REPORT OF THE TASK FORCE ON SMOKER/NONSMOKER MORTALITY

ABSTRACT

The Task Force on Smoker/Nonsmoker Mortality was created by the Society of Actuaries early in the summer of 1982 in response to a request by the National Association of Insurance Commissioners (NAIC) Technical Advisory Committee on Dynamic Interest and Related Matters. That Committee was acting on behalf of the NAIC Technical Staff Actuarial Group, which had asked the Technical Advisory Committee to contact the Society regarding the development of an interim valuation mortality standard for nonsmoker and smoker ordinary insurance products.

The charge given to the Task Force on Smoker/Nonsmoker Mortality was to ''gather together whatever experience is available on nonsmoker mortality and to prepare a report analyzing that experience. The objective would be to produce a report which could be used by the NAIC and its Technical Advisory Committee as a basis for developing interim valuation standards for nonsmoker ordinary business.''

The Task Force has determined that the currently available information regarding the mortality experience of smoker and nonsmoker insured lives consists primarily of mortality experience of five companies (State Mutual, Mutual Security Life, Phoenix Mutual, Home Life, and Sun Life of Canada) as published in the *Record* and *Transactions of the Society of Actuaries*. Part I of this report presents the intercompany mortality experience currently available.

In December 1982, the Executive Committee of the Society of Actuaries amended the charge of the Task Force to include the development of ''a set of interim scaling factors from the data available to the Task Force by March 1, 1983, which, in the opinion of the Committee, will produce better valuations than not recognizing the smoker/nonsmoker differential at all.'' The Executive Committee recognized the time restrictions and indicated that a less than rigorous derivation of scaling factors would be better than producing no figures at all. The Task Force issued an exposure draft on March 1, containing scaling factors. Comments were requested and were reviewed. Part II of this final report presents the scaling factors that were developed by the Task Force; Part II reflects the revisions made as a result of the comments received. Part III of this report contains all the comments submitted, together with responses which reflect the position of the Task Force.

PART I. INTERCOMPANY EXPERIENCE

In Appendix A, the Task Force has summarized, compared, and contrasted the experience of the five companies that have published their nonsmoker mortality experience in the *Record* or *Transactions of the Society of Actuaries*. The Task Force would like to make the following technical comments:

1. In the experience published, the earliest year studied was 1973 and the latest was 1978, with an average of nearly five years per company. The experience of all five companies is comparable in terms of years of experience covered by the published data. In addition, the number of years included should be large enough to produce statistically credible data without covering an interval of time so long that the overall level of mortality would change significantly from the beginning of the interval to the end.

2. All five companies produced policy-year studies. Thus, there is complete consistency among these companies in the type of study performed.

3. Four companies have published mortality experience based on amounts of insurance, and three of these four have also published results based on number of policies. (The basis used by Sun Life is not clear from its experience as published in the *Transactions of the Society of Actuaries.*) Thus, intercompany experience by amounts of insurance, which should be the basis for the determination of premium or reserve differences between smokers and nonsmokers, is available for at least a few companies.

4. The basis of expected deaths used by four companies is the 1965–70 Basic Tables. Sun Life of Canada used its own tables as the basis of expected deaths in its study. Two companies that used the 1965–70 Basic Tables used the sex-distinct tables, and two used the tables with male and female lives combined. Since there is a considerable variation in the basis of expected deaths, the mortality ratios of the five companies are not strictly comparable.

5. Three companies have combined male and female lives into one group, one company kept male and female lives separate, and one company excluded female lives completely. Of the three companies which combined male and female lives, two based expected deaths on the 1965–70 Basic Tables for male and female lives combined and one used the sex-distinct tables. There are four different combinations of lives included and tables used. Thus, there is a strong possibility that the resulting mortality ratios do not reflect the relative levels of smoker and nonsmoker mortality consistently from company to company. This is especially true if the proportions of female lives are not substantially the same in all companies and in the tables used as the basis for calculating the expected deaths.

6. Three companies have included only medical issues, one company combined medical and nonmedical issues, and one company presented experience on medical and nonmedical issues separately. Since there are indications that the mortality differentials between smokers and nonsmokers are larger on medical business than on nonmedical business, the experience of these five companies might not be comparable.

7. Only Mutual Security Life included both standard and substandard lives; the remaining four companies studied standard lives only. Thus, the experience of Mutual Security Life might differ significantly from the other companies if the number of substandard lives included is substantial.

8. While all five companies exclude from the nonsmoker group any applicant who has

smoked cigarettes within twelve months of issue, there are three different definitions of a nonsmoker used by these five companies. Phoenix Mutual required its non-smokers to have met height and weight requirements. Pipe and cigar smokers can qualify as nonsmokers in State Mutual and Home Life, but they cannot be considered nonsmokers in Mutual Security Life or Sun Life. These variations in the definition of nonsmokers might produce significantly different mortality experience among the nonsmoker groups of these companies.

9. There are significant differences from company to company in the characteristics of the lives included in the "smoker" group. The procedures used in determining the "smoker" group of both State Mutual and Sun Life resulted in the inclusion of virtually no insureds who do not smoke cigarettes. Phoenix Mutual's "smoker" group includes not only cigarette smokers, but also insureds who did not receive special nonsmoker premiums because they failed to meet the height and weight requirements or because their age or the plan or amount of insurance made them ineligible. Thus, the Phoenix Mutual "smoker" group includes some insureds who do smoke cigarettes. Home Life's "smoker" group includes not only cigarette smok-ers but also noncigarette smokers who did not receive special nonsmoker premiums because of plan, sex, or amount, and therefore contains a substantial number of insureds who do not smoke cigarettes. The "smoker" group in the Mutual Security Life study included cigarette smoker applicants who were issued policies after 1964 as well as all applicants who were issued policies from 1961 to 1964. Thus, Mutual Security Life's "smoker" group includes a substantial number of insureds who do not smoke. These variations by company in the "smoker" group must be taken into account when comparing the resulting mortality ratios.

10. Since all companies have limited their nonsmoker premium reductions to certain issue ages or plans or amounts of insurance, their mortality experience studies also contain these limits. However, these limits are fairly minor and should not signifi-cantly affect the resulting mortality ratios.

PART II. SCALING FACTORS

The Task Force was faced with a small volume of experience data on which to base its development of scaling factors. As indicated in the abstract of this report, the currently available information regarding the mortality experience of smoker and nonsmoker insured lives consists primarily of the experience of five companies. An additional limitation arises from the fact that none of these companies has published any experience beyond the fif-teenth policy year.

The Task Force also faced the problems caused by inconsistencies in the published experience. (It seems probable that these inconsistencies are re-lated to the small volume of data.) For example, for males aged 20–29, the ratio of the level of nonsmoker mortality to the level of aggregate mortality

ranged from a low of 0.31 to a high of 1.32 in the experience of these five companies.

The procedure used by the Task Force to divide each of the 1980 CSO Male and Female Basic Tables into its smoker and nonsmoker component tables is the same as that used in the paper by Michael J. Cowell and Brian L. Hirst (*TSA*, XXXII, 206). This method uses, at each age, the proportions of smokers and nonsmokers in the data underlying the table, and the relative mortality of smokers and nonsmokers. This procedure is illustrated below:

P_x^s = Imputed proportion of smokers, at age x, in the 1980 CSO,

P_x^{ns} = Imputed proportion of nonsmokers, at age x, in the 1980 CSO.

(Clearly, $P_x^s + P_x^{ns} = 1$.)

R_x = Assumed ratio of smoker mortality rate to nonsmoker mortality rate, at age x, in the 1980 CSO,

Q_x^{CSO} = Mortality rate at age x in the 1980 CSO,

Q_x^{ns} = Nonsmoker mortality rate at age x, consistent with the 1980 CSO,

Q_x^s = Smoker mortality rate at age x, consistent with the 1980 CSO.

Two simultaneous equations must be solved:

$$(P_x^{ns} Q_x^{ns}) + (P_x^s Q_x^s) = Q_x^{CSO}$$

and

$$Q_x^s = R_x Q_x^{ns}.$$

This procedure was applied at ages 15 and above. The distinction between smokers and nonsmokers at ages 14 and under is, at least for insurance purposes, nebulous at best.

The first step in applying this method is the determination of the proportions of smokers and nonsmokers in the data underlying the 1980 CSO Basic

Tables. Since the 1980 CSO is based on experience from 1970 to 1975, the Task Force had to determine the proportions of smokers and nonsmokers among insured lives during that time period. The Task Force reviewed the insurance data available, as well as data contained in the 1979 *Report of the Surgeon General*, which are based on general population studies. The Task Force then developed the proportions of smokers in the data underlying the 1980 CSO. These proportions varied by age and sex, and are shown in Appendix B. For both males and females, the proportion of smokers at age 15 is relatively low. The proportions increase sharply to a peak at age 35, and thereafter decrease as age increases into the 90s.

The next step in the process of developing scaling factors is the determination of the ratio of the level of smoker mortality to nonsmoker mortality. Again, the Task Force reviewed the available insured lives and general population data. The experience studies contained in the *Report of the Surgeon General* were especially valuable at the higher ages, where the experience on insured lives is quite limited and the differences in mortality levels between insured lives and the general population are decreasing. The Task Force also received some unpublished data developed by the American Cancer Society for ages 65 and above.

The Task Force found, in the experience of the five insurance companies, wide variations in both the levels and patterns of excess mortality among smokers. These variations were far more than could be explained by the relatively minor differences among companies in their mortality studies, as detailed in Part I and Appendix A. Nonetheless, the Task Force developed a set of ratios of the level of smoker mortality to nonsmoker mortality for males, varying by age. The ratio is equal to 1.50 at age 15, increases to a peak of 2.50 at age 45, and thereafter decreases as age increases, eventually reaching 1.00 at ages 95 and above.

As a technical note, it was pointed out in Part I that while the nonsmoker groups of the various companies are relatively homogeneous, the smoker groups vary widely. Therefore, in order to compare the mortality experience of these companies, the Task Force first had to develop consistent statistics. The ratio of smoker mortality to aggregate mortality was calculated for each company. Then, using an assumed proportion of smokers in each company's experience and solving simultaneous equations similar to those above, the ratio of the mortality among true cigarette smokers to that among true non–cigarette smokers was calculated. This removed the effects of the different definitions of smokers and nonsmokers among the five companies. It is this statistic which showed wide variations from company to company.

The Task Force found very little data on the relative mortality of female

smokers as compared to female nonsmokers. Thus, it was decided to adjust the ratios of smoker to nonsmoker mortality among males rather than attempt to independently develop a set of female ratios. Based on the Sun Life experience and data contained in the 1979 *Report of the Surgeon General*, the ratio of excess mortality among female smokers to the excess mortality among male smokers ranged from 0.54 to 0.68. Since there was not a significant volume of data available to determine whether or not these ratios varied by age, the Task Force determined the mortality level of female smokers (relative to female nonsmokers) by setting the excess mortality among female smokers equal to 0.60 times the excess mortality among male smokers at all ages. The complete set of both male and female ratios of the level of smoker mortality to nonsmoker mortality is presented in Appendix C.

The ratio of 0.60 does not imply that the physical effects of smoking are less severe for women than they are for men. Rather, women smokers have lower overall exposure to cigarette smoke than men. As reported by the Surgeon General, women have started smoking at higher ages than men, women smoke cigarettes with lower tar and nicotine content than men smoke, and women smoke fewer cigarettes per day than men smoke. In fact, the Surgeon General reports that women and men with similar smoking characteristics experience similar levels of excess mortality.

The proportions of smokers, developed in Appendix B, and the ratios of the level of smoker mortality to nonsmoker mortality, developed in Appendix C, when taken together with the 1980 CSO Basic Tables, allow the solution of one pair of simultaneous equations at each age. The solutions to the equations produce the division of the 1980 CSO Male and Female Basic Tables into smoker and nonsmoker components, shown in Appendix D.

In order to produce tables appropriate for valuation purposes, margins must be added to the separate smoker and nonsmoker mortality rates developed above. Margins in the 1980 CSO were calculated by applying a formula to the 1980 CSO Basic Tables. The same formula was used for both the male table and the female table. From this fact, the Task Force inferred that the formula is appropriate for two significantly different mortality tables. The Task Force applied this same margin formula to its smoker and nonsmoker basic tables. In each table, the resulting margins were not significantly different from the margins which were produced by applying the margin formula to the aggregate 1980 CSO Basic Tables. In order to avoid the inconsistencies which would arise if the margins in the separate smoker and nonsmoker tables were not identical, the Task Force added the actual margins used in the 1980 CSO to its separate smoker and nonsmoker basic

tables. The resulting loaded male nonsmoker, male smoker, female nonsmoker, and female smoker mortality rates are presented in Appendix E.

The amended charge of the Task Force included the development of "scaling factors." The Task Force calculated scaling factors simply by dividing the loaded mortality rate developed in each cell (defined by age, sex, and smoking classification), by the loaded mortality rate in the corresponding 1980 CSO cell (defined by age and sex only). The resulting scaling factors are presented in Table 1. The Task Force also developed smoker and non-

TABLE 1

1980 CSO SMOKER AND NONSMOKER SCALING FACTORS

Age Nearest Birthday

MALES

Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor
15....	.9699	1.2406	45.....	.7297	1.3780	75.....	.9160	1.3050
16....	.9470	1.2384	46.....	.7297	1.3882	76.....	.9224	1.2916
17....	.9222	1.2275	47.....	.7293	1.3985	77.....	.9289	1.2775
18....	.8989	1.2135	48.....	.7300	1.4077	78.....	.9353	1.2623
19....	.8925	1.2151	49.....	.7311	1.4171	79.....	.9415	1.2465
20....	.8842	1.2158	50.....	.7317	1.4247	80.....	.9477	1.2302
21....	.8743	1.2199	51.....	.7329	1.4301	81.....	.9539	1.2133
22....	.8677	1.2169	52.....	.7362	1.4347	82.....	.9597	1.1957
23....	.8656	1.2151	53.....	.7382	1.4397	83.....	.9651	1.1775
24....	.8626	1.2143	54.....	.7416	1.4435	84.....	.9705	1.1586
25....	.8588	1.2090	55.....	.7469	1.4460	85.....	.9755	1.1389
26....	.8555	1.2023	56.....	.7531	1.4476	86.....	.9802	1.1186
27....	.8538	1.2047	57.....	.7598	1.4484	87.....	.9846	1.0975
28....	.8471	1.2000	58.....	.7667	1.4489	88.....	.9877	1.0833
29....	.8421	1.2047	59.....	.7766	1.4455	89.....	.9904	1.0686
30....	.8324	1.2139	60.....	.7861	1.4422	90.....	.9929	1.0537
31....	.8258	1.2191	61.....	.7948	1.4401	91.....	.9952	1.0386
32....	.8197	1.2240	62.....	.8035	1.4377	92.....	.9972	1.0232
33....	.8115	1.2304	63.....	.8124	1.4354	93.....	.9982	1.0154
34....	.8050	1.2400	64.....	.8220	1.4322	94.....	.9992	1.0076
35....	.8009	1.2464	65.....	.8312	1.4276	95.....	1.0000	1.0000
36....	.7902	1.2545	66.....	.8402	1.4208	96.....	1.0000	1.0000
37....	.7833	1.2667	67.....	.8495	1.4129	97.....	1.0000	1.0000
38....	.7752	1.2791	68.....	8587	1.4025	98.....	1.0000	1.0000
39....	.7670	1.2903	69.....	.8676	1.3912	99.....	1.0000	1.0000
40....	.7583	1.3046	70.....	.8765	1.3789			
41....	.7508	1.3191	71.....	.8848	1.3647			
42....	.7444	1.3343	72.....	.8932	1.3501			
43....	.7390	1.3488	73.....	.9012	1.3342			
44....	.7327	1.3628	74.....	.9094	1.3174			

TABLE 1—*Continued*

FEMALES

Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor
15....	.9882	1.1059	45.....	.8399	1.2949	75.....	.9759	1.2197
16....	.9778	1.1000	46.....	.8395	1.3026	76.....	.9784	1.2083
17....	.9684	1.0947	47.....	.8420	1.3111	77.....	.9806	1.1961
18....	.9694	1.1122	48.....	.8430	1.3118	78.....	.9828	1.1830
19....	.9608	1.1078	49.....	.8423	1.3132	79.....	.9848	1.1695
20....	.9619	1.1048	50.....	.8448	1.3185	80.....	.9868	1.1556
21....	.9533	1.1028	51.....	.8475	1.3183	81.....	.9886	1.1413
22....	.9541	1.1101	52.....	.8509	1.3193	82.....	.9902	1.1267
23....	.9459	1.1081	53.....	.8553	1.3220	83.....	.9917	1.1117
24....	.9474	1.1140	54.....	.8593	1.3238	84.....	.9925	1.1044
25....	.9397	1.1121	55.....	.8646	1.3258	85.....	.9938	1.0889
26....	.9412	1.1261	56.....	.8705	1.3276	86.....	.9945	1.0812
27....	.9344	1.1311	57.....	.8780	1.3288	87.....	.9957	1.0652
28....	.9286	1.1270	58.....	.8843	1.3282	88.....	.9964	1.0572
29....	.9231	1.1385	59.....	.8904	1.3255	89.....	.9975	1.0410
30....	.9185	1.1481	60.....	.8986	1.3210	90.....	.9981	1.0328
31....	.9071	1.1500	61.....	.9042	1.3189	91.....	.9986	1.0246
32....	.9034	1.1586	62.....	.9106	1.3130	92.....	.9991	1.0163
33....	.9000	1.1667	63.....	.9160	1.3128	93.....	.9996	1.0081
34....	.8987	1.1772	64.....	.9230	1.3079	94.....	1.0000	1.0000
35....	.8909	1.1758	65.....	.9287	1.3071	95.....	1.0000	1.0000
36....	.8864	1.1875	66.....	.9356	1.2994	96.....	1.0000	1.0000
37....	.8836	1.2063	67.....	.9415	1.2955	97.....	1.0000	1.0000
38....	.8775	1.2206	68.....	.9480	1.2845	98.....	1.0000	1.0000
39....	.8694	1.2297	69.....	.9533	1.2780	99.....	1.0000	1.0000
40....	.8595	1.2397	70.....	.9588	1.2641			
41....	.8561	1.2614	71.....	.9633	1.2567			
42....	.8502	1.2683	72.....	.9672	1.2486			
43....	.8479	1.2816	73.....	.9704	1.2398			
44....	.8434	1.2892	74.....	.9732	1.2302			

smoker mortality tables on an age-last-birthday (ALB) basis, using the same formula as used in the 1980 CSO (*TSA*, XXXIII, 671). Smoker and non-smoker scaling factors for the 1980 ALB CSO were similarly calculated and are presented in Table 2.

In addition, the Task Force developed smoker and nonsmoker CET tables on both age-nearest-birthday and age-last-birthday bases. Both tables were derived from the corresponding CSO table by adding a loading equal to the greater of 0.75 deaths per thousand or 30 percent of the CSO mortality rate. This is the same loading used in the development of the 1980 CET. Smoker

TABLE 2

1980 CSO SMOKER AND NONSMOKER SCALING FACTORS

Age Last Birthday

MALES

Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor
15....	.9577	1.2394	45.....	.7294	1.3848	75.....	.9196	1.2977
16....	.9308	1.2327	46.....	.7285	1.3926	76.....	.9259	1.2840
17....	.9128	1.2209	47.....	.7288	1.4033	77.....	.9323	1.2694
18....	.8956	1.2143	48.....	.7303	1.4137	78.....	.9385	1.2539
19....	.8883	1.2128	49.....	.7307	1.4211	79.....	.9447	1.2379
20....	.8842	1.2211	50.....	.7329	1.4286	80.....	.9508	1.2212
21....	.8737	1.2211	51.....	.7339	1.4325	81.....	.9568	1.2040
22....	.8670	1.2128	52.....	.7371	1.4382	82.....	.9625	1.1863
23....	.8641	1.2174	53.....	.7404	1.4425	83.....	.9679	1.1677
24....	.8611	1.2111	54.....	.7443	1.4456	84.....	.9730	1.1486
25....	.8571	1.2057	55.....	.7500	1.4471	85.....	.9778	1.1287
26....	.8547	1.2035	56.....	.7569	1.4478	86.....	.9824	1.1082
27....	.8480	1.1988	57.....	.7630	1.4479	87.....	.9862	1.0905
28....	.8471	1.2059	58.....	.7715	1.4464	88.....	.9890	1.0762
29....	.8372	1.2093	59.....	.7815	1.4436	89.....	.9916	1.0616
30....	.8286	1.2171	60.....	.7911	1.4411	90.....	.9940	1.0466
31....	.8222	1.2222	61.....	.7990	1.4385	91.....	.9961	1.0315
32....	.8128	1.2246	62.....	.8082	1.4359	92.....	.9977	1.0196
33....	.8103	1.2359	63.....	.8176	1.4332	93.....	.9987	1.0118
34....	.8049	1.2439	64.....	.8265	1.4293	94.....	.9995	1.0042
35....	.7972	1.2535	65.....	.8358	1.4237	95.....	1.0000	1.0000
36....	.7845	1.2586	66.....	.8452	1.4164	96.....	1.0000	1.0000
37....	.7791	1.2731	67.....	.8544	1.4074	97.....	1.0000	1.0000
38....	.7724	1.2873	68.....	.8635	1.3965	98.....	1.0000	1.0000
39....	.7621	1.3000	69.....	.8723	1.3846	99.....	1.0000	1.0000
40....	.7556	1.3143	70.....	.8808	1.3710			
41....	.7485	1.3275	71.....	.8891	1.3566			
42....	.7412	1.3423	72.....	.8976	1.3415			
43....	.7345	1.3548	73.....	.9055	1.3251			
44....	.7300	1.3707	74.....	.9129	1.3105			

and nonsmoker CET scaling factors are presented in Tables 3 and 4. Smoker and nonsmoker mortality rates for all tables are contained in Appendix F.

It should be noted that the scaling factors contained in this report are to be used only with the specific valuation table to which they apply. They should *not* be used in conjunction with any other valuation table or any basic mortality table.

TABLE 2—*Continued*

FEMALES

Age	Nonsmoker Scaling Factor	Smoking Scaling Factor	Age	Nonsmoker Scaling Factor	Smoking Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor
15....	.9885	1.1034	45.....	.8397	1.2989	75.....	.9773	1.2135
16....	.9783	1.0978	46.....	.8418	1.3087	76.....	.9795	1.2018
17....	.9688	1.1042	47.....	.8425	1.3103	77.....	.9816	1.1890
18....	.9600	1.1100	48.....	.8415	1.3125	78.....	.9838	1.1758
19....	.9612	1.1068	49.....	.8434	1.3173	79.....	.9858	1.1621
20....	.9528	1.1038	50.....	.8460	1.3197	80.....	.9877	1.1480
21....	.9537	1.1019	51.....	.8491	1.3200	81.....	.9895	1.1336
22..	.9455	1.1091	52.....	.8530	1.3209	82.....	.9909	1.1187
23..	.9464	1.1161	53.....	.8574	1.3229	83.....	.9920	1.1077
24..	.9391	1.1130	54.....	.8613	1.3241	84.....	.9932	1.0963
25..	.9402	1.1197	55..	.8677	1.3261	85.....	.9942	1.0847
26..	.9417	1.1333	56..	.8744	1.3282	86.....	.9951	1.0731
27..	.9274	1.1290	57.....	.8812	1.3285	87.....	.9961	1.0611
28..	.9219	1.1328	58.....	.8874	1.3276	88.....	.9970	1.0492
29..	.9242	1.1439	59..	.8946	1.3239	89.....	.9979	1.0370
30....	.9124	1.1533	60....	.9010	1.3194	90.....	.9984	1.0288
31....	.9085	1.1549	61.....	.9080	1.3159	91.....	.9988	1.0206
32..	.9048	1.1633	62.....	.9130	1.3124	92.....	.9993	1.0124
33..	.8961	1.1688	63....	.9200	1.3104	93.....	.9998	1.0044
34....	.8944	1.1801	64.....	.9260	1.3068	94.....	1.0000	1.0000
35....	.8882	1.1824	65.....	.9326	1.3028	95.....	1.0000	1.0000
36....	.8846	1.1978	66.....	.9384	1.2974	96.....	1.0000	1.0000
37....	.8827	1.2143	67.....	.9448	1.2896	97.....	1.0000	1.0000
38....	.8732	1.2254	68.....	.9510	1.2813	98.....	1.0000	1.0000
39....	.8621	1.2328	69.....	.9562	1.2704	99.....	1.0000	1.0000
40....	.8577	1.2490	70.....	.9611	1.2599			
41....	.8545	1.2655	71.....	.9655	1.2526			
42....	.8490	1.2752	72.....	.9681	1.2429			
43....	.8469	1.2875	73.....	.9719	1.2344			
44....	.8401	1.2907	74.....	.9745	1.2244			

While, at first glance, it might be expected that the nonsmoker reserves resulting from the above calculations would always be less than the corresponding smoker reserves, such is not the case. An analysis of the effects of using either one aggregate table or two component tables for valuation purposes, with a numerical example, is presented in Appendix G.

In the appendix to its report, the Special Committee to Recommend New Mortality Tables for Valuation developed selection factors which could be applied to the 1980 CSO loaded mortality rates to produce an alternative valuation method. The Task Force has reviewed the question of selection as

TABLE 3

1980 CET SMOKER AND NONSMOKER SCALING FACTORS

Age Nearest Birthday

MALES

Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor
15....	.9808	1.1538	45.....	.7297	1.3767	75.....	.9160	1.3050
16....	.9646	1.1593	46.....	.7297	1.3875	76.....	.9225	1.2916
17....	.9463	1.1570	47.....	.7283	1.3974	77.....	.9289	1.2775
18....	.9289	1.1502	48.....	.7306	1.4075	78.....	.9353	1.2623
19....	.9234	1.1533	49.....	.7311	1.4176	79.....	.9415	1.2464
20....	.9170	1.1547	50.....	.7317	1.4255	80.....	.9477	1.2302
21....	.9098	1.1579	51.....	.7334	1.4299	81.....	.9539	1.2134
22....	.9053	1.1553	52.....	.7362	1.4348	82.....	.9597	1.1957
23....	.9042	1.1533	53.....	.7385	1.4399	83.....	.9652	1.1775
24....	.9027	1.1518	54.....	.7418	1.4433	84.....	.9704	1.1586
25....	.9008	1.1468	55.....	.7472	1.4460	85.....	.9755	1.1389
26....	.8992	1.1411	56.....	.7530	1.4477	86.....	.9802	1.1185
27....	.8984	1.1423	57.....	.7599	1.4483	87.....	.9846	1.0975
28....	.8939	1.1388	58.....	.7668	1.4488	88.....	.9877	1.0833
29....	.8902	1.1423	59.....	.7766	1.4458	89.....	.9904	1.0687
30....	.8831	1.1492	60.....	.7861	1.4426	90.....	.9929	1.0538
31....	.8775	1.1542	61.....	.7947	1.4404	91.....	.9952	1.0386
32....	.8721	1.1589	62.....	.8036	1.4377	92.....	.9972	1.0232
33....	.8647	1.1654	63.....	.8123	1.4354	93.....	.9982	1.0154
34....	.8582	1.1745	64.....	.8221	1.4322	94.....	.9992	1.0076
35....	.8531	1.1958	65.....	.8312	1.4275	95.....	1.0000	1.0000
36....	.8428	1.2207	66.....	.8401	1.4206	96.....	1.0000	1.0000
37....	.8349	1.2540	67.....	.8496	1.4129	97.....	1.0000	1.0000
38....	.8209	1.2806	68.....	.8586	1.4025	98.....	1.0000	1.0000
39....	.7961	1.2893	69.....	.8675	1.3913	99.....	1.0000	1.0000
40....	.7735	1.3028	70.....	.8766	1.3789			
41....	.7523	1.3178	71.....	.8847	1.3647			
42....	.7451	1.3348	72.....	.8931	1.3500			
43....	.7396	1.3499	73.....	.9012	1.3342			
44....	.7321	1.3615	74.....	.9095	1.3174			

it applies to the use of separate smoker and nonsmoker tables for valuation purposes. The Task Force has found no inconsistencies in applying these selection factors to both the smoker and nonsmoker loaded mortality rates that result when the scaling factors are applied to the 1980 CSO loaded mortality rates.

TABLE 3—*Continued*

FEMALES

Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor
15....	.9938	1.0563	45.....	.8402	1.2937	75.....	.9761	1.2197
16....	.9879	1.0545	46.....	.8401	1.3036	76.....	.9783	1.2084
17....	.9824	1.0529	47.....	.8406	1.3093	77.....	.9806	1.1962
18....	.9827	1.0636	48.....	.8437	1.3108	78.....	.9827	1.1829
19....	.9774	1.0621	49.....	.8422	1.3123	79.....	.9848	1.1694
20....	.9778	1.0611	50.....	.8450	1.3178	80.....	.9868	1.1556
21....	.9725	1.0604	51.....	.8478	1.3188	81.....	.9886	1.1413
22....	.9728	1.0652	52.....	.8516	1.3198	82.....	.9902	1.1267
23....	.9677	1.0645	53.....	.8550	1.3213	83.....	.9917	1.1117
24....	.9683	1.0688	54.....	.8591	1.3248	84.....	.9925	1.1045
25....	.9634	1.0681	55....	.8644	1.3254	85.....	.9938	1.0889
26....	.9639	1.0773	56....	.8709	1.3283	86.....	.9945	1.0812
27....	.9594	1.0812	57....	.8784	1.3285	87.....	.9957	1.0652
28....	.9552	1.0796	58....	.8847	1.3288	88.....	.9964	1.0572
29....	.9512	1.0878	59.....	.8907	1.3262	89.....	.9975	1.0410
30....	.9476	1.0952	60.....	.8985	1.3209	90.....	.9981	1.0328
31....	.9395	1.0977	61.....	.9043	1.3189	91.....	.9986	1.0246
32....	.9364	1.1045	62.....	.9102	1.3130	92.....	.9991	1.0163
33....	.9333	1.1111	63.....	.9155	1.3122	93.....	.9996	1.0081
34....	.9313	1.1202	64.....	.9228	1.3076	94.....	1.0000	1.0000
35....	.9250	1.1208	65.....	.9288	1.3068	95.....	1.0000	1.0000
36....	.9203	1.1315	66.....	.9356	1.2995	96.....	1.0000	1.0000
37....	.9167	1.1477	67.....	.9413	1.2952	97.....	1.0000	1.0000
38....	.9104	1.1613	68.....	.9481	1.2846	98.....	1.0000	1.0000
39....	.9024	1.1953	69.....	.9532	1.2781	99.....	1.0000	1.0000
40....	.8927	1.2303	70.....	.9589	1.2644			
41....	.8776	1.2624	71.....	.9632	1.2568			
42....	.8552	1.2681	72.....	.9674	1.2488			
43....	.8483	1.2811	73.....	.9706	1.2399			
44....	.8426	1.2870	74.....	.9732	1.2301			

TABLE 4

1980 CET SMOKER AND NONSMOKER SCALING FACTORS

Age Last Birthday

MALES

Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor
15	.9724	1.1567	45	.7301	1.3854	75	.9195	1.2976
16	.9530	1.1581	46	.7282	1.3919	76	.9259	1.2840
17	.9393	1.1538	47	.7288	1.4033	77	.9323	1.2694
18	.9261	1.1518	48	.7307	1.4137	78	.9385	1.2539
19	.9202	1.1521	49	.7310	1.4202	79	.9447	1.2378
20	.9170	1.1585	50	.7330	1.4286	80	.9508	1.2212
21	.9094	1.1585	51	.7339	1.4325	81	.9568	1.2040
22	.9049	1.1521	52	.7368	1.4377	82	.9625	1.1863
23	.9035	1.1544	53	.7405	1.4423	83	.9679	1.1678
24	.9020	1.1490	54	.7448	1.4458	84	.9730	1.1486
25	.9000	1.1440	55	.7502	1.4470	85	.9778	1.1287
26	.8988	1.1417	56	.7571	1.4479	86	.9824	1.1082
27	.8943	1.1382	57	.7634	1.4478	87	.9862	1.0905
28	.8939	1.1429	58	.7716	1.4466	88	.9890	1.0762
29	.8866	1.1457	59	.7815	1.4434	89	.9916	1.0616
30	.8800	1.1520	60	.7912	1.4409	90	.9940	1.0466
31	.8745	1.1569	61	.7989	1.4382	91	.9961	1.0315
32	.8664	1.1603	62	.8081	1.4358	92	.9977	1.0196
33	.8630	1.1704	63	.8175	1.4331	93	.9987	1.0118
34	.8571	1.1857	64	.8266	1.4295	94	.9996	1.0042
35	.8493	1.2123	65	.8359	1.4236	95	1.0000	1.0000
36	.8371	1.2378	66	.8453	1.4164	96	1.0000	1.0000
37	.8302	1.2716	67	.8543	1.4072	97	1.0000	1.0000
38	.8103	1.2902	68	.8635	1.3964	98	1.0000	1.0000
39	.7851	1.2997	69	.8722	1.3847	99	1.0000	1.0000
40	.7634	1.3122	70	.8808	1.3711			
41	.7483	1.3258	71	.8891	1.3566			
42	.7427	1.3423	72	.8977	1.3415			
43	.7347	1.3550	73	.9055	1.3251			
44	.7306	1.3715	74	.9129	1.3105			

TABLE 4—*Continued*

FEMALES

Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor	Age	Nonsmoker Scaling Factor	Smoker Scaling Factor
15....	.9938	1.0556	45.....	.8410	1.2992	75.....	.9772	1.2135
16....	.9880	1.0539	46.....	.8412	1.3078	76.....	.9795	1.2017
17....	.9825	1.0585	47.....	.8422	1.3101	77.....	.9818	1.1891
18....	.9771	1.0629	48.....	.8419	1.3127	78.....	.9837	1.1758
19....	.9775	1.0618	49.....	.8427	1.3162	79.....	.9857	1.1620
20....	.9724	1.0608	50....	.8456	1.3193	80.....	.9876	1.1480
21....	.9727	1.0601	51.....	.8490	1.3203	81.....	.9894	1.1336
22....	.9676	1.0649	52....	.8532	1.3208	82.....	.9909	1.1187
23....	.9679	1.0695	53.....	.8577	1.3233	83.....	.9921	1.1076
24....	.9632	1.0684	54.....	.8608	1.3232	84.....	.9931	1.0963
25....	.9635	1.0729	55....	.8678	1.3263	85.....	.9942	1.0847
26....	.9641	1.0821	56....	.8748	1.3284	86.	.9951	1.0731
27....	.9548	1.0804	57....	.8807	1.3281	87.	.9961	1.0611
28....	.9507	1.0837	58....	.8877	1.3280	88.	.9970	1.0493
29	.9517	1.0918	59....	.8946	1.3236	89.	.9979	1.0376
30....	.9434	1.0991	60.	.9011	1.3195	90.	.9984	1.0288
31....	.9401	1.1014	61....	.9080	1.3161	91.	.9988	1.0206
32....	.9369	1.1081	62.	.9130	1.3119	92.....	.9993	1.0124
33....	.9301	1.1135	63.	.9202	1.3106	93.....	.9998	1.0044
34....	.9280	1.1229	64.....	.9260	1.3066	94.....	1.0000	1.0000
35....	.9224	1.1265	65.....	.9326	1.3028	95.....	1.0000	1.0000
36....	.9183	1.1401	66.....	.9383	1.2974	96.....	1.0000	1.0000
37....	.9151	1.1550	67.....	.9448	1.2894	97.....	1.0000	1.0000
38....	.9063	1.1771	68.....	.9509	1.2811	98.....	1.0000	1.0000
39....	.8958	1.2117	69.....	.9562	1.2703	99.....	1.0000	1.0000
40....	.8875	1.2492	70.....	.9611	1.2597			
41....	.8659	1.2626	71.....	.9657	1.2525			
42....	.8501	1.2765	72.....	.9687	1.2437			
43....	.8462	1.2885	73.....	.9719	1.2344			
44....	.8412	1.2908	74.....	.9744	1.2242			

PART III. COMMENTS AND RESPONSES

The comments below reflect all the comments received by the Task Force regarding the exposure draft (dated March 1, 1983), which was distributed to all Society members. Where appropriate, comments have been paraphrased for the sake of brevity or to combine multiple comments on the same subject. The responses reflect the position of the Task Force.

Percentage of Smokers in Data Underlying 1980 CSO Basic Table

Comment: The Task Force percentages are too low. For example, for a male aged 55, the experience of Sun Life of Canada showed 48.3 percent smokers, while the Task Force assumption is 36.2 percent.

Response: The two figures quoted are *not* comparable. The Sun Life figure is based on calculations made with pipe and cigar smokers excluded completely. The Task Force figure includes pipe and cigar smokers in the nonsmoker category. This reflects the most common classification currently used, and leads to a smaller percentage of smokers than the Sun Life figure. Also, the experience of Sun Life is based two-thirds on Canadian lives and one-third on United States lives, while the Task Force figure is meant to reflect United States lives only. The percentage of cigarette smokers among United States lives has been approximately 10 percentage points less than among Canadian lives. The Task Force believes that its figure of 36.2 percent is reasonably in line with the *comparable* figure derived from the Sun Life experience, which we have estimated to be less than 40 percent.

Comment: Fewer people admit to smoking on an application for life insurance, where there is money at stake, than to a government survey. Also, many companies find that approximately 30 percent of their current issues are to smokers; this seems to be significantly lower than the Task Force percentages, which, for males, exceed 40 percent for ages 25–47.

Response: The Task Force reviewed data contained in the 1979 *Report of the Surgeon General* in order to better understand the *relative* levels of smoking by age, sex, occupation class, and other categories. We based our assumption of the *absolute* levels of smoking on insurance company data, which we feel is appropriate. In addition, given the significant decrease in the percentage of smokers over the last fifteen years or so, we believe that the level of smoking used in the report (over 40 percent for many ages during the years 1970–75) is not inconsistent with the 30 percent figure quoted for *current* issues.

Ratio of the Level of Smoker Mortality to Nonsmoker Mortality

Comment: General population studies summarized in the 1979 Surgeon

General's Report show male smoker/nonsmoker mortality ratios of 1.7 to 1. If we take into account that former smokers are underwritten as nonsmokers, and that smoking habits can change after policy issue, a lower ratio would be appropriate for insured lives, if insured mortality followed population mortality. This contrasts to a ratio of about 2 to 1 in insurance company studies and in the Task Force report.

Response: Insured mortality does *not* follow population mortality, as shown by the differences between the 1980 CSO Basic Male Table (based on 1970–75 experience) and the 1969–71 U.S. Life Male Table. At age 25, for example, the mortality rate in the U.S. Life Table is more than 100 percent higher than in the 1980 CSO Basic Table (2.17 compared to 1.08 deaths per thousand). Even at age 70, the difference is still as high as 46 percent (49.91 compared to 34.07). If we assume that approximately the same number of extra deaths are removed from both groups of insured smokers and groups of insured nonsmokers, via the selection process, then the ratio of smoker to nonsmoker mortality in an insured population should be higher than in the general population. The Task Force ratio of 2 to 1, which is higher than the surgeon general's ratio of 1.7 to 1, is consistent with this fact and consistent with the actual mortality experience published by five life insurance companies.

Comment: In order to be valid, a smoker/nonsmoker mortality study should be based on analysis of causes of death specifically related to smoking alone and exclude all other extraneous data such as accidents and other underwriting criteria. It remains to be demonstrated that smoking alone is the cause of the mortality differentials shown in the report.

Response: The Task Force disagrees with the contention that the differences between smoker and nonsmoker basic tables should reflect only the extra mortality *caused* by smoking. Rather, we believe that the separate smoker and nonsmoker tables should reflect the actual mortality experience of groups of insured smokers and insured nonsmokers. We find precedent for this nonreliance on cause in the construction of the 1980 CSO. In the "Report of the Special Committee to Recommend New Mortality Tables for Valuation" (*TSA*, XXXIII, 617–69), six considerations are given as the justification for recommending

separate male and female mortality tables. First among these considerations is the fact that "mortality differences by sex are clearly demonstrated by current mortality studies." Significantly, there is *no* statement regarding whether or not these differences are *caused* by the difference in gender. The Task Force believes that mortality differences by smoking status are also clearly demonstrated by current mortality studies, and that such differences should be fully reflected in separate smoker and nonsmoker basic mortality tables, without requiring a determination regarding the cause of these observed differences.

Comment: The American Cancer Society has conducted a study which produced the largest and most reliable body of data on the mortality of smokers and nonsmokers at ages 65 and above. This study shows distinctly higher ratios of smoker to nonsmoker mortality than those used in the Task Force report.

Response: Since insured life mortality experience on smokers and nonsmokers is extremely limited at the higher ages, the Task Force reviewed general population studies contained in the *Report of the Surgeon General* for additional information on which to base our assumptions at the higher ages. The data which were submitted with this comment proved to be an extremely valuable source of additional information regarding the mortality of smokers and nonsmokers at ages 65 and above. The Task Force has revised its assumptions at the higher ages to reflect this newly available mortality experience data.

Comment: The experience of Sun Life of Canada shows ratios of smoker to nonsmoker mortality significantly different from those in the Task Force report. At many ages, these differences tend to make the Task Force smoker basic rates higher, and the nonsmoker basic rates lower, than the Sun Life experience.

Response: As stated in Part II of this Report, "the Task Force found, in the experience of the five insurance companies, wide variations in both the levels and patterns of excess mortality among smokers." We attempted to develop ratios of smoker to nonsmoker mortality which reflected the aggregate experience of all companies that have published their smoker/nonsmoker mortality experience. In so doing, we developed ratios that do not match the experience of any one company at all ages, for both males and females. Given these variations by company, we believe that this result is not inappropriate.

Comment: Since use of low tar and nicotine cigarettes (which have a reduced mortality hazard) is increasing, it may be inappropriate to assume that smoker extra mortality will be as great in the future as in the past. Also, since the differences in smoking habits between men and women are decreasing, it may be inappropriate to reflect in the table the full extent of the male/female differences in smoking habits.

Response: While the Task Force agrees that future mortality experience may not be the same as past mortality experience for many reasons, we believe this is not relevant to our tables. The 1980 CSO Basic Table reflects actual mortality experienced between 1970 and 1975; it does not represent an attempt to project future mortality experience. Similarly, the separate smoker and nonsmoker basic tables produced by the Task Force reflect our best estimates of the actual mortality experienced between 1970 and 1975 by smokers and nonsmokers separately. We do not believe our tables should reflect a projection of future mortality.

Margins

Comment: It seems difficult to believe that the 1980 CSO margin formula, when applied to the smoker and nonsmoker basic tables separately, would produce margins that are "not significantly different" from the actual 1980 CSO margins, when the basic mortality rates are so different.

Response: The 1980 CSO margin formula, for age x, consists of a fraction, the numerator of which $(0.035 - 0.00025x + 0.000009x^2)$ depends on age only and not on the mortality rate, and the denominator of which is the curtate expectation of life calculated from the basic table. As an example, consider the margin at age 50. The numerator equals 0.045 for males or females, smokers or nonsmokers, since the numerator does not depend on any mortality rate. For a male smoker, the denominator equals 23.68; for a male nonsmoker it is 27.78; and, in the 1980 CSO, for a male whose smoking status has not been determined, it is 26.47. Thus, the formula produces margins of 1.90 for a smoker, 1.62 for a nonsmoker, and 1.70 in the 1980 CSO. The corresponding basic mortality rates are 7.87 smoker, 3.21 nonsmoker, and 5.01 in the 1980 CSO. For smokers, the smoker margin produces a loaded mortality rate

of 9.77, while the 1980 CSO margin results in a loaded rate
of 9.57. It is these two mortality rates that the Task Force
believes are ''not significantly different.'' Similarly, for non-
smokers, the nonsmoker margin produces a loaded mortality
rate of 4.83, and the 1980 CSO margin produces a loaded
mortality rate of 4.91. Again, the Task Force believes that
these two loaded mortality rates are not significantly different.

Comment: At any age, the dollar loading for nonsmokers should be lower
than for smokers, since loading should vary inversely accord-
ing to the expectation of life. The margins used by the Task
Force are not in accordance with this 1980 CSO loading prin-
ciple. One alternative could involve basing scaling factors on
the basic mortality rates, before margins are added. The 1980
CSO dollar amount of loading could then be multiplied by
these scaling factors to produce larger loadings in the smoker
table than in the nonsmoker table, while still allowing the
loaded smoker and nonsmoker tables to reproduce the 1980
CSO when recombined using the percentages of smokers in
Appendix B.

Response: When first addressing the question of margins in its separate
smoker and nonsmoker tables, the Task Force established three
goals:

1. Margins should closely follow the 1980 CSO margin formula.
2. The resulting loaded smoker and nonsmoker tables should, when
   recombined using the percentags of smokers in Appendix B, repro-
   duce the 1980 CSO.
3. Loading on smokers should exceed loading on nonsmokers, since the
   expectation of life for nonsmokers exceeds that of smokers.

Unfortunately, it became clear that it would not be possible to
achieve all three goals. The method suggested would achieve
the second and third goals, but in neither the smoker nor the
nonsmoker table would the pattern of margins follow the 1980
CSO margin formula. This method would produce smoker
margins equal to the nonsmoker margin times the ratio of the
basic mortality rates at each attained age. These smoker mar-
gins are far in excess of the margins which result if the non-
smoker margins are multiplied by the ratio of the expectation
of life, which is consistent with the 1980 CSO margin formula.
If, instead, margins are based on the 1980 CSO formula ap-

plied to the separate smoker and nonsmoker basic tables, achieving the first and third goals, the resulting loaded tables would not reproduce the 1980 CSO. It should be noted that margins are intended to produce policy reserves that guard against insolvency, whether caused by adverse mortality or by other factors. While the mortality portion of a margin should be a function of age and/or mortality rates at current and higher ages, margins for expenses and other contingencies should not be strongly related to mortality rates.

The problem of determining margins for smokers and non-smokers is similar to the problem of determining margins for males and females, since the mortality differences are of the same order of magnitude. Note that, despite the substantial differences between male and female mortality rates in the 1980 CSO, the differences in margins are relatively small. Similarly, the margins calculated using the actual smoker and nonsmoker mortality rates in the margin formula were not significantly different from the actual margin in the 1980 CSO. Thus, the Task Force decided that only the third goal could be sacrificed without causing serious problems.

Selection Factors

Comment: The experience of Sun Life of Canada shows, in general, that the effect of selection is greater for nonsmokers than for smokers.

Response: The Task Force recognizes the possibility that the effects of selection might not be the same for smokers as they are for nonsmokers. (It should be noted that the original publication of the Sun Life experience, *TSA*, XXXII, 227, stated "our data suggest that the mortality variation between smokers and nonsmokers does not depend on policy duration," which apparently contradicts this comment.) However, since there is very little published mortality experience on smokers and non-smokers beyond the first ten policy years (the selection period of the 1980 CSO), the Task Force was not able to develop separate selection factors for smokers and for nonsmokers. In addition, since the use of selection factors in valuation mortality tables is a very new and not yet fully developed procedure, any attempt to produce a useful set of selection factors

which vary by issue age, policy year, sex, and smoking status does not seem justified.

Reserves

Comment: There is what seems to be an inconsistency in the reserves at the higher ages: nonsmoker reserves are higher than 1980 CSO, and smoker reserves are lower. Is a modification called for in order to remove this anomaly?

Response: It is true that nonsmoker reserves exceed smoker reserves at the higher attained ages. It is also true that in the 1980 CSO, a similar situation exists: female reserves exceed male reserves at the higher attained ages. This results from the fact that, although at most ages the nonsmoker death rate is less than smoker, and the female death rate is less than male, for all categories the death rate at age 99 is artificially set equal to 1.00. These anomalies, which the Task Force believes are minor, will always be present in the 1980 CSO or another table derived from it.

Comment: It appears that minimum net level premium reserves would change very slightly under the separate smoker/nonsmoker table approach, as compared to all reserves on the "blended" 1980 CSO Table. Since the 1980 CSO allows for the use of "ten-year selection factors" which go a long way toward eliminating the deficiency reserve problem, why do we need smoker/nonsmoker valuation tables? Should statutory reserves by law distinguish between smokers and nonsmokers?

Response: For any one company, total reserves would change very slightly only if that company had the same proportions of smokers and nonsmokers as were used in the development of the separate smoker and nonsmoker tables. One company's reserves might increase or decrease markedly if its proportion of smokers differed markedly from the industry average. The 1980 CSO with selection factors has certainly helped to reduce deficiency reserve requirements, but deficiency reserves continue to be a problem, especially on nonsmoker policies. For example, if a company that had charged 1980 CSO net premiums plus an appropriate loading decided to recognize smoking status by charging smoker and nonsmoker net premiums based on the mortality rates developed by the Task Force, plus a similar

margin, deficiency reserves would, most likely, currently be required on nonsmoker policies. Yet the separate smoker and nonsmoker gross premiums are no more "deficient" than the blended gross premium was. The Task Force believes the use of valuation tables based on smoking status is not inappropriate. The question of whether or not state laws should *require* different reserves for smokers and nonsmokers is one to be answered by the NAIC through its various actuarial committees, rather than by this Task Force.

Appendix G

Comment: In Appendix G, would it not be more appropriate to weight the smoker and nonsmoker reserves by the issue-age proportions rather than the attained-age proportions? This would avoid the anomaly of having the percentage of smokers increase from issue age 25, duration 1 to issue age 25, duration 10. This change would not significantly change the figures in the table or text of Appendix G.

Response: The Task Force agrees that the weighting should be changed. Appendix G has been revised to reflect this change.

CONCLUSION

The charge of the Task Force on Smoker/Nonsmoker Mortality has always referred to "interim" valuation standards. The Task Force has used procedures which are consistent with its charge. Thus, this report is *not* the definitive statement with regard to separate valuation standards for smokers and nonsmokers. There are numerous areas in which more research is necessary. These areas include the specific selection factors appropriate in separate smoker and nonsmoker valuation tables. In addition to such research, there is a definite need for a large volume of basic mortality experience among groups of insured smokers and insured nonsmokers.

Members of the Task Force on Smoker/Nonsmoker Mortality include: Peter A. Marion, chairman, Douglas Doll, Melvin C. McFall, and Abbott M. Weber.

APPENDIX A

SUMMARY OF CURRENTLY AVAILABLE NONSMOKER MORTALITY EXPE-
RIENCE

STATE MUTUAL

Years of experience:	1973–78
Type of study:	Policy year study
Number or amount:	Both number and amount
Basis of expected deaths:	1965–70 Basic Tables, male lives on male table, female lives on female table
Male or female:	Male and female lives combined
Medical or nonmedical:	Medical and nonmedical issues separately
Standard or substandard:	Standard issues only
Nonsmoker definition:	Nonsmokers must not have smoked cigarettes for at least twelve months prior to application. Pipe and cigar smokers can qualify as nonsmokers.
"Smoker" group:	"Smoker" group consists of individuals who pay regular premiums on plans of insurance for which the company also offers lower premium rates for nonsmokers. Thus, the "smoker" group should include virtually no one who does not smoke cigarettes.
Other limits:	Issue ages 20 and over. Face amount $10,000 and over. Four permanent plans of insurance.

MUTUAL SECURITY LIFE

Years of experience:	1976–78
Type of study:	Policy year study
Number or amount:	Both number and amount
Basis of expected deaths:	1965–70 Basic Tables, male and female lives combined
Male or female:	Male and female lives combined
Medical or nonmedical:	Medical and nonmedical issues combined
Standard or substandard:	Standard and substandard issues combined
Nonsmoker definition:	Nonsmokers must not have smoked tobacco for at least twelve months prior to application.

	Pipe and cigar smokers do not qualify as non-smokers.
"Smoker" group:	"Smoker" group consists of policies on one of six major plans of insurance but without nonsmoker premiums. "Smoker" group includes all policies issued from 1961 to 1964, before the company gave nonsmoker discounts. Thus, the "smoker" group includes a substantial number of insureds who do not smoke.
Other limits:	Six major plans of insurance only

PHOENIX MUTUAL

Years of experience:	1973–78
Type of study:	Policy year study
Number or amount:	Amount of insurance only
Basis of expected deaths:	1965–70 Basic Tables, male lives
Male or female:	Male lives only
Medical or nonmedical:	Medical issues only
Standard or substandard:	Standard issues only
Nonsmoker definition:	Nonsmokers must not have smoked cigarettes for at least twelve months prior to application, and applicant must meet height and weight requirements. Pipe and cigar smokers can qualify as nonsmokers.
"Smoker" group:	"Smoker" group consists of all permanent business excluding cases receiving nonsmoker premium classification. This includes cases failing to receive nonsmoker premiums because of age, plan, amount, or build, so the "smoker" group includes some insureds who do not smoke cigarettes.
Other limits:	Issue ages 20 and over. Face amount $15,000 and over. Permanent plans only.

HOME LIFE

Years of experience:	1973–78
Type of study:	Policy year study
Number or amount:	Both number and amount

Basis of expected deaths: 1965–70 Basic Tables, male and female lives combined

Male or female: Male and female lives combined

Medical or nonmedical: Medical issues only

Standard or substandard: Standard issues only

Nonsmoker definition: Nonsmokers must not have smoked cigarettes for at least twelve months prior to application. Pipe and cigar smokers can qualify as nonsmokers.

"Smoker" group: "Smoker" group consists of all permanent business excluding cases receiving nonsmoker premium classification. "Smoker" group includes cases failing to receive nonsmoker premiums because of plan, sex, or amount, and therefore contains a substantial number of insureds who do not smoke cigarettes.

Other limits: Issue ages 20 and over. Face amount $10,000 and over. Permanent plans only.

SUN LIFE OF CANADA

Years of experience: 1973–77

Type of study: Policy year study

Number or amount: Unknown

Basis of expected deaths: Sun Life Tables

Male or female   Male and female lives separately

Medical or nonmedical: Medical issues only

Standard or substandard: Standard issues only

Nonsmoker definition: Nonsmokers must not have smoked tobacco for at least twelve months prior to application Pipe and cigar smokers do not qualify as nonsmokers.

"Smoker" group: "Smokers" are insureds who have smoked within twelve months prior to application. Three categories of smokers are used:
  1. Light cigarette smokers.
  2. Heavy cigarette smokers.
  3. Pipe or cigar smokers.
The "smoker" group should include virtually no one who does not smoke.

Other limits: Issue ages 15 and over

APPENDIX B

Age	Percent Smoker	Age	Percent Smoker	Age	Percent Smoker
15	11.7	45	41.7	75	21.6
16	17.3	46	41.0	76	21.0
17	25.3	47	40.4	77	20.4
18	31.5	48	39.8	78	19.8
19	33.5	49	39.2	79	19.2
20	34.9	50	38.7	80	18.5
21	36.2	51	38.3	81	17.8
22	37.4	52	37.8	82	17.1
23	38.5	53	37.3	83	16.4
24	39.5	54	36.8	84	15.7
25	40.5	55	36.2	85	15.0
26	41.4	56	35.6	86	14.3
27	42.2	57	34.9	87	13.6
28	42.9	58	34.2	88	12.9
29	43.5	59	33.4	89	12.3
30	44.0	60	32.6	90	11.7
31	44.4	61	31.8	91	11.1
32	44.7	62	31.0	92	10.6
33	44.9	63	30.1	93	10.3
34	45.0	64	29.2	94	10.1
35	45.0	65	28.3	95	10.0
36	45.0	66	27.5	96	10.0
37	44.9	67	26.7	97	10.0
38	44.7	68	26.0	98	10.0
39	44.4	69	25.3	99	10.0
40	44.1	70	24.6		
41	43.8	71	24.0		
42	43.4	72	23.4		
43	42.9	73	22.8		
44	42.3	74	22.2		

FEMALE INDIVIDUALLY INSURED LIVES

Age	Percent Smoker	Age	Percent Smoker	Age	Percent Smoker
15	11.7	45	34.8	75	9.9
16	16.8	46	34.5	76	9.4
17	20.4	47	34.1	77	9.0
18	23.1	48	33.7	78	8.6
19	25.4	49	33.3	79	8.2
20	27.3	50	32.8	80	7.8
21	28.9	51	32.3	81	7.5
22	30.3	52	31.7	82	7.2
23	31.5	53	31.0	83	6.9
24	32.5	54	30.2	84	6.7
25	33.4	55	29.3	85	6.5
26	34.2	56	28.3	86	6.3
27	34.9	57	27.2	87	6.1
28	35.5	58	26.1	88	5.9
29	36.0	59	25.1	89	5.7
30	36.4	60	24.1	90	5.5
31	36.7	61	23.1	91	5.4
32	36.9	62	22.1	92	5.3
33	37.0	63	21.1	93	5.2
34	37.0	64	20.0	94	5.1
35	37.0	65	18.8	95	5.0
36	36.9	66	17.7	96	5.0
37	36.7	67	16.6	97	5.0
38	36.5	68	15.5	98	5.0
39	36.3	69	14.4	99	5.0
40	36.1	70	13.4		
41	35.9	71	12.5		
42	35.7	72	11.7		
43	35.4	73	11.0		
44	35.1	74	10.4		

APPENDIX C

RATIO OF LEVEL OF SMOKER MORTALITY TO NONSMOKER MORTALITY AMONG MALES

Age	Ratio	Age	Ratio	Age	Ratio
15	1.50	45	2.50	75	1.49
16	1.51	46	2.49	76	1.46
17	1.53	47	2.48	77	1.43
18	1.55	48	2.47	78	1.40
19	1.57	49	2.46	79	1.37
20	1.60	50	2.45	80	1.34
21	1.63	51	2.43	81	1.31
22	1.66	52	2.40	82	1.28
23	1.69	53	2.37	83	1.25
24	1.72	54	2.34	84	1.22
25	1.75	55	2.30	85	1.19
26	1.78	56	2.26	86	1.16
27	1.82	57	2.22	87	1.13
28	1.87	58	2.18	88	1.11
29	1.93	59	2.13	89	1.09
30	2.00	60	2.08	90	1.07
31	2.07	61	2.04	91	1.05
32	2.13	62	2.00	92	1.03
33	2.18	63	1.96	93	1.02
34	2.22	64	1.92	94	1.01
35	2.25	65	1.88	95	1.00
36	2.28	66	1.84	96	1.00
37	2.31	67	1.80	97	1.00
38	2.34	68	1.76	98	1.00
39	2.37	69	1.72	99	1.00
40	2.40	70	1.68		
41	2.43	71	1.64		
42	2.45	72	1.60		
43	2.47	73	1.56		
44	2.49	74	1.52		

RATIO OF LEVEL OF SMOKER MORTALITY TO NONSMOKER MORTALITY AMONG FEMALES

Age	Ratio	Age	Ratio	Age	Ratio
15	1.30	45	1.90	75	1.30
16	1.31	46	1.90	76	1.28
17	1.32	47	1.89	77	1.26
18	1.33	48	1.88	78	1.24
19	1.34	49	1.87	79	1.22
20	1.35	50	1.86	80	1.20
21	1.36	51	1.84	81	1.18
22	1.38	52	1.82	82	1.16
23	1.40	53	1.80	83	1.14
24	1.42	54	1.78	84	1.13
25	1.44	55	1.76	85	1.11
26	1.46	56	1.74	86	1.10
27	1.49	57	1.72	87	1.08
28	1.52	58	1.70	88	1.07
29	1.56	59	1.68	89	1.05
30	1.60	60	1.65	90	1.04
31	1.64	61	1.63	91	1.03
32	1.67	62	1.60	92	1.02
33	1.70	63	1.58	93	1.01
34	1.72	64	1.55	94	1.00
35	1.74	65	1.53	95	1.00
36	1.76	66	1.50	96	1.00
37	1.78	67	1.48	97	1.00
38	1.80	68	1.45	98	1.00
39	1.82	69	1.43	99	1.00
40	1.84	70	1.40		
41	1.86	71	1.38		
42	1.87	72	1.36		
43	1.88	73	1.34		
44	1.89	74	1.32		

APPENDIX D

DIVISION OF 1980 CSO MALE BASIC TABLE INTO SMOKER AND NONSMOKER COMPONENTS

Age	Percent Smokers	Ratio of Smoker to Nonsmoker Mortality Levels	1980 CSO Basic 1,000 Q	1980 CSO Basic Nonsmoker 1,000 Q	1980 CSO Basic Smoker 1,000 Q
15	11.7	1.50	0.77	0.73	1.09
16	17.3	1.51	0.94	0.86	1.30
17	25.3	1.53	1.09	0.96	1.47
18	31.5	1.55	1.19	1.01	1.57
19	33.5	1.57	1.25	1.05	1.65
20	34.9	1.60	1.28	1.06	1.69
21	36.2	1.63	1.28	1.04	1.70
22	37.4	1.66	1.25	1.00	1.66
23	38.5	1.69	1.20	0.95	1.60
24	39.5	1.72	1.15	0.90	1.54
25	40.5	1.75	1.08	0.83	1.45
26	41.4	1.78	1.02	0.77	1.37
27	42.2	1.82	0.98	0.73	1.33
28	42.9	1.87	0.95	0.69	1.29
29	43.5	1.93	0.94	0.67	1.29
30	44.0	2.00	0.94	0.65	1.31
31	44.4	2.07	0.96	0.65	1.35
32	44.7	2.13	0.99	0.66	1.40
33	44.9	2.18	1.04	0.68	1.48
34	45.0	2.22	1.10	0.71	1.58
35	45.0	2.25	1.18	0.76	1.70
36	45.0	2.28	1.28	0.81	1.85
37	44.9	2.31	1.41	0.89	2.05
38	44.7	2.34	1.55	0.97	2.27
39	44.4	2.37	1.72	1.07	2.53
40	44.1	2.40	1.91	1.18	2.83
41	43.8	2.43	2.13	1.31	3.18
42	43.4	2.45	2.36	1.45	3.55
43	42.9	2.47	2.62	1.61	3.97
44	42.3	2.49	2.89	1.77	4.41
45	41.7	2.50	3.19	1.96	4.91
46	41.0	2.49	3.50	2.17	5.41
47	40.4	2.48	3.84	2.40	5.96
48	39.8	2.47	4.19	2.64	6.53
49	39.2	2.46	4.58	2.91	7.17
50	38.7	2.45	5.01	3.21	7.86
51	38.3	2.43	5.51	3.56	8.65
52	37.8	2.40	6.08	3.98	9.54
53	37.3	2.37	6.74	4.46	10.57
54	36.8	2.34	7.48	5.01	11.72

MALES—*Continued*

Age	Percent Smokers	Ratio of Smoker to Nonsmoker Mortality	1980 CSO Basic 1,000 Q	1980 CSO Basic Nonsmoker 1,000 Q	1980 CSO Basic Smoker 1,000 Q
55	36.2	2.30	8.28	5.63	12.95
56	35.6	2.26	9.15	6.32	14.28
57	34.9	2.22	10.06	7.06	15.66
58	34.2	2.18	11.02	7.85	17.12
59	33.4	2.13	12.05	8.75	18.63
60	32.6	2.08	13.20	9.76	20.31
61	31.8	2.04	14.49	10.89	22.21
62	31.0	2.00	15.95	12.18	24.35
63	30.1	1.96	17.62	13.67	26.79
64	29.2	1.92	19.48	15.36	29.48
65	28.3	1.88	21.52	17.23	32.39
66	27.5	1.84	23.70	19.25	35.42
67	26.7	1.80	26.01	21.43	38.58
68	26.0	1.76	28.45	23.76	41.81
69	25.3	1.72	31.10	26.31	45.25
70	24.6	1.68	34.07	29.19	49.04
71	24.0	1.64	37.46	32.47	53.25
72	23.4	1.60	41.38	36.29	58.06
73	22.8	1.56	45.89	40.69	63.48
74	22.2	1.52	50.92	45.65	69.39
75	21.6	1.49	56.35	50.96	75.93
76	21.0	1.46	62.08	56.61	82.65
77	20.4	1.43	68.00	62.52	89.40
78	19.8	1.40	74.04	68.61	96.05
79	19.2	1.37	80.39	75.06	102.83
80	18.5	1.34	87.28	82.11	110.03
81	17.8	1.31	94.94	89.98	117.87
82	17.1	1.28	103.61	98.88	126.56
83	16.4	1.25	113.41	108.94	136.18
84	15.7	1.22	124.08	119.94	146.32
85	15.0	1.19	135.33	131.58	156.58
86	14.3	1.16	146.90	143.61	166.59
87	13.6	1.13	158.63	155.87	176.14
88	12.9	1.11	170.44	168.06	186.54
89	12.3	1.09	182.33	180.33	196.56
90	11.7	1.07	194.38	192.80	206.30
91	11.1	1.05	206.75	205.61	215.89
92	10.6	1.03	219.77	219.07	225.65
93	10.3	1.02	234.08	233.60	238.27
94	10.1	1.01	250.97	250.72	253.22
95	10.0	1.00	273.02	273.02	273.02
96	10.0	1.00	309.92	309.92	309.92
97	10.0	1.00	367.46	367.46	367.46
98	10.0	1.00	470.80	470.80	470.80
99	10.0	1.00	656.70	656.70	656.70

DIVISION OF 1980 CSO FEMALE BASIC TABLE INTO SMOKER AND NONMOKER COMPONENTS

Age	Percent Smokers	Ratio of Smoker to Nonsmoker Mortality Levels	1980 CSO Basic 1,000 Q	1980 CSO Basic Nonsmoker 1,000 Q	1980 CSO Basic Smoker 1,000 Q
15	11.7	1.30	0.33	0.32	0.42
16	16.8	1.31	0.37	0.35	0.46
17	20.4	1.32	0.41	0.38	0.50
18	23.1	1.33	0.44	0.41	0.55
19	25.4	1.34	0.47	0.43	0.58
20	27.3	1.35	0.48	0.44	0.59
21	28.9	1.36	0.49	0.44	0.60
22	30.3	1.38	0.50	0.45	0.62
23	31.5	1.40	0.51	0.45	0.63
24	32.5	1.42	0.52	0.46	0.65
25	33.4	1.44	0.53	0.46	0.66
26	34.2	1.46	0.54	0.47	0.69
27	34.9	1.49	0.56	0.48	0.72
28	35.5	1.52	0.58	0.49	0.74
29	36.0	1.56	0.60	0.50	0.78
30	36.4	1.60	0.63	0.52	0.83
31	36.7	1.64	0.66	0.53	0.87
32	36.9	1.67	0.69	0.55	0.92
33	37.0	1.70	0.72	0.57	0.97
34	37.0	1.72	0.77	0.61	1.05
35	37.0	1.74	0.82	0.64	1.11
36	36.9	1.76	0.90	0.70	1.23
37	36.7	1.78	1.00	0.78	1.39
38	36.5	1.80	1.12	0.87	1.57
39	36.3	1.82	1.27	0.98	1.78
40	36.1	1.84	1.44	1.10	2.02
41	35.9	1.86	1.62	1.24	2.31
42	35.7	1.87	1.81	1.38	2.58
43	35.4	1.88	1.99	1.52	2.86
44	35.1	1.89	2.18	1.66	3.14
45	34.8	1.90	2.37	1.80	3.42
46	34.5	1.90	2.57	1.96	3.72
47	34.1	1.89	2.77	2.13	4.03
48	33.7	1.88	2.99	2.31	4.34
49	33.3	1.87	3.23	2.50	4.68
50	32.8	1.86	3.50	2.73	5.08
51	32.3	1.84	3.79	2.98	5.48
52	31.7	1.82	4.11	3.26	5.93
53	31.0	1.80	4.48	3.59	6.46
54	30.2	1.78	4.86	3.93	7.00

FEMALES—*Continued*

Age	Percent Smokers	Ratio of Smoker to Nonsmoker Mortality	1980 CSO Basic 1,000 Q	1980 CSO Basic Nonsmoker 1,000 Q	1980 CSO Basic Smoker 1,000 Q
55	29.3	1.76	5.26	4.30	7.57
56	28.3	1.74	5.65	4.67	8.13
57	27.2	1.72	6.01	5.03	8.65
58	26.1	1.70	6.35	5.37	9.13
59	25.1	1.68	6.70	5.72	9.61
60	24.1	1.65	7.11	6.15	10.15
61	23.1	1.63	7.64	6.67	10.87
62	22.1	1.60	8.33	7.35	11.76
63	21.1	1.58	9.23	8.22	12.99
64	20.0	1.55	10.29	9.27	14.37
65	18.8	1.53	11.45	10.41	15.93
66	17.7	1.50	12.67	11.64	17.46
67	16.6	1.48	13.88	12.86	19.03
68	15.5	1.45	15.06	14.08	20.42
69	14.4	1.43	16.32	15.37	21.98
70	13.4	1.40	17.79	16.88	23.63
71	12.5	1.38	19.60	18.71	25.82
72	11.7	1.36	21.89	21.01	28.57
73	11.0	1.34	24.75	23.86	31.97
74	10.4	1.32	28.15	27.24	35.96
75	9.9	1.30	31.99	31.07	40.39
76	9.4	1.28	36.21	35.28	45.16
77	9.0	1.26	40.72	39.79	50.14
78	8.6	1.24	45.50	44.58	55.28
79	8.2	1.22	50.70	49.80	60.76
80	7.8	1.20	56.56	55.69	66.83
81	7.5	1.18	63.29	62.45	73.69
82	7.2	1.16	71.11	70.30	81.55
83	6.9	1.14	80.14	79.37	90.48
84	6.7	1.13	90.19	89.41	101.03
85	6.5	1.11	101.01	100.38	111.42
86	6.3	1.10	112.76	112.05	123.26
87	6.1	1.08	125.07	124.46	134.42
88	5.9	1.07	138.00	137.43	147.05
89	5.7	1.05	151.55	151.12	158.68
90	5.5	1.04	165.80	165.44	172.06
91	5.4	1.03	180.91	180.62	186.04
92	5.3	1.02	197.20	196.99	200.93
93	5.2	1.01	215.31	215.20	217.35
94	5.1	1.00	236.52	236.52	236.52
95	5.0	1.00	263.38	263.38	263.38
96	5.0	1.00	301.01	301.01	301.01
97	5.0	1.00	359.66	359.66	359.66
98	5.0	1.00	462.34	462.34	462.34
99	5.0	1.00	647.43	647.43	647.43

APPENDIX E

MALES

Age	Male Smoker Basic 1,000 Q	Actual 1980 CSO Margin	Loaded Male Smoker 1,000 Q	Male Nonsmoker Basic 1,000 Q	Actual 1980 CSO Margin	Loaded Male Nonsmoker 1,000 Q
15	1.09	0.56	1.65	0.73	0.56	1.29
16	1.30	0.57	1.87	0.86	0.57	1.43
17	1.47	0.58	2.05	0.96	0.58	1.54
18	1.57	0.59	2.16	1.01	0.59	1.60
19 . .	1.65	0.61	2.26	1.05	0.61	1.66
20	1.69	0.62	2.31	1.06	0.62	1.68
21	1.70	0.63	2.33	1.04	0.63	1.67
22 . .	1.66	0.64	2.30	1.00	0.64	1.64
23	1.60	0.66	2.26	0.95	0.66	1.61
24	1.54	0.67	2.21	0.90	0.67	1.57
25	1.45	0.69	2.14	0.83	0.69	1.52
26	1.37	0.71	2.08	0.77	0.71	1.48
27	1.33	0.73	2.06	0.73	0.73	1.46
28	1.29	0.75	2.04	0.69	0.75	1.44
29	1.29	0.77	2.06	0.67	0.77	1.44
30	1.31	0.79	2.10	0.65	0.79	1.44
31	1.35	0.82	2.17	0.65	0.82	1.47
32	1.40	0.84	2.24	0.66	0.84	1.50
33	1.48	0.87	2.35	0.68	0.87	1.55
34	1.58	0.90	2.48	0.71	0.90	1.61
35	1.70	0.93	2.63	0.76	0.93	1.69
36	1.85	0.96	2.81	0.81	0.96	1.77
37	2.05	0.99	3.04	0.89	0.99	1.88
38	2.27	1.03	3.30	0.97	1.03	2.00
39	2.53	1.07	3.60	1.07	1.07	2.14
40	2.83	1.11	3.94	1.18	1.11	2.29
41	3.18	1.16	4.34	1.31	1.16	2.47
42	3.55	1.20	4.75	1.45	1.20	2.65
43	3.97	1.25	5.22	1.61	1.25	2.86
44	4.41	1.30	5.71	1.77	1.30	3.07
45	4.91	1.36	6.27	1.96	1.36	3.32
46	5.41	1.42	6.83	2.17	1.42	3.59
47	5.96	1.48	7.44	2.40	1.48	3.88
48	6.53	1.55	8.08	2.64	1.55	4.19
49	7.17	1.63	8.80	2.91	1.63	4.54
50	7.86	1.70	9.56	3.21	1.70	4.91
51	8.65	1.79	10.44	3.56	1.79	5.35
52	9.54	1.88	11.42	3.98	1.88	5.86
53	10.57	1.97	12.54	4.46	1.97	6.43
54	11.72	2.08	13.80	5.01	2.08	7.09

MALES

Age	Male Smoker Basic 1,000 Q	Actual 1980 CSO Margin	Loaded Male Smoker 1,000 Q	Male Nonsmoker Basic 1,000 Q	Actual 1980 CSO Margin	Loaded Male Nonsmoker 1,000 Q
55	12.95	2.19	15.14	5.63	2.19	7.82
56	14.28	2.31	16.59	6.32	2.31	8.63
57	15.66	2.43	18.09	7.06	2.43	9.49
58	17.12	2.57	19.69	7.85	2.57	10.42
59	18.63	2.72	21.35	8.75	2.72	11.47
60	20.31	2.88	23.19	9.76	2.88	12.64
61	22.21	3.05	25.26	10.89	3.05	13.94
62	24.35	3.24	27.59	12.18	3.24	15.42
63	26.79	3.44	30.23	13.67	3.44	17.11
64	29.48	3.66	33.14	15.36	3.66	19.02
65	32.39	3.90	36.29	17.23	3.90	21.13
66	35.42	4.15	39.57	19.25	4.15	23.40
67	38.58	4.43	43.01	21.43	4.43	25.86
68	41.81	4.74	46.55	23.76	4.74	28.50
69	45.25	5.07	50.32	26.31	5.07	31.38
70	49.04	5.44	54.48	29.19	5.44	34.63
71	53.25	5.84	59.09	32.47	5.84	38.31
72	58.06	6.27	64.33	36.29	6.27	42.56
73	63.48	6.75	70.23	40.69	6.75	47.44
74	69.39	7.27	76.66	45.65	7.27	52.92
75	75.93	7.84	83.77	50.96	7.84	58.80
76	82.65	8.45	91.10	56.61	8.45	65.06
77	89.40	9.12	98.52	62.52	9.12	71.64
78	96.05	9.86	105.91	68.61	9.86	78.47
79	102.83	10.66	113.49	75.06	10.66	85.72
80	110.03	11.56	121.59	82.11	11.56	93.67
81	117.87	12.54	130.41	89.98	12.54	102.52
82	126.56	13.64	140.20	98.88	13.64	112.52
83	136.18	14.85	151.03	108.94	14.85	123.79
84	146.32	16.17	162.49	119.94	16.17	136.11
85	156.58	17.62	174.20	131.58	17.62	149.20
86	166.59	19.19	185.78	143.61	19.19	162.80
87	176.14	20.92	197.06	155.87	20.92	176.79
88	186.54	22.83	209.37	168.06	22.83	190.89
89	196.56	24.96	221.52	180.33	24.96	205.29
90	206.30	27.39	233.69	192.80	27.39	220.19
91	215.89	30.23	246.12	205.61	30.23	235.84
92	225.65	33.68	259.33	219.07	33.68	252.75
93	238.27	38.03	276.30	233.60	38.03	271.63
94	253.22	44.93	298.15	250.72	44.93	295.65
95	273.02	56.94	329.96	273.02	56.94	329.96
96	309.92	74.63	384.55	809.92	74.63	384.55
97	367.46	112.74	480.20	867.46	112.74	480.20
98	470.80	187.18	657.98	470.80	187.18	657.98
99	656.70	343.30	1,000.00	656.70	343.30	1,000.00

DEVELOPMENT OF SEPARATE LOADED SMOKER AND NONSMOKER MORTALITY TABLES

FEMALES

Age	Female Smoker Basic 1,000 Q	Actual 1980 CSO Margin	Loaded Female Smoker 1,000 Q	Female Nonsmoker Basic 1,000 Q	Actual 1980 CSO Margin	Loaded Female Nonsmoker 1,000 Q
15	0.42	0.52	0.94	0.32	0.52	0.84
16	0.46	0.53	0.99	0.35	0.53	0.88
17	0.50	0.54	1.04	0.38	0.54	0.92
18	0.55	0.54	1.09	0.41	0.54	0.95
19	0.58	0.55	1.13	0.43	0.55	0.98
20	0.59	0.57	1.16	0.44	0.57	1.01
21	0.60	0.58	1.18	0.44	0.58	1.02
22	0.62	0.59	1.21	0.45	0.59	1.04
23	0.63	0.60	1.23	0.45	0.60	1.05
24	0.65	0.62	1.27	0.46	0.62	1.08
25	0.66	0.63	1.29	0.46	0.63	1.09
26	0.69	0.65	1.34	0.47	0.65	1.12
27	0.72	0.66	1.38	0.48	0.66	1.14
28	0.74	0.68	1.42	0.49	0.68	1.17
29	0.78	0.70	1.48	0.50	0.70	1.20
30	0.83	0.72	1.55	0.52	0.72	1.24
31	0.87	0.74	1.61	0.53	0.74	1.27
32	0.92	0.76	1.68	0.55	0.76	1.31
33	0.97	0.78	1.75	0.57	0.78	1.35
34	1.05	0.81	1.86	0.61	0.81	1.42
35	1.11	0.83	1.94	0.64	0.83	1.47
36	1.23	0.86	2.09	0.70	0.86	1.56
37	1.39	0.89	2.28	0.78	0.89	1.67
38	1.57	0.92	2.49	0.87	0.92	1.79
39	1.78	0.95	2.73	0.98	0.95	1.93
40	2.02	0.98	3.00	1.10	0.98	2.08
41	2.31	1.02	3.33	1.24	1.02	2.26
42	2.58	1.06	3.64	1.38	1.06	2.44
43	2.86	1.10	3.96	1.52	1.10	2.62
44	3.14	1.14	4.28	1.66	1.14	2.80
45	3.42	1.19	4.61	1.80	1.19	2.99
46	3.72	1.23	4.95	1.96	1.23	3.19
47	4.03	1.28	5.31	2.13	1.28	3.41
48	4.34	1.34	5.68	2.31	1.34	3.65
49	4.68	1.40	6.08	2.50	1.40	3.90
50	5.08	1.46	6.54	2.73	1.46	4.19
51	5.48	1.52	7.00	2.98	1.52	4.50
52	5.93	1.59	7.52	3.26	1.59	4.85
53	6.46	1.67	8.13	3.59	1.67	5.26
54	7.00	1.75	8.75	3.93	1.75	5.68

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FEMALES

Age	Female Smoker Basic 1,000 Q	Actual 1980 CSO Margin	Loaded Female Smoker 1,000 Q	Female Nonsmoker Basic 1,000 Q	Actual 1980 CSO Margin	Loaded Female Nonsmoker 1,000 Q
55	7.57	1.83	9.40	4.30	1.83	6.13
56	8.13	1.92	10.05	4.67	1.92	6.59
57	8.65	2.02	10.67	5.03	2.02	7.05
58	9.13	2.12	11.25	5.37	2.12	7.49
59	9.61	2.24	11.85	5.72	2.24	7.96
60	10.15	2.36	12.51	6.15	2.36	8.51
61	10.87	2.49	13.36	6.67	2.49	9.16
62	11.76	2.63	14.39	7.35	2.63	9.98
63	12.99	2.79	15.78	8.22	2.79	11.01
64	14.37	2.96	17.33	9.27	2.96	12.23
65	15.93	3.14	19.07	10.41	3.14	13.55
66	17.46	3.33	20.79	11.64	3.33	14.97
67	19.03	3.55	22.58	12.86	3.55	16.41
68	20.42	3.78	24.20	14.08	3.78	17.86
69	21.98	4.04	26.02	15.37	4.04	19.41
70	23.63	4.32	27.95	16.88	4.32	21.20
71	25.82	4.63	30.45	18.71	4.63	23.34
72	28.57	4.98	33.55	21.01	4.98	25.99
73	31.97	5.36	37.33	23.86	5.36	29.22
74	35.96	5.78	41.74	27.24	5.78	33.02
75	40.39	6.25	46.64	31.07	6.25	37.32
76	45.16	6.76	51.92	35.28	6.76	42.04
77	50.14	7.32	57.46	39.79	7.32	47.11
78	55.28	7.95	63.23	44.58	7.95	52.53
79	60.76	8.65	69.41	49.80	8.65	58.45
80	66.83	9.43	76.26	55.69	9.43	65.12
81	73.69	10.31	84.00	62.45	10.31	72.76
82	81.55	11.29	92.84	70.30	11.29	81.59
83	90.48	12.39	102.87	79.37	12.39	91.76
84	101.03	13.62	114.65	89.41	13.62	103.03
85	111.42	15.00	126.42	100.38	15.00	115.38
86	123.26	16.53	139.79	112.05	16.53	128.58
87	134.42	18.25	152.67	124.46	18.25	142.71
88	147.05	20.18	167.23	137.43	20.18	157.61
89	158.68	22.39	181.07	151.12	22.39	173.51
90	172.06	24.95	197.01	165.44	24.95	190.39
91	186.04	27.96	214.00	180.62	27.96	208.58
92	200.93	31.61	232.54	196.99	31.61	228.60
93	217.35	36.20	253.55	215.20	36.20	251.40
94	236.52	42.79	279.31	236.52	42.79	279.31
95	263.38	53.94	317.32	263.38	53.94	317.32
96	301.01	74.73	375.74	301.01	74.73	375.74
97	359.66	115.31	474.97	359.66	115.31	474.97
98	462.34	193.51	655.85	462.34	193.51	655.85
99	647.43	352.57	1,000.00	647.43	352.57	1,000.00

APPENDIX F

1980 CSO MALE SMOKER AND NONSMOKER MORTALITY RATES

Age Nearest Birthday

Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker
15....	1.29	1.65	45.....	3.32	6.27	75.....	58.80	83.77
16....	1.43	1.87	46.....	3.59	6.83	76.....	65.06	91.10
17....	1.54	2.05	47.....	3.88	7.44	77.....	71.64	98.52
18....	1.60	2.16	48.....	4.19	8.08	78.....	78.47	105.91
19....	1.66	2.26	49.....	4.54	8.80	79.....	85.72	113.49
20....	1.68	2.31	50.....	4.91	9.56	80.....	93.67	121.59
21....	1.67	2.33	51.....	5.35	10.44	81.....	102.52	130.41
22....	1.64	2.30	52.....	5.86	11.42	82.....	112.52	140.20
23....	1.61	2.26	53.....	6.43	12.54	83.....	123.79	151.03
24....	1.57	2.21	54.....	7.09	13.80	84.....	136.11	162.49
25....	1.52	2.14	55..	7.82	15.14	85.....	149.20	174.20
26....	1.48	2.08	56.....	8.63	16.59	86.....	162.80	185.78
27....	1.46	2.06	57....	9.49	18.09	87.....	176.79	197.06
28....	1.44	2.04	58.....	10.42	19.69	88.....	190.89	209.37
29....	1.44	2.06	59.....	11.47	21.35	89.....	205.29	221.52
30....	1.44	2.10	60....	12.64	23.19	90.....	220.19	233.69
31....	1.47	2.17	61.....	13.94	25.26	91.....	235.84	246.12
32....	1.50	2.24	62.....	15.42	27.59	92.....	252.75	259.33
33....	1.55	2.35	63.....	17.11	30.23	93.....	271.63	276.30
34....	1.61	2.48	64.....	19.02	33.14	94.....	295.65	298.15
35....	1.69	2.63	65.....	21.13	36.29	95.....	329.96	329.96
36....	1.77	2.81	66.....	23.40	39.57	96.....	384.55	384.55
37....	1.88	3.04	67.....	25.86	43.01	97.....	480.20	480.20
38....	2.00	3.30	68.....	28.50	46.55	98.....	657.98	657.98
39....	2.14	3.60	69.....	31.38	50.32	99.....	1,000.00	1,000.00
40....	2.29	3.94	70....	34.63	54.48			
41....	2.47	4.34	71....	38.91	59.09			
42....	2.65	4.75	72....	42.56	64.33			
43....	2.86	5.22	73....	47.44	70.23			
44....	3.07	5.71	74....	52.92	76.66			

1980 CSO FEMALE SMOKER AND NONSMOKER MORTALITY RATES

Age Nearest Birthday

Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker
15	0.84	0.94	45	2.99	4.61	75	37.32	46.64
16	0.88	0.99	46	3.19	4.95	76	42.04	51.92
17	0.92	1.04	47	3.41	5.31	77	47.11	57.46
18	0.95	1.09	48	3.65	5.68	78	52.53	63.23
19	0.98	1.13	49	3.90	6.08	79	58.45	69.41
20	1.01	1.16	50	4.19	6.54	80	65.12	76.26
21	1.02	1.18	51	4.50	7.00	81	72.76	84.00
22	1.04	1.21	52	4.85	7.52	82	81.59	92.84
23	1.05	1.23	53	5.26	8.13	83	91.76	102.87
24	1.08	1.27	54	5.68	8.75	84	103.03	114.65
25	1.09	1.29	55	6.13	9.40	85	115.38	126.42
26	1.12	1.34	56	6.59	10.05	86	128.58	139.79
27	1.14	1.38	57	7.05	10.67	87	142.71	152.67
28	1.17	1.42	58	7.49	11.25	88	157.61	167.23
29	1.20	1.48	59	7.96	11.85	89	173.51	181.07
30	1.24	1.55	60	8.51	12.51	90	190.39	197.01
31	1.27	1.61	61	9.16	13.36	91	208.58	214.00
32	1.31	1.68	62	9.98	14.39	92	228.60	232.54
33	1.35	1.75	63	11.01	15.78	93	251.40	253.55
34	1.42	1.86	64	12.23	17.33	94	279.31	279.31
35	1.47	1.94	65	13.55	19.07	95	317.32	317.32
36	1.56	2.09	66	14.97	20.79	96	375.74	375.74
37	1.67	2.28	67	16.41	22.58	97	474.97	474.97
38	1.79	2.49	68	17.86	24.20	98	655.85	655.85
39	1.93	2.73	69	19.41	26.02	99	1,000.00	1,000.00
40	2.08	3.00	70	21.20	27.95			
41	2.26	3.33	71	23.34	30.45			
42	2.44	3.64	72	25.99	33.55			
43	2.62	3.96	73	29.22	37.33			
44	2.80	4.28	74	33.02	41.74			

1980 CSO MALE SMOKER AND NONSMOKER MORTALITY RATES

Age Last Birthday

Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker
15	1.36	1.76	45	3.45	6.55	75	61.84	87.27
16	1.48	1.96	46	3.73	7.13	76	68.24	94.63
17	1.57	2.10	47	4.03	7.76	77	74.93	102.02
18 . . .	1.63	2.21	48 . . .	4.36	8.44	78 . . .	81.95	109.49
19	1.67	2.28	49	4.72	9.18	79 . . .	89.52	117.30
20 . .	1.68	2.32	50	5.13	10.00	80	97.88	125.71
21 . .	1.66	2.32	51	5.60	10.93	81 . . .	107.25	134.96
22 . .	1.63	2.28	52 . . .	6.14	11.98	82 . .	117.82	145.21
23 . .	1.59	2.24	53 . . .	6.76	13.17	83 . . .	129.54	156.29
24 . .	1.55	2.18	54	7.45	14.47	84	142.18	167.83
25	1.50	2.11	55	8.22	15.86	85	155.45	179.44
26 . .	1.47	2.07	56 . .	9.06	17.33	86	169.18	190.84
27 . .	1.45	2.05	57 . .	9.95	18.88	87	183.16	202.54
28 . .	1.44	2.05	58 . .	10.94	20.51	88	197.33	214.73
29 . .	1.44	2.08	59 . . .	12.05	22.26	89 . . .	211.89	226.85
30	1.45	2.13	60	13.29	24.21	90	227.05	239.08
31	1.48	2.20	61	14.67	26.41	91	243.16	251.80
32	1.52	2.29	62	16.26	28.89	92	260.82	266.55
33	1.58	2.41	63	18.06	31.66	93	281.75	285.47
34	1.65	2.55	64	20.06	34.69	94	309.83	311.27
35	1.73	2.72	65 . . .	22.25	37.90	95	351.86	351.86
36	1.82	2.92	66	24.62	41.26	96	420.99	420.99
37	1.94	3.17	67	27.16	44.74	97	541.00	541.00
38	2.07	3.45	68	29.92	48.39	98	745.15	745.15
39	2.21	3.77	69	32.98	52.35	99	1,000.00	1,000.00
40	2.38	4.14	70 . . .	36.44	56.72			
41	2.56	4.54	71	40.39	61.63			
42	2.75	4.98	72	44.95	67.18			
43	2.96	5.46	73 . . .	50.11	73.33			
44 . . .	3.19	5.99	74	55.78	80.07			

1980 CSO FEMALE SMOKER AND NONSMOKER MORTALITY RATES

Age Last Birthday

Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker
15....	0.86	0.96	45.....	3.09	4.78	75....	39.64	49.22
16....	0.90	1.01	46.....	3.30	5.13	76....	44.52	54.62
17....	0.93	1.06	47.....	3.53	5.49	77....	49.75	60.26
18....	0.96	1.11	48.....	3.77	5.88	78....	55.41	66.22
19....	0.99	1.14	49.....	4.04	6.31	79....	61.68	72.71
20....	1.01	1.17	50.....	4.34	6.77	80....	68.81	79.98
21....	1.03	1.19	51.....	4.67	7.26	81....	77.01	88.23
22....	1.04	1.22	52.....	5.05	7.82	82....	86.46	97.61
23....	1.06	1.25	53.....	5.47	8.44	83....	97.12	108.44
24....	1.08	1.28	54.....	5.90	9.07	84....	108.87	120.18
25....	1.10	1.31	55.....	6.36	9.72	85....	121.58	132.65
26....	1.13	1.36	56.....	6.82	10.36	86....	135.16	145.75
27....	1.15	1.40	57.....	7.27	10.96	87....	149.59	159.35
28....	1.18	1.45	58.....	7.72	11.55	88....	164.88	173.52
29....	1.22	1.51	59.....	8.23	12.18	89....	181.15	188.25
30....	1.25	1.58	60.....	8.83	12.93	90....	198.53	204.58
31....	1.29	1.64	61.....	9.57	13.87	91....	217.42	222.16
32....	1.33	1.71	62.....	10.49	15.08	92....	238.53	241.66
33....	1.38	1.80	63.....	11.62	16.55	93....	263.35	264.56
34....	1.44	1.90	64.....	12.89	18.19	94....	295.23	295.23
35....	1.51	2.01	65.....	14.26	19.92	95....	341.02	341.02
36....	1.61	2.18	66.....	15.68	21.68	96....	413.88	413.88
37....	1.73	2.38	67.....	17.13	23.38	97....	537.24	537.24
38....	1.86	2.61	68.....	18.63	25.10	98....	743.96	743.96
39....	2.00	2.86	69.....	20.30	26.97	99.....	1,000,000	1,000.00
40....	2.17	3.16	70.....	22.26	29.18			
41....	2.35	3.48	71.....	24.65	31.98			
42....	2.53	3.80	72.....	27.58	35.41			
43....	2.71	4.12	73.....	31.09	39.49			
44....	2.89	4.44	74.....	35.13	44.14			

1980 CET MALE SMOKER AND NONSMOKER MORTALITY RATES
Age Nearest Birthday

Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker
15....	2.04	2.40	45.....	4.32	8.15	75.....	76.44	108.90
16....	2.18	2.62	46.....	4.67	8.88	76.....	84.58	118.43
17....	2.29	2.80	47.....	5.04	9.67	77.....	93.13	128.08
18....	2.35	2.91	48.....	5.45	10.50	78.....	102.01	137.68
19....	2.41	3.01	49.....	5.90	11.44	79.....	111.44	147.54
20....	2.43	3.06	50.....	6.38	12.43	80.....	121.77	158.07
21....	2.42	3.08	51.....	6.96	13.57	81.....	133.28	169.53
22....	2.39	3.05	52.....	7.62	14.85	82.....	146.28	182.26
23....	2.36	3.01	53.....	8.36	16.30	83.....	160.93	196.34
24....	2.32	2.96	54.....	9.22	17.94	84..	176.94	211.24
25....	2.27	2.89	55.....	10.17	19.68	85.....	193.96	226.46
26....	2.23	2.83	56.....	11.22	21.57	86.....	211.64	241.51
27....	2.21	2.81	57.....	12.34	23.52	87..	229.83	256.18
28....	2.19	2.79	58.....	13.55	25.60	88..	248.16	272.18
29....	2.19	2.81	59.....	14.91	27.76	89..	266.88	287.98
30....	2.19	2.85	60.....	16.43	30.15	90..	286.25	303.80
31....	2.22	2.92	61.....	18.12	32.84	91..	306.59	319.96
32....	2.25	2.99	62.....	20.05	35.87	92..	328.58	337.13
33....	2.30	3.10	63.....	22.24	39.30	93.....	353.12	359.19
34....	2.36	3.23	64.....	24.73	43.08	94.....	384.35	387.60
35....	2.44	3.42	65.....	27.47	47.18	95.....	428.95	428.95
36....	2.52	3.65	66.....	30.42	51.44	96.....	499.92	499.92
37....	2.63	3.95	67.....	33.62	55.91	97.....	624.26	624.26
38....	2.75	4.29	68.....	37.05	60.52	98.....	855.37	855.37
39....	2.89	4.68	69.....	40.79	65.42	99.....	1,000.00	1,000.00
40....	3.04	5.12	70.....	45.02	70.82			
41....	3.22	5.64	71.....	49.80	76.82			
42....	3.45	6.18	72.....	55.33	83.63			
43....	3.72	6.79	73.....	61.67	91.30			
44....	3.99	7.42	74.....	68.80	99.66			

1980 CET FEMALE SMOKER AND NONSMOKER MORTALITY RATES

Age Nearest Birthday

Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker
15	1.59	1.69	45	3.89	5.99	75	48.52	60.63
16	1.63	1.74	46	4.15	6.44	76	54.65	67.50
17	1.67	1.79	47	4.43	6.90	77	61.24	74.70
18	1.70	1.84	48	4.75	7.38	78	68.29	82.20
19	1.73	1.88	49	5.07	7.90	79	75.99	90.23
20	1.76	1.91	50	5.45	8.50	80	84.66	99.14
21	1.77	1.93	51	5.85	9.10	81	94.59	109.20
22	1.79	1.96	52	6.31	9.78	82	106.07	120.69
23	1.80	1.98	53	6.84	10.57	83	119.29	133.73
24	1.83	2.02	54	7.38	11.38	84	133.94	149.05
25	1.84	2.04	55	7.97	12.22	85	149.99	164.35
26	1.87	2.09	56	8.57	13.07	86	167.15	181.73
27	1.89	2.13	57	9.17	13.87	87	185.52	198.47
28	1.92	2.17	58	9.74	14.63	88	204.89	217.40
29	1.95	2.23	59	10.35	15.41	89	225.56	235.39
30	1.99	2.30	60	11.06	16.26	90	247.51	256.11
31	2.02	2.36	61	11.91	17.37	91	271.15	278.20
32	2.06	2.43	62	12.97	18.71	92	297.18	302.30
33	2.10	2.50	63	14.31	20.51	93	326.82	329.62
34	2.17	2.61	64	15.90	22.53	94	363.10	363.10
35	2.22	2.69	65	17.62	24.79	95	412.52	412.52
36	2.31	2.84	66	19.46	27.03	96	488.46	488.46
37	2.42	3.03	67	21.33	29.35	97	617.46	617.46
38	2.54	3.24	68	23.22	31.46	98	852.61	852.61
39	2.68	3.55	69	25.23	33.83	99	1,000.00	1,000.00
40	2.83	3.90	70	27.56	36.34			
41	3.01	4.33	71	30.34	39.59			
42	3.19	4.73	72	33.79	43.62			
43	3.41	5.15	73	37.99	48.53			
44	3.64	5.56	74	42.93	54.26			

1980 CET MALE SMOKER AND NON-SMOKER MORTALITY RATES
Age Last Birthday

Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker
15....	2.11	2.51	45....	4.49	8.52	75....	80.39	113.45
16....	2.23	2.71	46....	4.85	9.27	76....	88.71	123.02
17....	2.32	2.85	47....	5.24	10.09	77....	97.41	132.63
18....	2.38	2.96	48....	5.67	10.97	78....	106.54	142.34
19....	2.42	3.03	49....	6.14	11.93	79....	116.38	152.49
20....	2.43	3.07	50....	6.67	13.00	80....	127.24	163.42
21....	2.41	3.07	51....	7.28	14.21	81....	139.43	175.45
22....	2.38	3.03	52....	7.98	15.57	82....	153.17	188.77
23....	2.34	2.99	53....	8.79	17.12	83....	168.40	203.18
24....	2.30	2.93	54....	9.69	18.81	84....	184.83	218.18
25....	2.25	2.86	55....	10.69	20.62	85....	202.09	233.27
26....	2.22	2.82	56....	11.78	22.53	86....	219.93	248.09
27....	2.20	2.80	57....	12.94	24.54	87....	238.11	263.30
28....	2.19	2.80	58....	14.22	26.66	88....	256.53	279.15
29....	2.19	2.83	59....	15.67	28.94	89....	275.46	294.91
30....	2.20	2.88	60....	17.28	31.47	90....	295.17	310.80
31....	2.23	2.95	61....	19.07	34.33	91....	316.11	327.34
32....	2.27	3.04	62....	21.14	37.56	92....	339.07	346.52
33....	2.33	3.16	63....	23.48	41.16	93....	366.28	371.11
34....	2.40	3.32	64....	26.08	45.10	94....	402.78	404.65
35....	2.48	3.54	65....	28.93	49.27	95....	457.42	457.42
36....	2.57	3.80	66....	32.01	53.64	96....	547.29	547.29
37....	2.69	4.12	67....	35.31	58.16	97....	703.30	703.30
38....	2.82	4.49	68....	38.90	62.91	98....	968.70	968.70
39....	2.96	4.90	69....	42.87	68.06	99....	1,000.00	1,000.00
40....	3.13	5.38	70....	47.37	73.74			
41....	3.33	5.90	71....	52.51	80.12			
42....	3.58	6.47	72....	58.44	87.33			
43....	3.85	7.10	73....	65.14	95.33			
44....	4.15	7.79	74....	72.51	104.09			

1980 CET FEMALE SMOKER AND NONSMOKER MORTALITY RATES
Age Last Birthday

Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker	Age	Nonsmoker	Smoker
15....	1.61	1.71	45.....	4.02	6.21	75.....	51.53	63.99
16....	1.65	1.76	46.....	4.29	6.67	76....	57.88	71.01
17....	1.68	1.81	47.....	4.59	7.14	77....	64.68	78.34
18....	1.71	1.86	48.....	4.90	7.64	78.....	72.03	86.09
19....	1.74	1.89	49.....	5.25	8.20	79.....	80.18	94.52
20....	1.76	1.92	50.....	5.64	8.80	80.....	89.45	103.97
21....	1.78	1.94	51.....	6.07	9.44	81...	100.11	114.70
22....	1.79	1.97	52.....	6.57	10.17	82....	112.40	126.89
23....	1.81	2.00	53.....	7.11	10.97	83.....	126.26	140.97
24....	1.83	2.03	54.....	7.67	11.79	84.....	141.53	156.23
25....	1.85	2.06	55....	8.27	12.64	85.....	158.05	172.45
26....	1.88	2.11	56.....	8.87	13.47	86.....	175.71	189.48
27....	1.90	2.15	57....	9.45	14.25	87.....	194.47	207.16
28....	1.93	2.20	58.....	10.04	15.02	88.....	214.34	225.58
29...	1.97	2.26	59.....	10.70	15.83	89.....	235.50	244.73
30....	2.00	2.33	60.....	11.48	16.81	90.....	258.09	265.95
31....	2.04	2.39	61.....	12.44	18.03	91.....	282.65	288.81
32....	2.08	2.46	62.....	13.64	19.60	92.....	310.09	314.16
33....	2.13	2.55	63.....	15.11	21.52	93.....	342.36	343.93
34....	2.19	2.65	64.....	16.76	23.65	94.....	383.80	383.80
35....	2.26	2.76	65.....	18.54	25.90	95.....	443.33	443.33
36....	2.36	2.93	66.....	20.38	28.18	96.....	538.04	538.04
37....	2.48	3.13	67.....	22.27	30.39	97.....	698.41	698.41
38...	2.61	3.39	68.....	24.22	32.63	98.....	967.15	967.15
39....	2.75	3.72	69.....	26.39	35.06	99.....	1,000.00	1,000.00
40....	2.92	4.11	70.....	28.94	37.93			
41....	3.10	4.52	71.....	32.05	41.57			
42....	3.29	4.94	72.....	35.85	46.03			
43...	3.52	5.36	73.....	40.42	51.34			
44....	3.76	5.77	74.....	45.67	57.38			

APPENDIX G

RESERVE ANALYSIS

When the experience of two dissimilar groups is combined into one composite mortality table, total reserves calculated according to the composite table will generally *not* be the same as reserves calculated according to two separate mortality tables, one for each group. This is true even if the actual distribution of lives in each group and the actual mortality rates experienced by each group are exactly as assumed in the tables. The following simplified example illustrates this occurrence.

Suppose

$$Q_{98}^S = 0.80, \ Q_{98}^{NS} = 0.50,$$

$$Q_{99}^S = 1.00, \ Q_{99}^{NS} = 1.00,$$

and $i = 0$ percent.

Assume that 50 percent of all individuals aged 98 are smokers and that \$1,000 policies were issued to 100 people aged 98 on January 1, 1983. The number surviving is as shown in the accompanying table.

Age	Smokers	Nonsmokers	Composite
98 . . .	50	50	100
99 . . .	10	25	35
100 . . .	0	0	0

Using basic principles, net annual premiums per policy are

Smokers:	(50/60)	× 1,000	= 833.33;
Nonsmokers:	(50/75)	× 1,000	= 666.67;
Composite:	(100/135)	× 1,000	= 740.74.

Terminal reserves per policy at December 31, 1983, the end of the first policy year, are

Smokers:	(1 − 0.83333)	× 1,000	= 166.67;
Nonsmokers:	(1 − 0.66667)	× 1,000	= 333.33;
Composite:	(1 − 0.74074)	× 1,000	= 259.26.

Total reserves held on December 31, 1983, are the following:

Using separate smoker and nonsmoker tables:

$$(10 \times 166.67) + (25 \times 333.33) = 10,000;$$

Using the composite table:

$$35 \times 259.26 = 9,074.$$

It should be noted that when the net premiums are added, the initial reserves at the beginning of the second policy year (January 1, 1984), are the following:

Using separate smoker and nonsmoker tables:

$$10,000 + (10 \times 833.33) + (25 \times 666.67) = 35,000;$$

Using the composite table:

$$9,074 + (35 \times 740.74) = 35,000.$$

In this example, although terminal reserves differ, initial reserves calculated under either basis are exactly equal to the total benefits to be paid.

As an alternative illustration, assume that there are no differences in smoking habits among different generations. For a group of policies issued on a level premium plan of insurance at one issue age, the present value of future benefits at any duration could be calculated using either the composite table or the separate smoker and nonsmoker tables. If actual experience is the same as that in the tables, these two calculations should produce the same results. Since the smokers in the group have higher mortality rates than the nonsmokers, as the group ages it will have a higher proportion of nonsmokers than it had at issue. If the separate smoker and nonsmoker tables are used, the average net premium per $1,000 will decrease as the group ages. Thus, the total net premiums collected using the separate tables must be higher, in the early durations, than that calculated using the composite table, and be lower at the later durations. Since the present value of future benefits is the same using the separate tables as it is using the composite table, but the present value of future premiums is, at any point after issue, lower using the separate tables, terminal reserves (which equal the present value of future benefits minus the present value of future premiums) must, at any point after issue, be higher using the separate tables than using the composite table.

The above assumptions are not completely consistent with actual experience. For example, the percentage of smokers in the insured population has been decreasing for several years, and it varies significantly from company to company. Nevertheless, it should be evident that the use of separate smoker and nonsmoker tables tends to increase terminal reserves. The accompanying table gives some indication of the magnitude of the increase. As shown in column (6), aggregate reserves calculated using the separate smoker and nonsmoker tables tend to be higher than those calculated on the composite table, but they are less than 4 percent higher. Female reserves using the separate tables also tend to be 1–4 percent higher than on the composite table.

WHOLE LIFE NLP TERMINAL RESERVES, MALE, 1980 CSO AT 4½ PERCENT INTEREST

Issue Age (1)	1980 CSO (Composite) Table (2)	1980 CSO Nonsmoker Table (3)	1980 CSO Smoker Table (4)	Weighted* Average of Smoker and Nonsmoker (5)	(5) ÷ (2) (6)
Duration 1					
25	6.07	5.52	7.08	6.15	1.013
45	15.10	14.34	17.46	15.64	1.036
65	32.15	32.74	33.27	32.89	1.023
Duration 10					
25	75.19	68.69	87.79	76.43	1.016
45	168.28	163.20	189.23	174.08	1.034
65	316.83	323.22	315.88	321.14	1.014
Duration 20					
25	181.92	169.05	210.03	185.65	1.021
45	365.33	362.24	394.59	375.73	1.028
65	575.76	586.85	553.67	577.46	1.003

* Weights used are the issue-age proportions of smokers and nonsmokers used in the development of the scaling factors in Table 1.