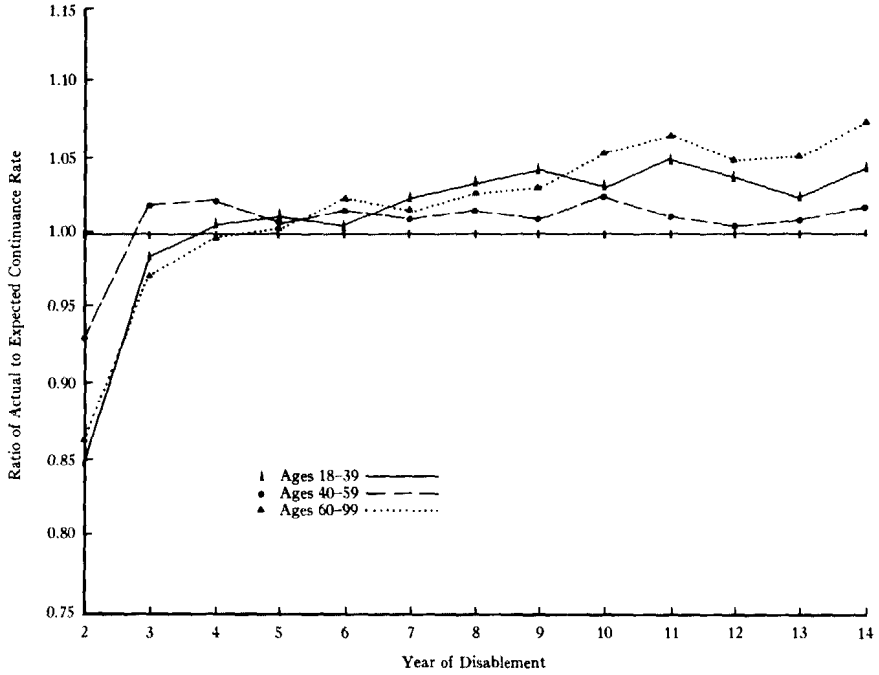
SUMMARY

In conclusion, we feel that, for disability business similar in characteristics to the data base used for our study, the 1964 Commissioners Disability Table may produce deficient claim reserves, because for claims of more than a few years duration, the termination rates in the 1964 CDT appear optimistic. It is true that, given the proper mix of claims by duration, the 1964 CDT would produce reserves that would be adequate in the aggregate. In other words, as long as a sufficient proportion of the claims remain in the early claim durations, the 1964 CDT reserves will maintain some conservatism. However, as the average claim duration increases, inadequate reserves could develop.

We studied the claims with respect to various possible determinants of continuance characteristics. A distinct difference in continuance curves was found between accident and sickness claims. In addition, for claims due to sickness, female continuance equalled or exceeded male continuance. Occupational class and length of elimination period showed only minor variances in the characteristics of the underlying continuance. The size of the monthly benefit seemed to produce some differences, higher continuance being associated with the smaller monthly benefit amounts. As was mentioned earlier, this may have been the result of influences other than benefit size. It should be pointed out that the graphs displaying the actual-to-expected continuance ratios for blue-collar risks are nearly identical with the graphs for small-amount cases. This probably is not accidental, since the blue-collar underwriting risks tend to purchase smaller monthly benefit amounts. House confinement as a requirement for receipt of sickness benefits influenced the continuance rates through the early years of claim, but this influence diminished with advancing age at disablement.

We had hoped to study our experience according to the length of the benefit period. However, the data file used for this study precluded our doing so.

We hope that this paper presents an informative study of the continuance characteristics of our disability business and the appropriateness of the 1964 CDT as a basis for establishing claim reserves on disabled lives. We also hope that others will be stimulated to discuss this paper and present the findings of their own studies.

GRAPH A

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
TOTAL FILE

Ratio of Actual to Expected Continuance Rate

▲ Ages 18–39 ———
● Ages 40–59 — — —
▲ Ages 60–99 ·············

Year of Disablement

Beginning Exposure Count			
Year of Disable-ment	Age at Disablement		
	18–39	40–59	60–99
2	2,100	15,997	12,760
3	974	9,581	7,322
4	613	7,110	5,366
5	433	5,584	4,212
6	306	4,327	3,179
7	241	3,537	2,556
8	197	2,965	2,060
9	171	2,539	1,710
10	155	2,203	1,402
11	134	1,893	1,112
12	128	1,631	902
13	113	1,419	710
14	107	1,208	558
15	100	1,020	438

Actual-to-Expected Continuance Ratios			
Year of Disable-ment	Age at Disablement		
	18–39	40–59	60–99
2	.8472	.9330	.8619
3	.9870	1.0208	.9735
4	1.0057	1.0244	.9987
5	1.0129	1.0078	1.0051
6	1.0058	1.0176	1.0254
7	1.0255	1.0088	1.0155
8	1.0345	1.0161	1.0285
9	1.0433	1.0095	1.0332
10	1.0320	1.0256	1.0568
11	1.0532	1.0105	1.0677
12	1.0383	1.0037	1.0494
13	1.0234	1.0085	1.0526
14	1.0450	1.0185	1.0755

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GRAPH B

OBSERVED ANNUAL CONTINUANCE RATES
TOTAL FILE

Legend within graph:
- Ages 18–39 ——————
- Ages 40–59 —— —— ——
- Ages 60–99 ·············

Y-axis: Observed Annual Continuance Rate
X-axis: Year of Disablement

Beginning Exposure Count			
Year of Disable-ment	Age at Disablement		
	18–39	40–59	60–99
2	2,100	15,997	12,760
3	974	9,581	7,322
4	613	7,110	5,366
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11	134	1,893	1,112
12	128	1,631	902
13	113	1,419	710
14	107	1,208	558
15	100	1,020	438

Observed Continuance Probabilities			
Year of Disable-ment	Age at Disablement		
	18–39	40–59	60–99
2	.7500	.7566	.7546
3	.7741	.8784	.8599
4	.8548	.9118	.8878
5	.8938	.9174	.8932
6	.9052	.9358	.9097
7	.9419	.9316	.8975
8	.9594	.9403	.9039
9	.9708	.9346	.9023
10	.9548	.9505	.9151
11	1.0000	.9382	.9173
12	.9609	.9344	.8936
13	.9646	.9338	.8873
14	.9813	.9445	.8978

GRAPH C

Annual Actual-to-Expected Continuance Ratios
Based on 1964 Commissioners Disability Table
By Sex, for Ages 18–39 at Disablement

Ratio of Actual to Expected Continuance Rate

Year of Disablement

I Male ——————
• Female — — —

Beginning Exposure Count				Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex			Year of Disable-ment	Sex	
	Male	Female			Male	Female
2	1,674	426		2	.8509	.8336
3	789	185		3	.9631	1.0889
4	486	127		4	.9949	1.0468
5	339	94		5	.9929	1.0851
6	237	69		6	.9986	1.0306
7	186	55		7	1.0243	1.0293
8	148	49		8	1.0200	1.0783
9	125	46		9	1.0404	1.0514
10	112	43		10	1.0326	1.0305
11	95	39		11	1.0532	1.0532
12	89	39		12	1.0319	1.0528
13	75	38		13	1.0185	1.0331
14	70	37		14	1.0345	1.0649
15	64	36				

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GRAPH D

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY SEX, FOR AGES 40–59 AT DISABLEMENT

Ratio of Actual to Expected Continuance Rate (vertical axis)

Year of Disablement (horizontal axis)

I Male ——————
• Female — — —

Beginning Exposure Count		
Year of Disable-ment	Sex	
	Male	Female
2	11,687	4,310
3	7,117	2,464
4	5,291	1,819
5	4,123	1,461
6	3,176	1,151
7	2,599	938
8	2,169	796
9	1,849	690
10	1,596	607
11	1,352	541
12	1,149	482
13	989	430
14	839	369
15	712	308

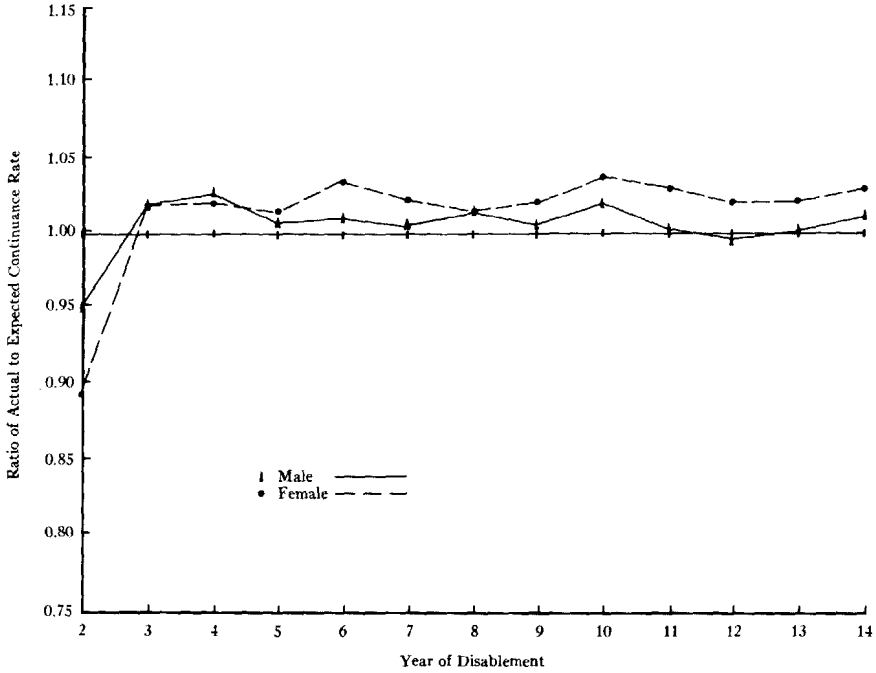| Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex	
	Male	Female
2	.9479	.8930
3	1.0208	1.0206
4	1.0252	1.0222
5	1.0050	1.0158
6	1.0101	1.0383
7	1.0041	1.0217
8	1.0163	1.0154
9	1.0048	1.0222
10	1.0202	1.0399
11	1.0022	1.0313
12	.9965	1.0207
13	1.0025	1.0223
14	1.0128	1.0316

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GRAPH E

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY SEX, FOR AGES 60–99 AT DISABLEMENT
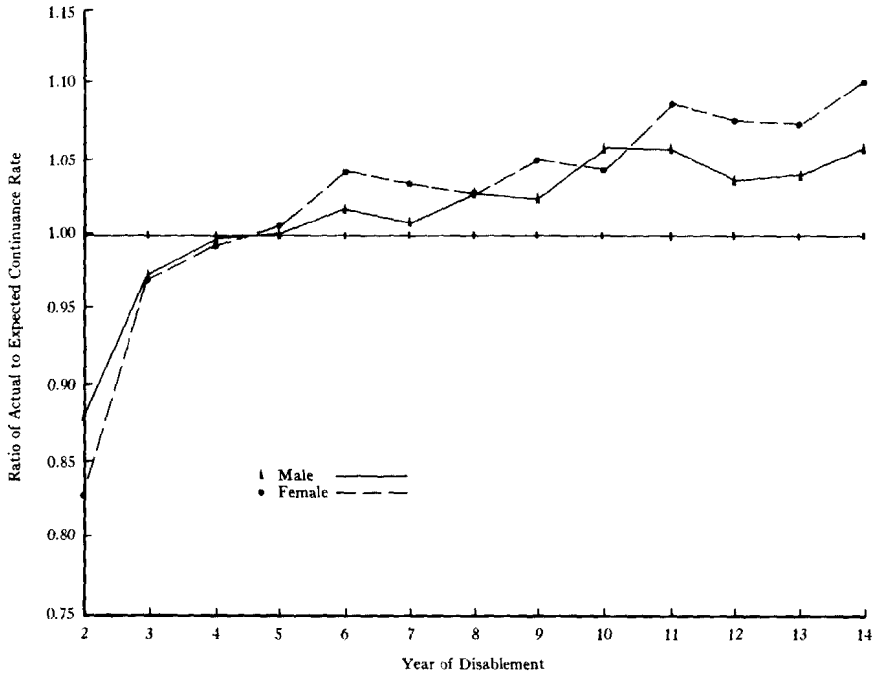
Beginning Exposure Count		
Year of Disable-ment	Sex	
	Male	Female
2	9,322	3,438
3	5,584	1,738
4	4,115	1,251
5	3,234	978
6	2,428	751
7	1,923	633
8	1,523	537
9	1,253	457
10	1,008	394
11	805	307
12	647	255
13	506	204
14	398	160
15	314	124

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex	
	Male	Female
2	.8745	.8278
3	.9740	.9719
4	.9994	.9963
5	1.0046	1.0068
6	1.0190	1.0461
7	1.0091	1.0350
8	1.0288	1.0277
9	1.0253	1.0548
10	1.0609	1.0464
11	1.0584	1.0919
12	1.0382	1.0776
13	1.0432	1.0758
14	1.0624	1.1080

GRAPH F-1
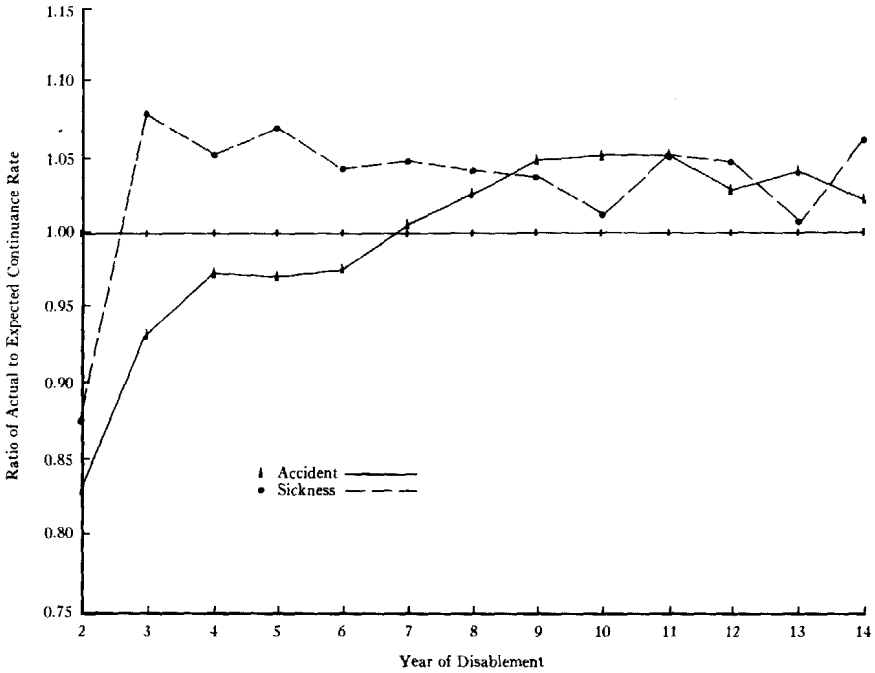
Beginning Exposure Count		
Year of Disable-ment	Cause of Disability	
	Accident	Sickness
2	1,298	802
3	614	360
4	367	246
5	253	180
6	172	134
7	133	108
8	105	92
9	84	87
10	75	80
11	66	68
12	64	64
13	53	60
14	50	57
15	45	55

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Cause of Disability	
	Accident	Sickness
2	.8269	.8807
3	.9324	1.0802
4	.9745	1.0521
5	.9721	1.0704
6	.9755	1.0448
7	1.0069	1.0484
8	1.0269	1.0431
9	1.0492	1.0377
10	1.0520	1.0133
11	1.0532	1.0532
12	1.0298	1.0467
13	1.0410	1.0079
14	1.0223	1.0649

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GRAPH G-1

**ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY CAUSE OF DISABILITY—ACCIDENT VERSUS SICKNESS—
FOR AGES 40–59 AT DISABLEMENT**
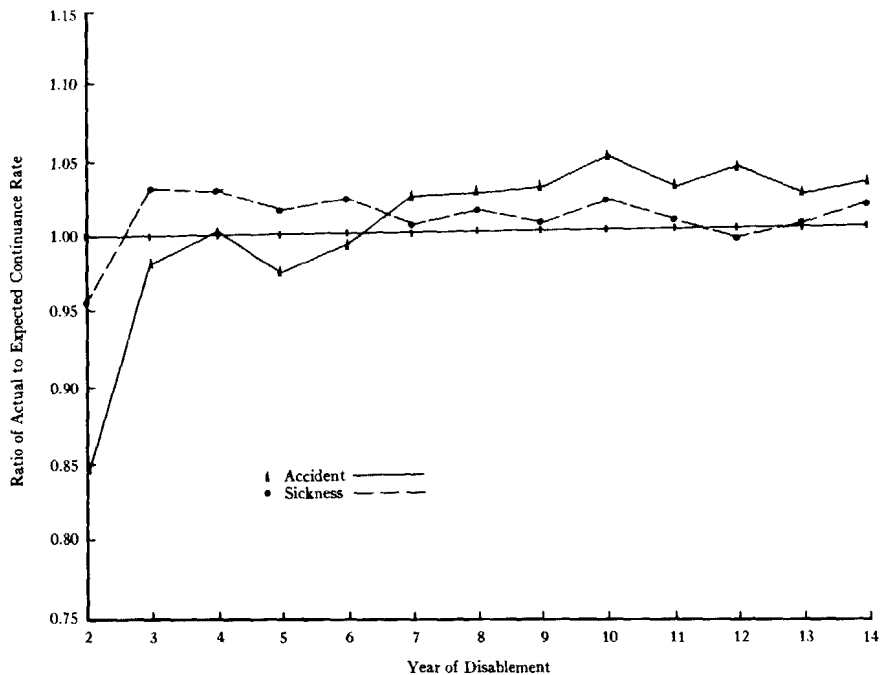
Beginning Exposure Count		
Year of Disable-ment	Cause of Disability	
	Accident	Sickness
2	3,356	12,641
3	1,905	7,676
4	1,369	5,741
5	1,037	4,547
6	768	3,559
7	621	2,916
8	539	2,426
9	461	2,078
10	408	1,795
11	365	1,528
12	330	1,301
13	302	1,117
14	262	946
15	225	795

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Cause of Disability	
	Accident	Sickness
2	.8446	.9563
3	.9821	1.0303
4	1.0021	1.0298
5	.9735	1.0156
6	.9926	1.0230
7	1.0236	1.0056
8	1.0264	1.0138
9	1.0286	1.0053
10	1.0499	1.0201
11	1.0298	1.0059
12	1.0416	.9941
13	1.0229	1.0047
14	1.0289	1.0156

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GRAPH H-1

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY CAUSE OF DISABILITY—ACCIDENT VERSUS SICKNESS—
FOR AGES 60–99 AT DISABLEMENT

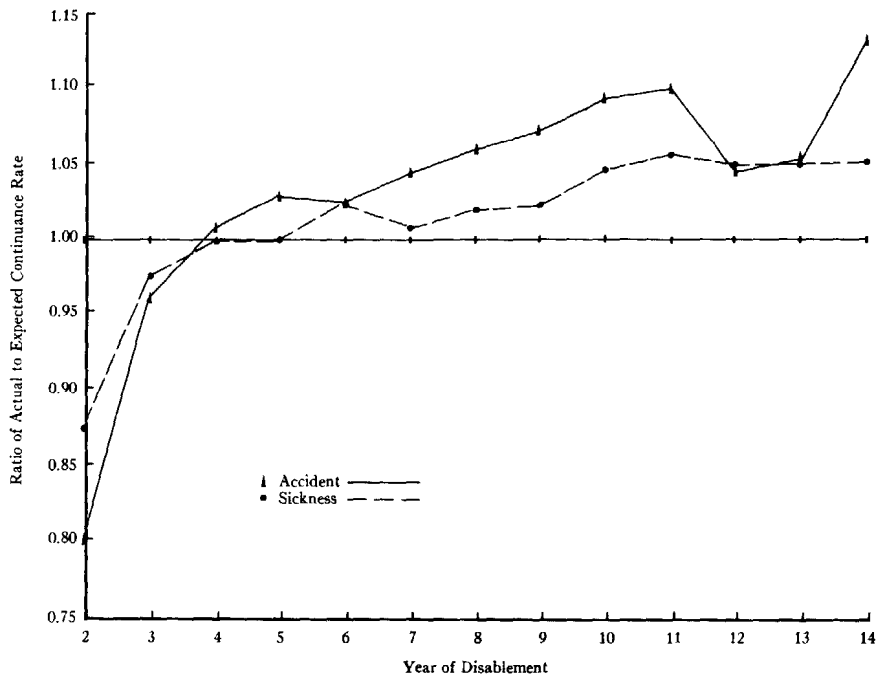| Beginning Exposure Count		
Year of Disable-ment	Cause of Disability	
	Accident	Sickness
2	1,734	11,026
3	1,049	6,273
4	808	4,558
5	632	3,580
6	516	2,663
7	440	2,116
8	373	1,687
9	329	1,381
10	286	1,116
11	256	856
12	227	675
13	188	522
14	152	406
15	124	314

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Cause of Disability	
	Accident	Sickness
2	.7953	.8724
3	.9606	.9757
4	1.0093	.9968
5	1.0310	1.0006
6	1.0266	1.0251
7	1.0466	1.0090
8	1.0616	1.0212
9	1.0720	1.0240
10	1.0942	1.0472
11	1.1003	1.0579
12	1.0450	1.0508
13	1.0537	1.0522
14	1.1348	1.0533

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GRAPH F-2

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
ACCIDENT CLAIMS BY SEX, FOR AGES 18–39 AT DISABLEMENT
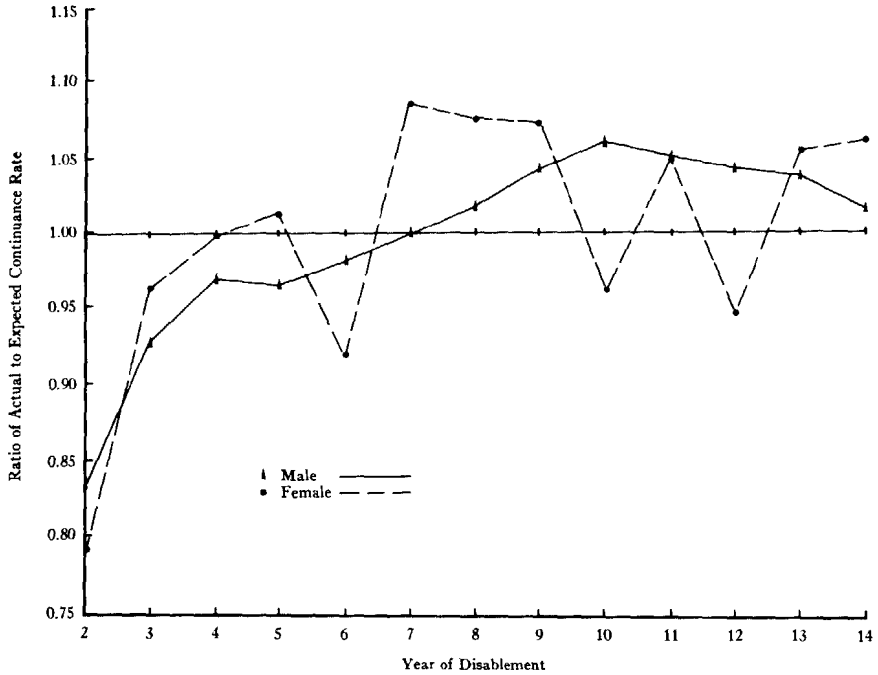
Beginning Exposure Count		
Year of Disable-ment	Sex	
	Male	Female
2	1,131	167
3	544	70
4	327	40
5	224	29
6	155	17
7	121	12
8	94	11
9	75	9
10	66	9
11	58	8
12	56	8
13	46	7
14	43	7
15	38	7

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex	
	Male	Female
2	.8323	.7873
3	.9281	.9654
4	.9714	1.0000
5	.9664	1.0161
6	.9821	.9150
7	.9987	1.0887
8	1.0209	1.0783
9	1.0461	1.0748
10	1.0644	.9607
11	1.0532	1.0532
12	1.0419	.9454
13	1.0379	1.0610
14	1.0154	1.0649

GRAPH G-2

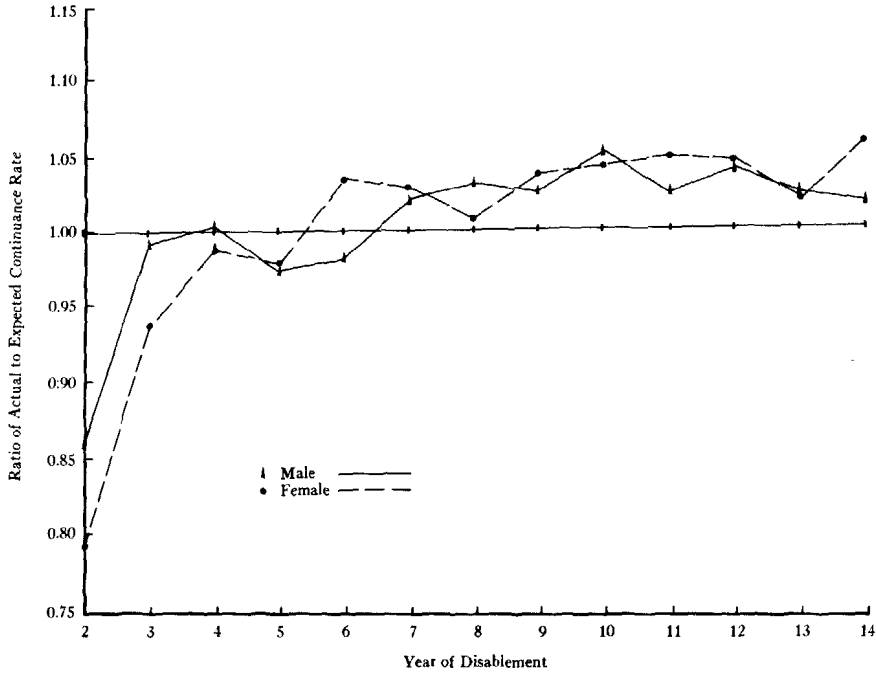| Beginning Exposure Count				Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex			Year of Disable-ment	Sex	
	Male	Female			Male	Female
2	2,554	802		2	.8607	.7940
3	1,467	438		3	.9949	.9392
4	1,083	286		4	1.0052	.9899
5	816	221		5	.9720	.9792
6	600	168		6	.9805	1.0356
7	479	142		7	1.0218	1.0295
8	420	119		8	1.0317	1.0079
9	361	100		9	1.0263	1.0369
10	316	92		10	1.0517	1.0438
11	282	83		11	1.0236	1.0511
12	254	76		12	1.0403	1.0459
13	232	70		13	1.0242	1.0184
14	203	59		14	1.0199	1.0600
15	170	55				

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GRAPH H-2

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
ACCIDENT CLAIMS BY SEX, FOR AGES 60–99 AT DISABLEMENT

Beginning Exposure Count		
Year of Disable-ment	Sex	
	Male	Female
2	1,070	664
3	661	388
4	501	307
5	395	237
6	322	194
7	268	172
8	218	155
9	189	140
10	157	129
11	144	112
12	123	104
13	97	91
14	77	75
15	66	58

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex	
	Male	Female
2	.8148	.7644
3	.9489	.9804
4	1.0193	.9930
5	1.0427	1.0114
6	1.0116	1.0516
7	1.0428	1.0525
8	1.0700	1.0498
9	1.0542	1.0960
10	1.1107	1.0742
11	1.0751	1.1328
12	1.0120	1.0840
13	1.0395	1.0689
14	1.1356	1.1340

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GRAPH F-3

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
SICKNESS CLAIMS BY SEX, FOR AGES 18–39 AT DISABLEMENT
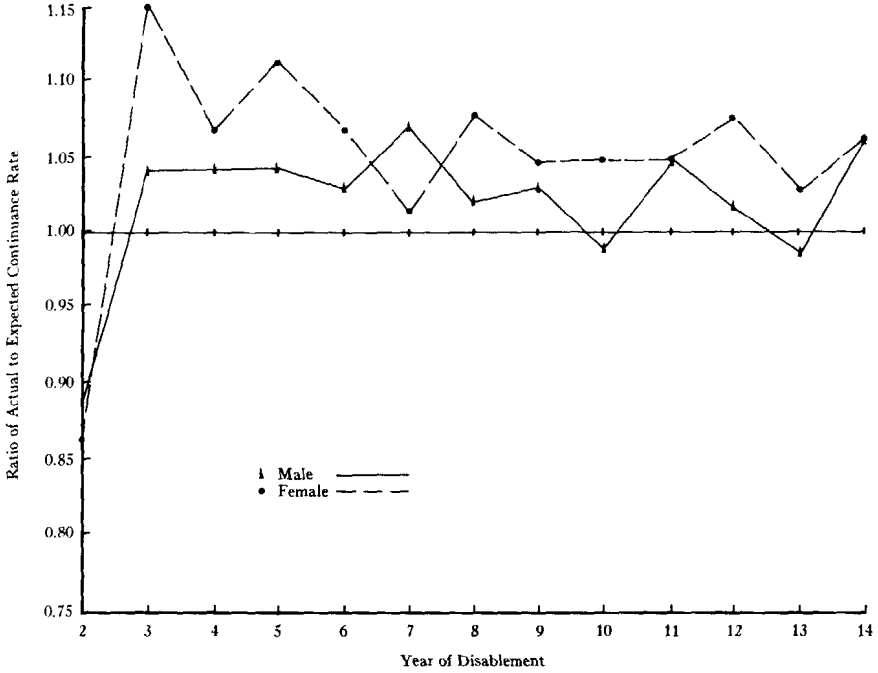
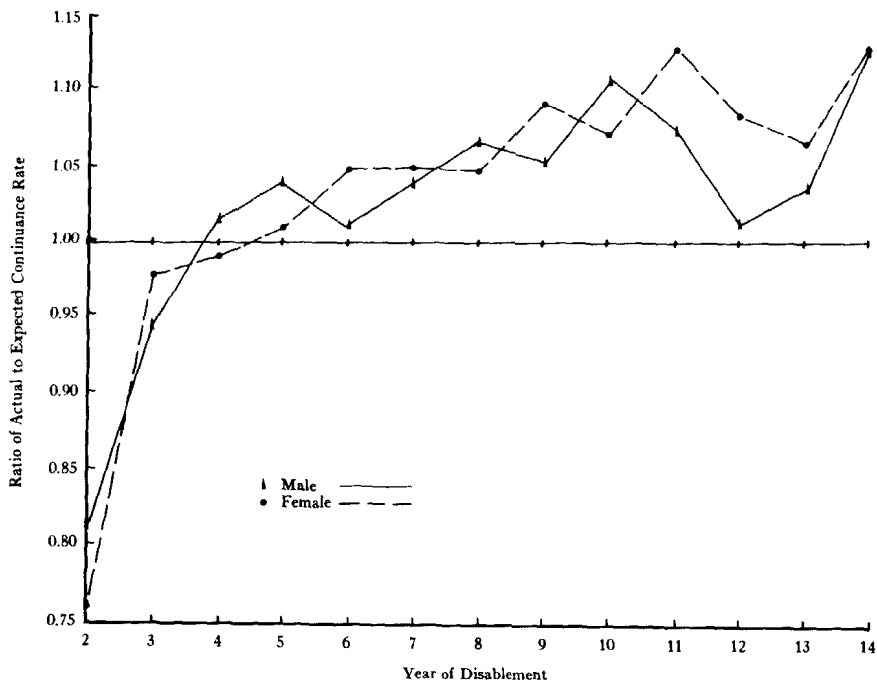| Beginning Exposure Count		
Year of Disable-ment	Sex	
	Male	Female
2	543	259
3	245	115
4	159	87
5	115	65
6	82	52
7	65	43
8	54	38
9	50	37
10	46	34
11	37	31
12	33	31
13	29	31
14	27	30
15	26	29

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex	
	Male	Female
2	.8894	.8626
3	1.0408	1.1641
4	1.0433	1.0683
5	1.0446	1.1159
6	1.0298	1.0684
7	1.0720	1.0128
8	1.0184	1.0783
9	1.0318	1.0457
10	.9868	1.0490
11	1.0532	1.0532
12	1.0150	1.0805
13	.9878	1.0268
14	1.0649	1.0649

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GRAPH G-3

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
SICKNESS CLAIMS BY SEX, FOR AGES 40–59 AT DISABLEMENT
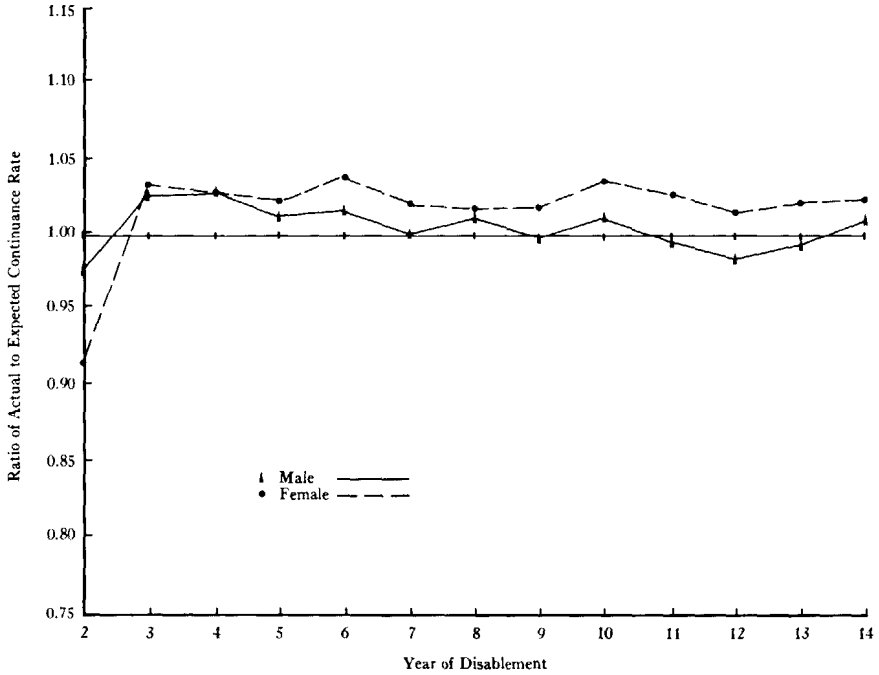
Beginning Exposure Count		
Year of Disable-ment	Sex	
	Male	Female
2	9,133	3,508
3	5,650	2,026
4	4,208	1,533
5	3,307	1,240
6	2,576	983
7	2,120	796
8	1,749	677
9	1,488	590
10	1,280	515
11	1,070	458
12	895	406
13	757	360
14	636	310
15	542	253

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex	
	Male	Female
2	.9719	.9155
3	1.0275	1.0382
4	1.0303	1.0282
5	1.0131	1.0223
6	1.0169	1.0388
7	1.0001	1.0203
8	1.0126	1.0167
9	.9995	1.0197
10	1.0124	1.0392
11	.9965	1.0277
12	.9841	1.0159
13	.9959	1.0231
14	1.0105	1.0261

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GRAPH H-3

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
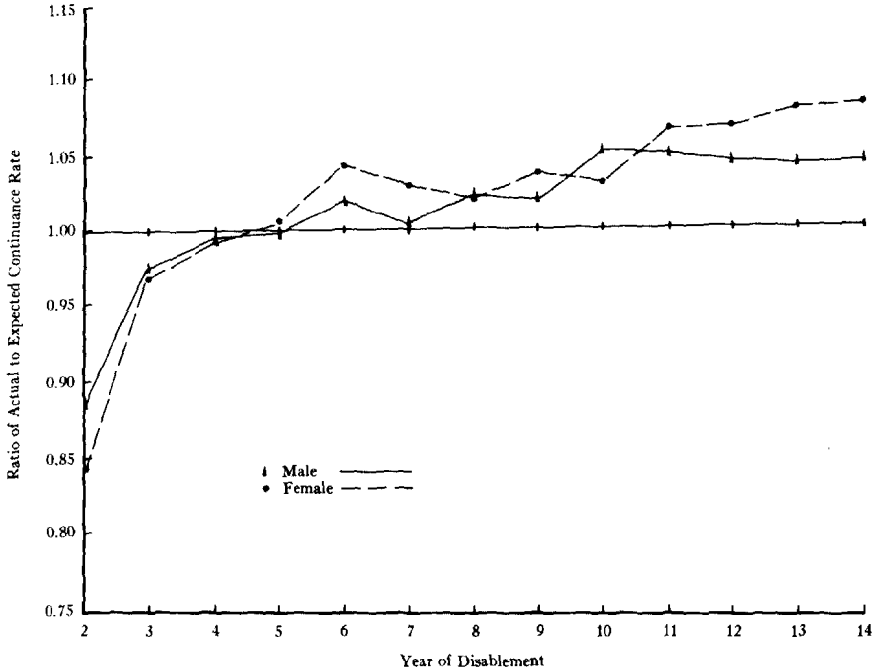SICKNESS CLAIMS BY SEX, FOR AGES 60–99 AT DISABLEMENT

Ratio of Actual to Expected Continuance Rate (y-axis)
Year of Disablement (x-axis)

ı Male ———
• Female — — —

Beginning Exposure Count		
Year of Disable-ment	Sex	
	Male	Female
2	8,252	2,774
3	4,923	1,350
4	3,614	944
5	2,839	741
6	2,106	557
7	1,655	461
8	1,305	382
9	1,064	317
10	851	265
11	661	195
12	524	151
13	409	113
14	321	85
15	248	66

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sex	
	Male	Female
2	.8823	.8432
3	.9774	.9695
4	.9966	.9974
5	.9993	1.0054
6	1.0201	1.0441
7	1.0036	1.0284
8	1.0219	1.0188
9	1.0202	1.0367
10	1.0517	1.0328
11	1.0548	1.0685
12	1.0444	1.0733
13	1.0441	1.0813
14	1.0448	1.0851

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GRAPH I

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY OCCUPATIONAL CLASS, FOR AGES 18–39 AT DISABLEMENT
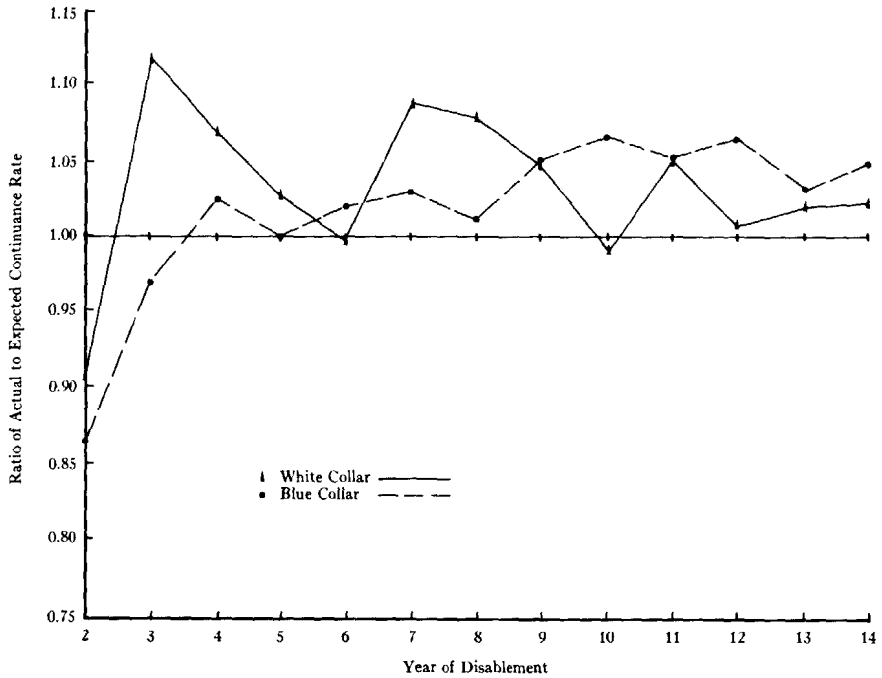
Beginning Exposure Count		
Year of Disable-ment	Occupational Class	
	White Collar	Blue Collar
2	289	1,108
3	146	524
4	106	319
5	84	219
6	59	159
7	46	132
8	40	111
9	38	95
10	36	86
11	31	78
12	29	75
13	26	70
14	25	67
15	23	62

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Occupational Class	
	White Collar	Blue Collar
2	.9083	.8619
3	1.1178	.9708
4	1.0655	1.0253
5	1.0254	.9988
6	.9981	1.0203
7	1.0887	1.0310
8	1.0783	1.0103
9	1.0465	1.0521
10	.9907	1.0682
11	1.0532	1.0532
12	1.0059	1.0661
13	1.0202	1.0307
14	1.0223	1.0490

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GRAPH J

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY OCCUPATIONAL CLASS, FOR AGES 40–59 AT DISABLEMENT
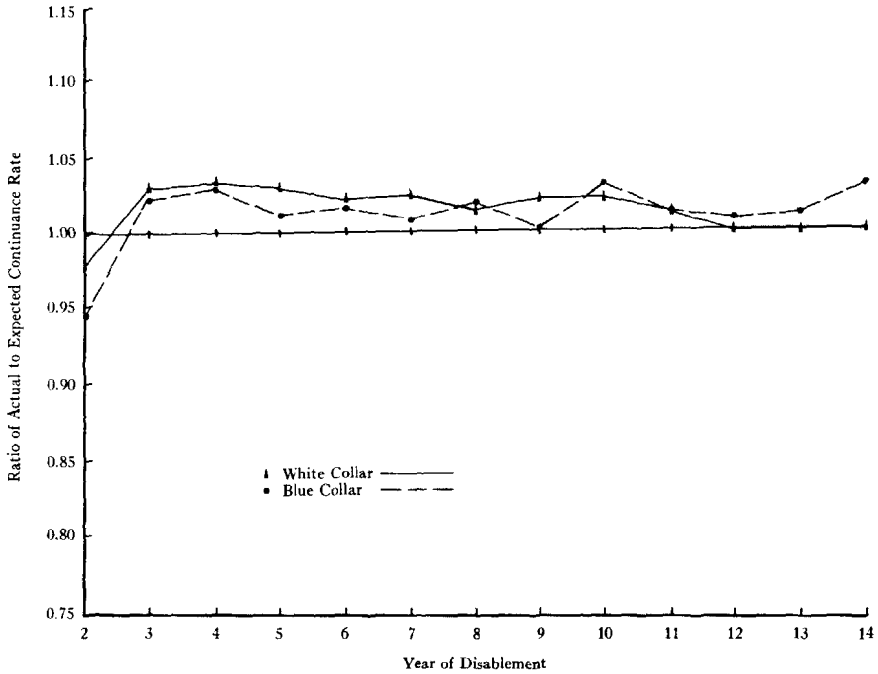
Beginning Exposure Count		
Year of Disable- ment	Occupational Class	
	White Collar	Blue Collar
2	3,611	8,099
3	2,441	5,074
4	1,912	3,791
5	1,553	2,991
6	1,295	2,394
7	1,068	2,001
8	923	1,683
9	801	1,446
10	715	1,236
11	640	1,076
12	545	946
13	481	817
14	414	692
15	340	593

Actual-to-Expected Continuance Ratios		
Year of Disable- ment	Occupational Class	
	White Collar	Blue Collar
2	.9789	.9477
3	1.0292	1.0228
4	1.0330	1.0290
5	1.0299	1.0111
6	1.0203	1.0152
7	1.0240	1.0071
8	1.0127	1.0196
9	1.0221	.9994
10	1.0232	1.0301
11	1.0131	1.0100
12	.9973	1.0071
13	1.0015	1.0127
14	1.0002	1.0300

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GRAPH K

Annual Actual-to-Expected Continuance Ratios
Based on 1964 Commissioners Disability Table
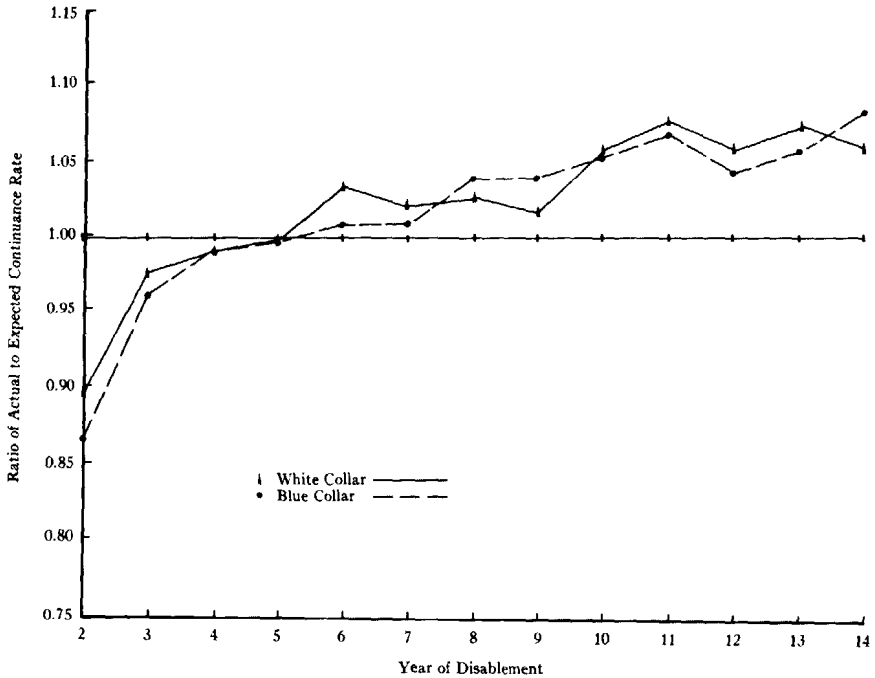### By Occupational Class, for Ages 60–99 at Disablement

Ratio of Actual to Expected Continuance Rate (y-axis)
Year of Disablement (x-axis)

- White Collar ———
- Blue Collar — — —

Beginning Exposure Count		
Year of Disable-ment	Occupational Class	
	White Collar	Blue Collar
2	3,404	4,796
3	2,295	2,959
4	1,790	2,205
5	1,445	1,711
6	1,138	1,347
7	944	1,073
8	774	873
9	632	736
10	522	600
11	416	480
12	343	374
13	265	297
14	216	224
15	162	177

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Occupational Class	
	White Collar	Blue Collar
2	.8937	.8676
3	.9778	.9634
4	.9923	.9917
5	.9992	.9984
6	1.0340	1.0108
7	1.0212	1.0102
8	1.0276	1.0401
9	1.0182	1.0408
10	1.0597	1.0566
11	1.0772	1.0694
12	1.0579	1.0425
13	1.0743	1.0584
14	1.0592	1.0855

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GRAPH L

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY ELIMINATION PERIOD, FOR AGES 18–39 AT DISABLEMENT
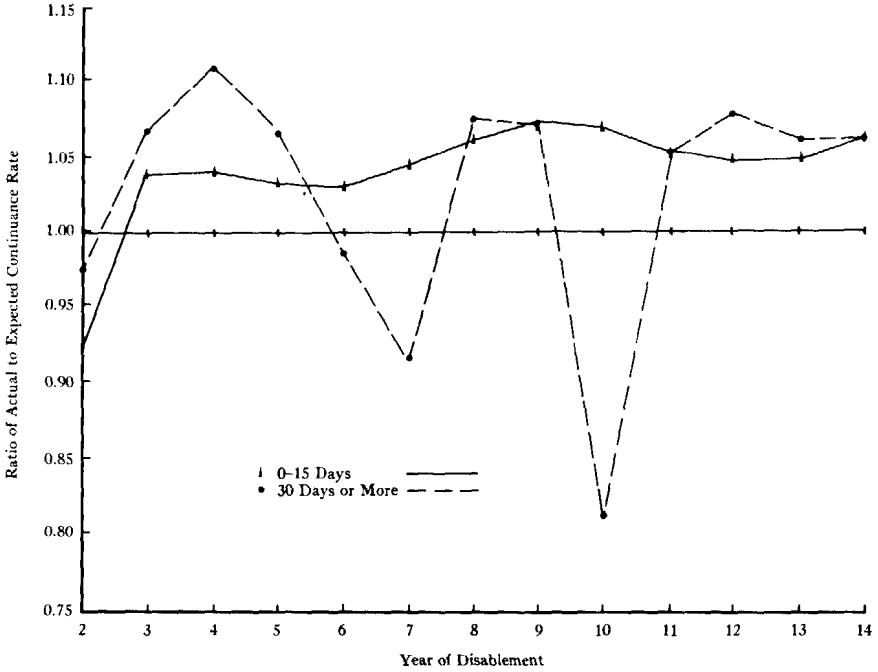
Beginning Exposure Count		
Year of Disable-ment	Elimination Period	
	0–15 Days	30 Days or More
2	1,432	174
3	680	99
4	431	71
5	306	52
6	220	36
7	175	25
8	145	15
9	125	15
10	117	12
11	105	6
12	100	6
13	89	4
14	87	3
15	82	3

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Elimination Period	
	0–15 Days	30 Days or More
2	.9194	.9740
3	1.0388	1.0689
4	1.0400	1.1102
5	1.0333	1.0679
6	1.0303	.9877
7	1.0452	.9145
8	1.0634	1.0783
9	1.0748	1.0748
10	1.0716	.8106
11	1.0532	1.0532
12	1.0480	1.0805
13	1.0491	1.0610
14	1.0649	1.0649

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GRAPH M

Beginning Exposure Count		
Year of Disable-ment	Elimination Period	
	0–15 Days	30 Days or More
2	10,316	1,633
3	6,529	1,069
4	4,942	732
5	3,899	518
6	3,059	374
7	2,540	274
8	2,166	191
9	1,874	151
10	1,666	111
11	1,460	80
12	1,281	61
13	1,126	52
14	974	39
15	830	27

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Elimination Period	
	0–15 Days	30 Days or More
2	1.0142	1.0073
3	1.0542	1.0555
4	1.0485	1.0637
5	1.0323	1.0497
6	1.0430	1.0380
7	1.0338	1.0117
8	1.0441	1.0240
9	1.0369	1.0515
10	1.0537	1.0012
11	1.0394	1.0501
12	1.0255	1.0389
13	1.0398	.9555
14	1.0418	1.0230

GRAPH N

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
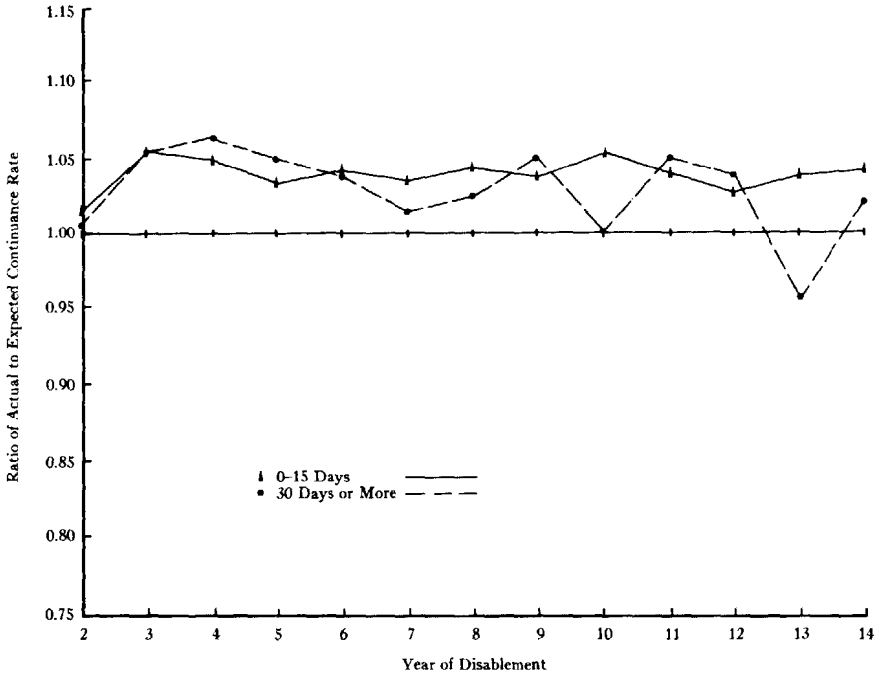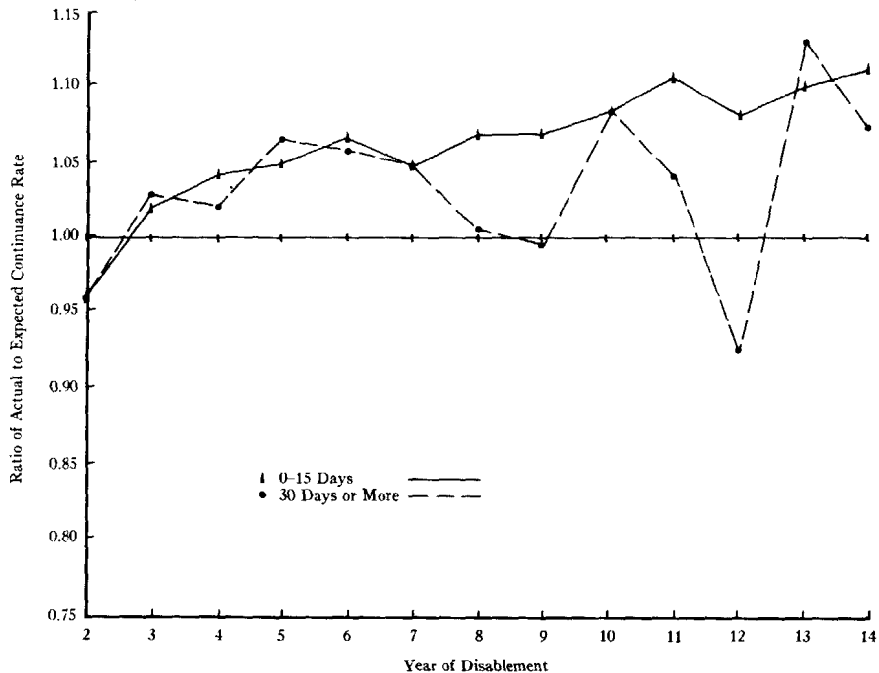### BY ELIMINATION PERIOD, FOR AGES 60–99 AT DISABLEMENT

Beginning Exposure Count		
Year of Disable-ment	Elimination Period	
	0–15 Days	30 Days or More
2	7,094	827
3	4,663	509
4	3,586	359
5	2,878	261
6	2,244	181
7	1,825	149
8	1,480	119
9	1,253	92
10	1,042	68
11	827	47
12	679	33
13	534	22
14	426	19
15	333	17

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Elimination Period	
	0–15 Days	30 Days or More
2	.9587	.9579
3	1.0215	1.0299
4	1.0424	1.0215
5	1.0503	1.0650
6	1.0653	1.0586
7	1.0472	1.0479
8	1.0687	1.0040
9	1.0692	.9957
10	1.0850	1.0869
11	1.1077	1.0401
12	1.0827	.9252
13	1.1018	1.1323
14	1.1135	1.0717

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GRAPH O

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY AMOUNT OF MONTHLY BENEFIT, FOR AGES 18–39 AT DISABLEMENT
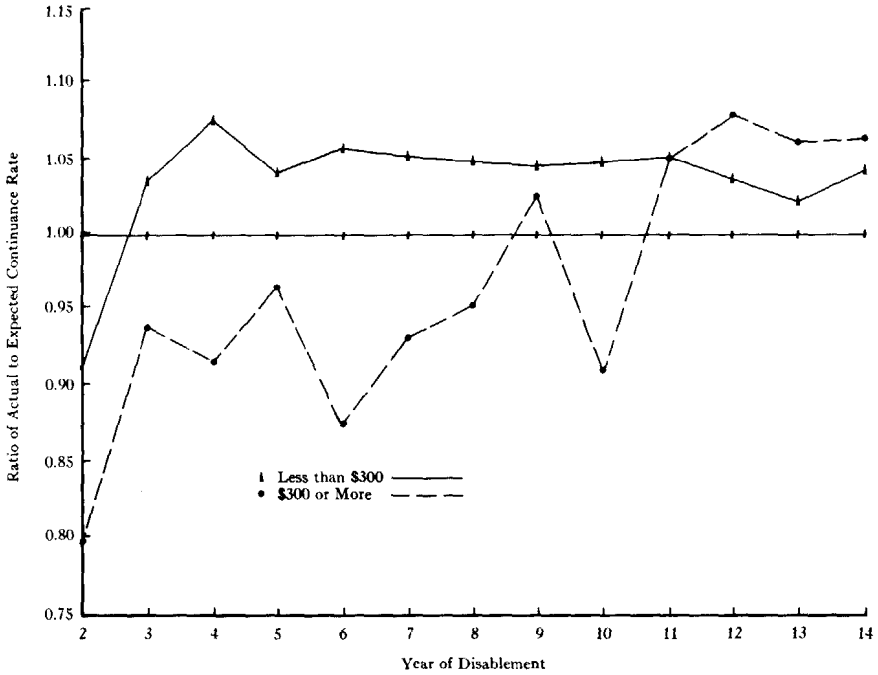
Beginning Exposure Count		
Year of Disable-ment	Monthly Benefit	
	Less than $300	$300 or More
2	903	1,197
3	473	501
4	335	278
5	267	166
6	216	90
7	184	57
8	162	35
9	148	23
10	136	19
11	123	11
12	120	8
13	108	5
14	103	4
15	96	4

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Monthly Benefit	
	Less than $300	$300 or More
2	.9117	.7973
3	1.0351	.9416
4	1.0781	.9183
5	1.0400	.9695
6	1.0597	.8765
7	1.0532	.9359
8	1.0516	.9550
9	1.0457	1.0280
10	1.0490	.9102
11	1.0532	1.0532
12	1.0354	1.0805
13	1.0217	1.0610
14	1.0443	1.0649

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GRAPH P

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY AMOUNT OF MONTHLY BENEFIT, FOR AGES 40–59 AT DISABLEMENT
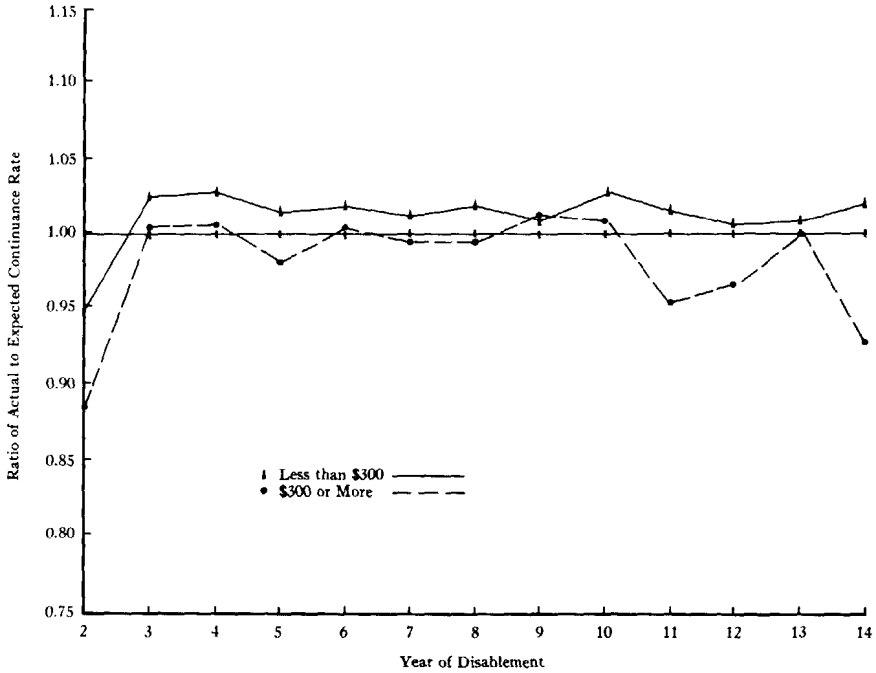
Beginning Exposure Count		
Year of Disable-ment	Monthly Benefit	
	Less than $300	$300 or More
2	11,556	4,441
3	7,316	2,265
4	5,619	1,491
5	4,575	1,009
6	3,728	599
7	3,124	413
8	2,677	288
9	2,325	214
10	2,034	169
11	1,780	113
12	1,560	71
13	1,363	56
14	1,173	35
15	999	21

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Monthly Benefit	
	Less than $300	$300 or More
2	.9508	.8851
3	1.0251	1.0066
4	1.0291	1.0067
5	1.0137	.9809
6	1.0198	1.0039
7	1.0107	.9937
8	1.0184	.9943
9	1.0090	1.0145
10	1.0270	1.0088
11	1.0141	.9531
12	1.0053	.9682
13	1.0088	1.0029
14	1.0213	.9243

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## GRAPH Q

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY AMOUNT OF MONTHLY BENEFIT, FOR AGES 60–99 AT DISABLEMENT

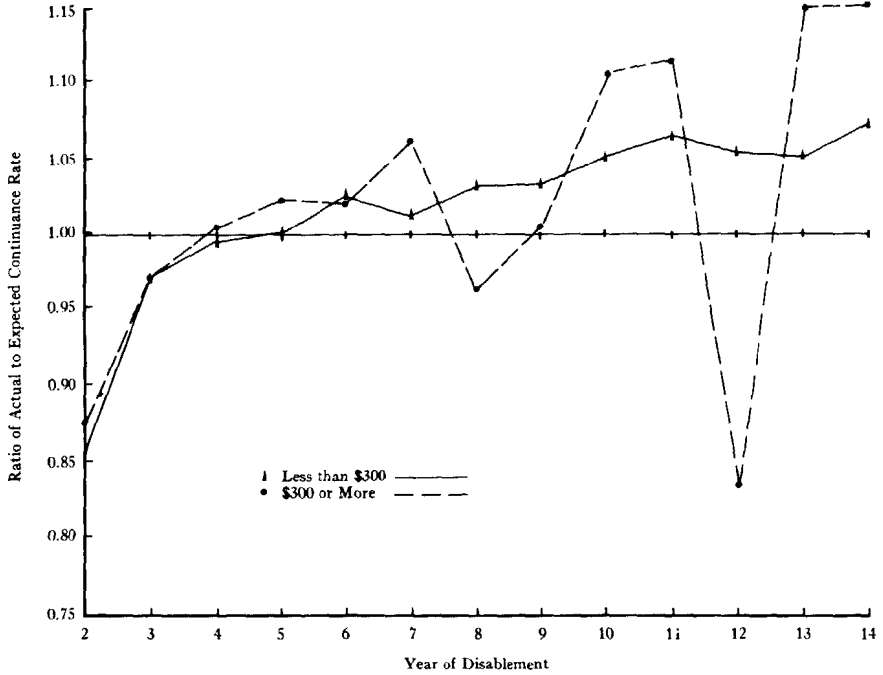|	Beginning Exposure Count			Actual-to-Expected Continuance Ratios	
Year of Disable-ment	Monthly Benefit		Year of Disable-ment	Monthly Benefit	
	Less than $300	$300 or More		Less than $300	$300 or More
2	10,948	1,812			
3	6,326	996	2	.8593	.8780
4	4,724	642	3	.9738	.9719
5	3,758	454	4	.9977	1.0057
6	2,935	244	5	1.0029	1.0237
7	2,392	164	6	1.0257	1.0209
8	1,950	110	7	1.0123	1.0625
9	1,636	74	8	1.0323	.9620
10	1,353	49	9	1.0345	1.0058
11	1,088	24	10	1.0549	1.1077
12	885	17	11	1.0666	1.1155
13	703	7	12	1.0536	.8290
14	554	4	13	1.0513	1.1862
15	437	1	14	1.0746	1.1978

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GRAPH R

Beginning Exposure Count		
Year of Disable-ment	Sickness Requirement	
	Confining	No Limitation
2	122	680
3	89	271
4	75	171
5	68	112
6	63	71
7	59	49
8	58	34
9	55	32
10	53	27
11	48	20
12	47	17
13	45	15
14	44	13
15	42	13

Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sickness Requirement	
	Confining	No Limitation
2	1.0994	.8394
3	1.1747	1.0492
4	1.0980	1.0320
5	1.0667	1.0726
6	1.0935	1.0016
7	1.0887	.9998
8	1.0411	1.0465
9	1.0552	1.0076
10	1.0196	1.0007
11	1.0532	1.0532
12	1.0575	1.0169
13	1.0374	.9195
14	1.0649	1.0649

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GRAPH S

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY SICKNESS REQUIREMENT, FOR AGES 40–59 AT DISABLEMENT

Beginning Exposure Count		
Year of Disable- ment	Sickness Requirement	
	Confining	No Limitation
2	5,025	7,616
3	3,616	4,060
4	3,027	2,714
5	2,655	1,892
6	2,360	1,199
7	2,082	834
8	1,830	596
9	1,616	462
10	1,422	373
11	1,260	268
12	1,094	207
13	935	182
14	796	150
15	669	126

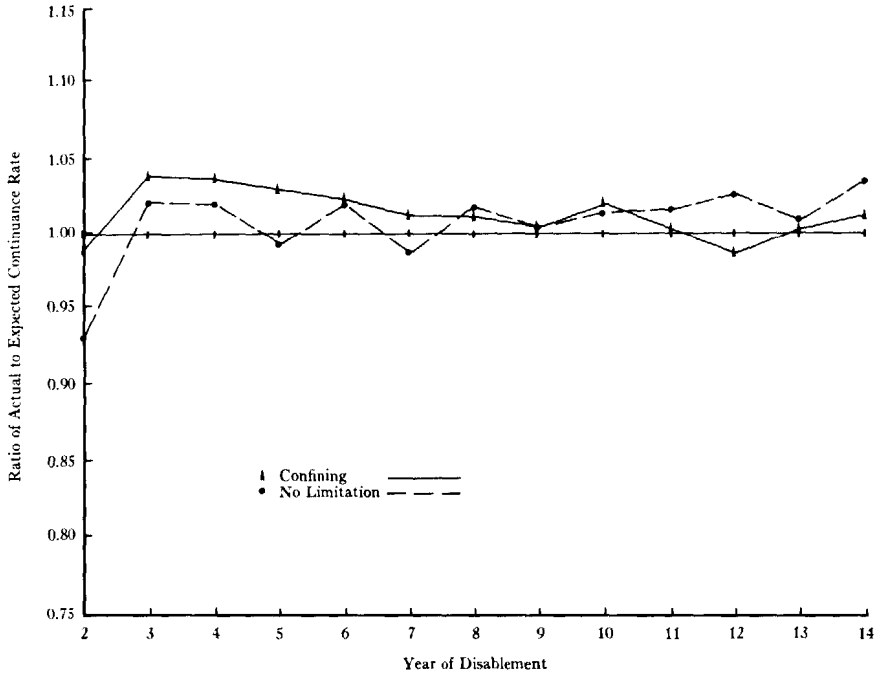| Actual-to-Expected Continuance Ratios		
Year of Disable- ment	Sickness Requirement	
	Confining	No Limitation
2	.9909	.9329
3	1.0393	1.0224
4	1.0378	1.0208
5	1.0306	.9946
6	1.0243	1.0203
7	1.0126	.9881
8	1.0121	1.0189
9	1.0053	1.0053
10	1.0213	1.0153
11	1.0035	1.0168
12	.9877	1.0274
13	1.0038	1.0089
14	1.0119	1.0352

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GRAPH T

ANNUAL ACTUAL-TO-EXPECTED CONTINUANCE RATIOS
BASED ON 1964 COMMISSIONERS DISABILITY TABLE
BY SICKNESS REQUIREMENT, FOR AGES 60–99 AT DISABLEMENT
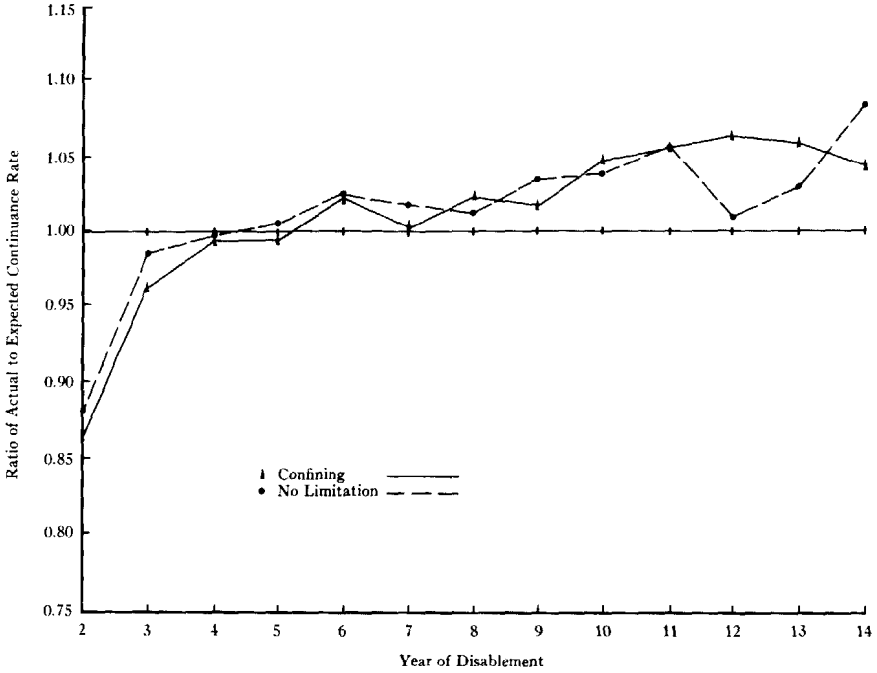
Beginning Exposure Count				Actual-to-Expected Continuance Ratios		
Year of Disable-ment	Sickness Requirement			Year of Disable-ment	Sickness Requirement	
	Confining	No Limitation			Confining	No Limitation
2	5,853	5,173		2	.8647	.8811
3	3,434	2,839		3	.9660	.9874
4	2,628	1,930		4	.9952	.9990
5	2,176	1,404		5	.9956	1.0083
6	1,780	883		6	1.0239	1.0276
7	1,468	648		7	1.0043	1.0197
8	1,206	481		8	1.0237	1.0149
9	1,002	379		9	1.0193	1.0363
10	823	293		10	1.0496	1.0405
11	648	208		11	1.0580	1.0576
12	509	166		12	1.0636	1.0116
13	400	122		13	1.0587	1.0307
14	311	95		14	1.0438	1.0844
15	240	74				

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DISCUSSION OF PRECEDING PAPER

JAMES OLSEN:

Very small amounts of claim data beyond the first year of disablement on individual policies providing total disability benefits have been published, and, therefore, this study should prove to be quite useful.

The expected continuance rates in the study were based on the 1964 Commissioners Disability Table. It should be noted that, in that table, the termination rates after one year from date of disablement are the same as the 1930-50 disabled life termination rates for Benefits 2 and 3 combined in the 1952 disability study of the Society of Actuaries.

The paper indicates that the data were split into three broad age-at-disablement groups: 18-39, 40-59, and 60 and over. The expected continuance rates were based on the unweighted averages of quinquennial-age values from the 1964 CDT. I wonder whether there is not a certain bias in doing this. Shouldn't the expected quinquennial-age values have been weighted according to the age distribution of the actual claims?

The claim exposure count for age group 18-39 is quite small. Also, since the policies of many companies do not provide benefits on claims incurred after age 65, and since Mutual of Omaha's claim volume for ages 60-64 is, therefore, probably much less than that shown for ages 60-99, the ratios of actual to expected continuance rates for ages 60-64 probably are lower than those shown for ages 60-99. Therefore, in attempting to evaluate the overall experience for claims incurred prior to age 65, it seems reasonable to be guided by the results for ages 40-59. The ratios of actual to expected for ages 40-59 remain quite constant at about 101 percent.

A 3 percent interest rate combined with the 1964 CDT would produce about the same disability annuity values as a 4 percent interest rate combined with 101 percent of the 1964 CDT continuance values. On the assumption that a 4 percent interest rate would be more realistic than 3 percent, it appears that the disability annuity values based on the 1964 CDT with 3 percent interest do produce barely adequate disability annuity reserves.

ALLAN R. ELSTEIN:

This paper describing Mutual of Omaha's disability continuance rates is an excellent contribution to an area in need of individual company

data. It is another indication that the 1964 CDT may be inadequate as a reserve basis for disabled life reserves on accident and health policies, particularly for long-benefit-period policies.

In a more general context, I attempted to test the adequacy of current reserve bases using examples of adverse experience from recent Society of Actuaries publications. For this purpose, a disabled life reserve program developed at Connecticut Mutual was modified to reflect the percent of termination rates experienced as compared with the 1952 disability study rates (Benefit 5).

The technique used (regardless of whether the ratio of actual to expected termination rates was based on the 1952 disability study or on the 1964 CDT) was to calculate disabled life annuities based on the 1952 disability study, and compare those annuities with corresponding annuities calculated by modifying the termination rates. For example, for Mutual of Omaha's experience, the annuities that we compared with the 1952 disability study Benefit 5 annuities were determined as follows: Termination rates were calculated from data given in the tables under Graphs A and B. These rates were compared with the 1964 CDT rates, producing actual-to-expected termination ratios based on the 1964 CDT. These termination ratios then were applied to the 1952 disability study termination rates to produce the modified termination rates used in the calculation of modified annuities. This indirect technique saved some work and produced very little distortion in ratios of actual to expected annuity values. (This is especially true after the first year of disability, where the 1964 CDT is based on the 1952 disability study.)

Four sets of actual-to-expected termination ratios were studied; these are summarized in Table 1 of this discussion.

First, elective waiver of premium ratios were developed from Tables 8A and 9A of the ordinary waiver of premium benefits experience study (*TSA, 1978 Reports*, p. 85). The elective ratios from 1959–74 of Table 8A were modified by multiplying them by the ratio of 1969–74 combined experience (elective plus automatic) to 1959–74 combined experience, producing estimated elective ratios for 1969–74. To get a table for 1970–75, the ratios were extrapolated for one more year.

Second, group long-term disability termination rates for 1971–75 were studied. Originally published in the *1977 Reports*, they are summarized in Table 3 of John Miller and Simon Courant's recent paper "Disability Termination Rates" (*TSA, XXXI*, 439). The male rates based on a six-month deferment period were used in our analysis.

Third, waiver of premium experience under Benefit 2 of the 1952 disability study for the period 1930–35 was studied. Originally published

in the *1952 Reports*, this material is summarized in Table 4 of Miller and Courant's paper.

Finally, the Mutual of Omaha continuance experience, as summarized in the data tables under Graphs A and B, was translated into termination rates and studied. The observed continuance probabilities were divided by the ratios of actual to expected continuance rates to get expected continuance probabilities. Termination ratios by age group and duration were calculated, and, using the beginning exposure counts as rough weights, average termination rates were calculated by duration for all ages at disablement combined.

Table 2 extends each of these studies to periods not studied, providing a basis for calculating modified 1952 study disabled life annuities. It should be noted that no termination rates larger than 100 percent were used. In order to test deterioration of elective waiver of premium rates

TABLE 1

RATIOS OF ACTUAL TO EXPECTED* TERMINATIONS
FOR VARIOUS BLOCKS OF EXPERIENCE

YEAR OF DISABLEMENT	BLOCK OF EXPERIENCE			
	Elective Waiver of Premium 1970–75	Group Long-Term Disability 6-Month Elimination Period 1971–75	Waiver of Premium 1930–35	Mutual of Omaha Disability Income 1970–77
1........	>100%	62%	95%	>100%
2........	77	72	93	>100
3........	71	70	73	>100
4........	63	62	70	90
5........	61	62	79	94
6........	69	62	83	81
7........	69	72	76	88
8........	69	73	84	79
9........	69	....	45	82
10.......	69	....	49	66
11.......	82	....	49	74
12.......	82	....	49	85
13.......	82	....	49	82
14.......	82	....	49	69
15.......	82	....	49	....

* Expected termination for the elective waiver experience based on Benefit 5; for the group long-term disability and the 1930–35 waiver of premium experience, based on Benefit 2 (including Benefit 3 after the first year of disablement); for the Mutual of Omaha experience, based on the 1964 CDT.

TABLE 2

EXTENDED RATIOS OF ACTUAL TO EXPECTED TERMINATIONS FOR MODEL*

Year of Disablement	Elective Waiver of Premium 1970–75	85% of Elective Waiver of Premium	Group Long-Term Disability 6-Month Elimination Period 1971–75	Waiver of Premium 1930–35	Mutual of Omaha Disability Income 1970–77
1........	100%	85%	62%	95%	100%
2........	77	65	72	93	100
3........	71	60	70	73	100
4........	63	54	62	70	90
5........	61	52	62	79	94
6........	69	59	62	83	81
7........	69	59	72	76	88
8........	69	59	73	84	79
9........	69	59	75	45	82
10.......	69	59	75	49	66
11.......	82	70	75	49	74
12.......	82	70	75	49	85
13.......	82	70	75	49	82
14.......	82	70	75	49	69
Over 14....	82	70	75	49	69

* See footnote to Table 1.

further, an analysis based on 85 percent of the elective rates also was made.

Table 3 summarizes these annuity values, and Table 4 summarizes the ratios of these values to those of the basic 1952 study. As can be seen, it is quite possible to get modified annuity values that are 20–50 percent larger than those of the 1952 study for large portions of the probable distribution of disabled lives. These annuities are based on a valuation interest rate of $3\frac{1}{2}$ percent.

In order to get a feel for the impact of these ratios on the total reserves a company might hold, a model office consisting of mature waiver of premium claims was created. Since the average benefit period of waiver claims is almost certain to be longer than that of a block of disability income claims, this technique will slightly overstate the reserves for disability income blocks. Results are shown in Table 5. Reserve ratios ranged from 115.6 percent for the Mutual of Omaha experience (as modified) to 137 percent for the 1930–35 waiver experience. As is illustrated, a 1 percent increase in valuation interest rate reduces reserve levels by roughly 8 percent.

In summary, under conditions of high unemployment and high consumer awareness, disabled life reserves based on the 1952 disability study or the 1964 CDT may be inadequate.

TABLE 3

DISABLED LIFE ANNUITY VALUES FOR VARIOUS BLOCKS OF EXPERIENCE

(Interest at 3½ Percent)

DURATION SINCE DISABLEMENT	BLOCK OF EXPERIENCE					
	1952 Study	Elective Waiver of Premium	85% of Elective Waiver of Premium	Group Long-Term Disability	1930–35 Waiver of Premium	Mutual of Omaha
Age 25						
1 year:						
5-year benefit....	1.745	1.955	2.211	2.388	1.942	1.768
10-year benefit...	2.213	2.763	3.272	3.450	2.661	2.293
To age 65.......	2.858	4.113	5.210	5.338	4.151	3.196
Lifetime.........	2.889	4.203	5.391	5.415	4.338	3.273
2 years:						
5-year benefit....	1.762	2.123	2.277	2.156	2.007	1.787
10-year benefit...	2.606	3.579	3.995	3.647	3.255	2.731
To age 65.......	3.767	6.009	7.165	6.301	5.841	4.358
Lifetime.........	3.822	6.169	7.428	6.409	6.166	4.496
5 years:						
10-year benefit...	2.896	3.291	3.410	3.306	3.130	3.046
To age 65.......	7.218	9.375	10.386	9.579	10.130	8.733
Lifetime.........	7.429	9.790	10.983	10.067	11.032	9.227
10 years:						
To age 65.......	9.713	10.833	11.635	11.238	13.221	11.451
Lifetime.........	10.212	11.607	12.673	12.152	14.990	12.488
15 years:						
To age 65.......	9.636	10.536	11.204	10.918	12.523	11.262
Lifetime.........	10.464	11.736	12.752	12.309	14.991	12.844
Age 35						
1 year:						
5-year benefit....	1.721	1.921	2.188	2.405	1.922	1.757
10-year benefit...	2.291	2.811	3.341	3.607	2.740	2.379
To age 65.......	3.041	4.179	5.259	5.495	4.223	3.355
Lifetime.........	3.140	4.412	5.647	5.851	4.636	3.554
2 years:						
5-year benefit....	1.891	2.229	2.372	2.261	2.120	1.914
10-year benefit...	2.983	3.934	4.333	4.001	3.624	3.108
To age 65.......	4.420	6.557	7.592	6.736	6.349	4.977
Lifetime.........	4.611	7.004	8.251	7.250	7.109	5.360
5 years:						
10-year benefit...	3.124	3.453	3.551	3.464	3.322	3.252
To age 65.......	7.648	9.382	10.146	9.512	9.891	8.840
Lifetime.........	8.270	10.425	11.521	10.685	11.770	10.015
10 years:						
To age 65.......	8.933	9.712	10.239	9.970	11.225	10.077
Lifetime.........	10.232	11.510	12.480	12.004	14.581	12.305
15 years:						
To age 65.......	8.124	8.616	8.966	8.818	9.624	8.996
Lifetime.........	10.235	11.361	12.260	11.868	14.259	12.342

TABLE 3—*Continued*

DURATION SINCE DISABLEMENT	BLOCK OF EXPERIENCE					
	1952 Study	Elective Waiver of Premium	85% of Elective Waiver of Premium	Group Long-Term Disability	1930–35 Waiver of Premium	Mutual of Omaha
Age 45						
1 year:						
5-year benefit....	1.966	2.157	2.410	2.633	2.166	2.010
10-year benefit...	2.827	3.345	3.869	4.170	3.291	2.931
To age 65.......	3.640	4.610	5.511	5.822	4.625	3.912
Lifetime........	4.012	5.301	6.529	6.792	5.682	4.524
2 years:						
5-year benefit....	2.181	2.463	2.579	2.488	2.374	2.200
10-year benefit...	3.718	4.584	4.928	4.639	4.312	3.845
To age 65.......	5.170	6.842	7.573	6.951	6.612	5.597
Lifetime........	5.834	8.076	9.212	8.310	8.432	6.689
5 years:						
10-year benefit...	3.335	3.598	3.677	3.606	3.497	3.442
To age 65.......	6.861	7.924	8.344	7.962	8.076	7.522
Lifetime........	8.522	10.357	11.317	10.593	11.788	10.129
10 years:						
To age 65.......	6.162	6.500	6.710	6.592	7.077	6.606
Lifetime........	9.306	10.442	11.309	10.882	13.225	11.151
15 years:						
To age 65.......	8.660	3.747	3.807	3.782	3.912	3.812
Lifetime........	8.802	9.793	10.596	10.245	12.430	10.670
Age 55						
1 year:						
5-year benefit....	2.532	2.703	2.899	3.064	2.706	2.571
10-year benefit...	3.875	4.409	4.853	5.055	4.336	3.996
To age 65.......	3.875	4.409	4.853	5.055	4.336	3.996
Lifetime........	5.388	6.722	7.799	7.860	7.241	6.029
2 years:						
5-year benefit....	2.520	2.729	2.810	2.745	2.667	2.536
10-year benefit...	4.487	5.227	5.503	5.264	5.006	4.623
To age 65.......	4.487	5.227	5.503	5.264	5.006	4.623
Lifetime........	6.703	8.616	9.565	8.812	9.174	7.600
5 years:						
10-year benefit...	3.391	3.634	3.708	3.641	3.542	3.492
To age 65.......	3.391	3.634	3.708	3.641	3.542	3.492
Lifetime........	7.807	9.368	10.197	9.569	10.692	9.197
10 years:						
Lifetime........	7.732	8.706	9.460	9.086	11.187	9.308
15 years:						
Lifetime........	6.761	7.598	8.292	7.986	9.950	8.355

TABLE 3—*Continued*

DURATION SINCE DISABLEMENT	BLOCK OF EXPEREINCE					
	1952 Study	Elective Waiver of Premium	85% of Elective Waiver of Premium	Group Long-Term Disability	1930–35 Waiver of Premium	Mutual of Omaha
	Age 62					
1 year:						
5-year benefit....	....	....	....	....	....	....
10-year benefit...	....	....	....	....	....	....
To age 65......	1.923	1.966	2.028	2.098	1.973	1.941
Lifetime.........	6.071	7.383	8.280	8.125	7.935	6.746
2 years:						
5-year benefit....	....	....	....	....	....	....
10-year benefit...	....	....	....	....	....	....
To age 65......	1.338	1.369	1.384	1.373	1.358	1.338
Lifetime.........	6.625	8.275	9.085	8.434	8.869	7.463
5 years:						
10-year benefit...	....	....	....	....	....	....
To age 65......	....	....	....	....	....	....
Lifetime.........	6.753	8.134	8.870	8.304	9.305	7.945
10 years:						
Lifetime.........	6.158	7.010	7.683	7.345	9.283	7.517
15 years:						
Lifetime.........	5.012	5.732	6.345	6.073	7.881	6.401

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TABLE 4

RATIOS OF DISABLED LIFE ANNUITY VALUES TO THOSE OF THE 1952 STUDY
FOR VARIOUS BLOCKS OF EXPERIENCE

(Interest at 3½ Percent)

DURATION SINCE DISABLEMENT	BLOCK OF EXPERIENCE				
	Elective Waiver of Premium	85% of Elective Waiver of Premium	Group Long-Term Disability	1930–35 Waiver of Premium	Mutual of Omaha
Age 25					
1 year:					
5-year benefit........	1.12	1.27	1.37	1.11	1.01
10-year benefit.......	1.25	1.48	1.56	1.20	1.04
To age 65............	1.44	1.82	1.87	1.45	1.12
Lifetime.............	1.45	1.87	1.87	1.50	1.13
2 years:					
5-year benefit........	1.20	1.29	1.22	1.14	1.01
10-year benefit.......	1.37	1.53	1.40	1.25	1.05
To age 65............	1.60	1.90	1.67	1.55	1.16
Lifetime.............	1.61	1.94	1.68	1.61	1.18
5 years:					
10-year benefit.......	1.14	1.18	1.14	1.08	1.05
To age 65............	1.30	1.44	1.33	1.40	1.21
Lifetime.............	1.32	1.48	1.36	1.48	1.24
10 years:					
To age 65............	1.12	1.20	1.16	1.36	1.18
Lifetime.............	1.14	1.24	1.19	1.47	1.22
15 years:					
To age 65............	1.09	1.16	1.13	1.30	1.17
Lifetime.............	1.12	1.22	1.18	1.43	1.23
Age 35					
1 year:					
5-year benefit........	1.12	1.27	1.40	1.12	1.02
10-year benefit.......	1.23	1.46	1.57	1.20	1.04
To age 65............	1.37	1.73	1.81	1.39	1.10
Lifetime.............	1.41	1.80	1.86	1.48	1.13
2 years:					
5-year benefit........	1.18	1.25	1.20	1.12	1.01
10-year benefit.......	1.32	1.45	1.34	1.21	1.04
To age 65............	1.48	1.72	1.52	1.44	1.13
Lifetime.............	1.52	1.79	1.57	1.54	1.16
5 years:					
10-year benefit.......	1.11	1.14	1.11	1.06	1.04
To age 65............	1.23	1.33	1.24	1.29	1.16
Lifetime.............	1.26	1.39	1.29	1.42	1.21
10 years:					
To age 65............	1.09	1.15	1.12	1.26	1.13
Lifetime.............	1.16	1.22	1.17	1.43	1.20
15 years:					
To age 65............	1.06	1.10	1.09	1.18	1.11
Lifetime.............	1.11	1.20	1.16	1.39	1.21

TABLE 4—*Continued*

DURATION SINCE DISABLEMENT	BLOCK OF EXPERIENCE				
	Elective Waiver of Premium	85% of Elective Waiver of Premium	Group Long-Term Disability	1930–35 Waiver of Premium	Mutual of Omaha
Age 45					
1 year:					
5-year benefit........	1.10	1.23	1.34	1.10	1.02
10-year benefit.......	1.18	1.37	1.48	1.16	1.04
To age 65............	1.27	1.51	1.60	1.27	1.07
Lifetime.............	1.32	1.63	·1.69	1.42	1.13
2 years:					
5-year benefit........	1.13	1.18	1.14	1.09	1.01
10-year benefit.......	1.23	1.33	1.25	1.16	1.03
To age 65............	1.32	1.46	1.34	1.28	1.08
Lifetime.............	1.38	1.58	1.42	1.45	1.15
5 years:					
10-year benefit.......	1.08	1.10	1.08	1.05	1.03
To age 65............	1.15	1.22	1.16	1.18	1.10
Lifetime.............	1.22	1.33	1.24	1.38	1.19
10 years:					
To age 65............	1.05	1.09	1.07	1.15	1.07
Lifetime.............	1.12	1.22	1.17	1.42	1.20
15 years:					
To age 65............	1.02	1.04	1.03	1.07	1.04
Lifetime.............	1.11	1.20	1.16	1.41	1.21
Age 55					
1 year:					
5-year benefit........	1.07	1.14	1.21	1.07	1.02
10-year benefit.......	1.14	1.25	1.30	1.12	1.03
To age 65............	1.14	1.25	1.30	1.12	1.03
Lifetime.............	1.25	1.45	1.46	1.34	1.12
2 years:					
5-year benefit........	1.08	1.12	1.09	1.06	1.01
10-year benefit.......	1.16	1.23	1.17	1.12	1.03
To age 65............	1.16	1.23	1.17	1.12	1.03
Lifetime.............	1.29	1.43	1.31	1.37	1.13
5 years:					
10-year benefit.......	1.07	1.09	1.07	1.04	1.03
To age 65............	1.07	1.09	1.07	1.04	1.03
Lifetime.............	1.20	1.31	1.23	1.37	1.18
10 years:					
Lifetime.............	1.12	1.22	1.18	1.45	1.20
15 years:					
Lifetime.............	1.12	1.23	1.18	1.47	1.24

TABLE 4—*Continued*

Duration since Disablement	Block of Experience				
	Elective Waiver of Premium	85% of Elective Waiver of Premium	Group Long-Term Disability	1930–35 Waiver of Premium	Mutual of Omaha
	Age 62				
1 year:					
To age 65	1.02	1.05	1.02	1.03	1.01
Lifetime	1.22	1.36	1.22	1.31	1.11
2 years:					
To age 65	1.02	1.03	1.02	1.01	1.00
Lifetime	1.25	1.37	1.25	1.34	1.13
5 years:					
Lifetime	1.20	1.31	1.20	1.38	1.18
10 years:					
Lifetime	1.14	1.25	1.14	1.51	1.22
15 years:					
Lifetime	1.14	1.27	1.14	1.57	1.28

TABLE 5

RATIOS, FOR A MATURE BLOCK OF WAIVER OF PREMIUM CLAIMS, OF
RESERVES ON THE STATED BASIS TO RESERVES BASED ON
THE 1952 DISABILITY STUDY AT $3\frac{1}{2}$ PERCENT

Block of Experience and Interest Rate	Ratio to 1952 Disability Study Reserves
Elective waiver of premium at $3\frac{1}{2}\%$	123.5%
85% of elective waiver of premium at $3\frac{1}{2}\%$	136.8
85% of elective waiver of premium at 4%	131.3
85% of elective waiver of premium at $4\frac{1}{2}\%$	126.1
1930–35 waiver of premium at $3\frac{1}{2}\%$	137.0
1971–75 group long-term disability at $3\frac{1}{2}\%$	129.3
1971–77 Mutual of Omaha disability income at $3\frac{1}{2}\%$*	115.6

* Experience as modified in the discussion.

FUNG-YEE CHAN:

I would like to draw some conclusions from this paper. Considering Graph A specifically, I tried using a moving-average procedure on the data after 2 years of disablement. Every two adjacent values of the response variable y—in this case, the actual-to-expected continuance ratio—are averaged, and so are the corresponding two values of t, the number of years of disablement. The reduced set of averages thus obtained will generally be smoother and hence show the shape of their relationship more clearly. In the present example, Group I (age group 18–39) and Group III (age group 60–99), except for a last point, suggest a common straight line, while Group II (age group 40–59) remains quite constant (as noted by the authors).

Actually, the following model emerges after this averaging process:

$$y = a|I - 2|t + b(|I - 2| + c),$$

where I is the respective group number and a, b, c are parameters to be estimated.

The use of an ordinary-least-squares computer package gives the following results:

	Estimate	Standard Error
a.......	0.00611	0.00068
b.......	−0.03749	0.00704
c.......	−27.054	5.131

($R^2 = 0.7385$). That is, the standard errors are about 20 percent of the estimates. In view of the R^2 value and the fact that we are fitting 36 data values with 3 parameters, we conclude that the empirical formula is functioning pretty well.

The advantage of such an empirical formula is twofold. First, it summarizes a smooth relationship in terms of 3 parameters. Second, it means that if the 1964 CDT is corrected with such a formula, its fit to Mutual of Omaha's claim continuance experience will be improved. At the inference level, it remains to be tested, however, whether the 1964 CDT, in either its present or its corrected form, will give a better fit to similar future experiences.

(AUTHORS' REVIEW OF DISCUSSION)

KERMITT L. COX AND ROBERT B. SHAPLAND:

We would like to thank Messrs. Olsen, Elstein, and Chan for taking time to analyze and comment on our paper.

Mr. Olsen correctly points out that a bias in the actual-to-expected ratios could arise under our large age groupings because we did not weight the quinquennial-age expected factors by our quinquennial-age exposures. Instead, we weighted them by the 1964 CDT $l^i_{[x]+t}$'s, which are based on a common exposure radix at each quinquennial age at disablement. After receiving Mr. Olsen's comments, we recalculated sample actual-to-expected ratios using our actual quinquennial-age exposures. This sample showed less than a 1 percent bias for age group 18–39 and no bias for age group 40–59.

We and others in the industry are indebted to Mr. Elstein for his analysis of the overall impact on claim reserves of basing them on various blocks of continuance experience as opposed to the 1964 CDT. All these bases produced reserves higher than the 1964 CDT. It might be noted that we recently contacted thirteen large writers of individual disability insurance and learned that studies of their own experience have led them to set claim reserves that vary by company from 100 percent to approximately 115 percent of the 1964 CDT reserves.

We also wish to thank Mr. Chan for the additional insight he has given to the results of our study by his development of an empirical formula to represent our grid of actual-to-expected ratios.