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MORTALITY DIFFERENCES BETWEEN SMOKERS AND NON-SMOKERS

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BY courtesy of Robin Michaelson, data derived from a United States of America life insurance experience (1970–75) for individually insured lives was made available. The data consisted of the proportions of smokers in the population and the ratio of smokers' mortality to that of non-smokers. In both cases separate data was collected for males and females and at integral ages from 15 to 84. From these data it was possible to construct separate life tables for smokers and non-smokers, which were subdivided for males and females. These tables are shown as Tables A–D at the end of this note.

The exercise was undertaken (by Mr Basha one of Professor Benjamin's post-graduate students) after inquiries in the U.S.A. in 1985 (at the time of Professor Benjamin's attendance at a meeting of experts in Washington organized by the U.S. National Academy of Sciences to discuss smoking behaviour and the effectiveness of anti-smoking policies) and later inquiries in the United Kingdom, had failed to identify any such existing table. Later, however, we received from Michael Cowell F.S.A. a copy of a paper which he and Brian Hirst had presented at the 1979 Annual Meeting of the Society of Actuaries together with an update of their experiences presented to the 1985 Annual Meeting. More recently we received a copy of a paper presented to the Society of Actuaries by Ed Lew and Laurence Garfinkel based on the American Cancer Society, Cancer Prevention Study 1960–72.

Table 1 compares the ratio of smoker/non-smoker death rates at quinary age points of all the experiences for males and females separately. (Where necessary values at exact quinary ages have been derived by interpolation.)

The values in Table 1 appear to be compatible bearing in mind: (i) that the State Mutual data are of lives select at age 35 (the mortality ratios are generally found to be higher for healthy lives than for those with impaired health); and (ii) that the LS Cancer Society Cancer Prevention Study related to the general population so that the ratios would be expected to be lower at younger ages than for a population underwritten for life insurance. Perhaps by the same token the Michaelson values may be regarded as applicable to the general population.

Turning now to Tables A–D, it is possible to make the following comparisons between smokers and non-smokers (Table 2).

It seems clear that the heavier mortality resulting from cigarette smoking has not yet as fully caught up with women as it has with men and as, undoubtedly, it is beginning to.

Table 1. *Ratio of death rates of smokers to those of non-smokers based on data from Michaelson (M), Cowell* et al. *(C) and Law* et al. *(L)*[b]

	Ratio of smokers' to non-smokers' death rates					
	Males			Females		
Age	M	C[a]	L	M	C[c]	L
15	1·50			1·50		
20	1·60			1·35		
25	1·75			1·44		
30	2·00			1·60		
35	2·25	3·4		1·74		
40	2·40	3·2	2·14	1·84		1·40
45	2·50	3·1	2·54	1·90		1·78
50	2·45	3·0	2·62	1·86		1·80
55	2·25	2·8	2·42	1·75	N.A.	1·84
60	1·90	2·6	2·21	1·56		1·79
65	1·68	2·4	2·02	1·41		1·69
70	1·50	2·1	1·88	1·50		1·66
75	1·35	1·9	1·67	1·20		1·50
80	1·25	1·5	1·50	1·13		1·33
85	1·15	1·0	1·41	1·08		1·21
90	1·05	1·0	1·30	1·03		1·18
95	1·00	1·0	1·05	1·00		1·10
100	1·00	1·0				

[a] State Mutual Life assurance experience 1965–70 select at age 35, aggregate from age 47.

[b] Except for the M values, values shown are values at exact ages and are estimates by interpolation from age group values.

[c] Not provided.

Table 2. *Expectations of life for smokers and non-smokers*

	Males			Females		
Age	Smokers	Non-smokers	Total population	Smokers	Non-smokers	Total population
15	52·5	58·0	55·8	59·5	62·6	61·8
25	42·8	48·4	46·3	49·8	52·8	52·0
35	33·3	38·7	36·7	40·1	43·0	42·3
45	24·2	29·2	27·7	31·0	33·5	32·9
55	16·5	20·3	19·1	22·6	24·5	24·1
65	10·4	12·8	12·2	15·1	16·2	16·1
75	6·4	7·6	7·3	9·0	9·5	9·5
85	3·9	4·2	4·1	4·9	5·0	5·0

DISCUSSION

At first blush one would feel that the expectation of life for non-smokers, as shown in Table 2 should be far more than for smokers. However, bearing in mind some of the comments or slogans one sees or hears, namely that every cigarette smoked shortens one's life by 5 minutes on average then the contrasting figures of 42·8 years for smokers and 48·4 years for non-smokers at age 25 are not unreasonable.

Contacts with actuaries in one to two life companies in the U.K. that do differentiate between smokers and non-smokers indicate that at the present time among those proposing for life assurance probably upwards of 70% admit and declare to be non-smokers (according to the company definition at the time of proposing). This may be beginning to fall in line with the national average. On the other hand, and this is really the crux of the matter because one cannot get any further information, it does seem to be that far more than half of the death claims recorded on classes of business where there is some form of differentiation in premium charges between smokers and non-smokers, come from smokers and this is disproportional therefore in the overall result of our calculations.

Table A. *Life tables for smokers among males (using ELT. 13)*

Age x	l_x	d_x	q_x	e_x	Age x	l_x	d_x	q_x	e_x
0	100000	1980	·01980	65·447	55	81712	1580	·01933	16·481
1	98020	117	·00119	65·758	56	80132	1700	·02122	15·796
2	97903	79	·00081	64·836	57	78432	1825	·02327	15·128
3	97824	61	·00062	63·888	58	76607	1947	·02542	14·476
4	97763	51	·00052	62·928	59	74660	2076	·02781	13·841
5	97712	46	·00047	61·960	60	72584	2212	·03048	13·222
6	97666	43	·00044	60·989	61	70372	2355	·03347	12·622
7	97623	40	·00041	60·016	62	68017	2498	·03672	12·042
8	97583	38	·00039	59·040	63	65519	2647	·04041	11·482
9	97545	35	·00036	58·063	64	62872	2790	·04437	10·944
10	97510	33	·00034	57·084	65	60082	2923	·04865	10·429
11	97477	32	·00033	56·103	66	57159	3041	·05320	9·937
12	97445	32	·00033	55·121	67	54118	3141	·05803	9·467
13	97413	35	·00036	54·139	68	50977	3213	·06303	9·020
14	97378	42	·00043	53·159	69	47764	3271	·06848	8·593
15	97336	77	·00079	52·181	70	44493	3296	·07408	8·188
16	97259	101	·00104	51·222	71	41197	3286	·07976	7·803
17	97158	136	·00140	50·275	72	37911	3242	·08553	7·436
18	97022	138	·00143	49·345	73	34669	3170	·09144	7·084
19	96884	139	·00144	48·414	74	31499	3071	·09751	6·747
20	96745	136	·00140	47·483	75	28428	2950	·10379	6·422
21	96609	131	·00135	46·549	76	25478	2826	·11092	6·107
22	96478	126	·00130	45·612	77	22652	2683	·11843	5·807
23	96352	121	·00126	44·671	78	19969	2523	·12635	5·520
24	96231	116	·00121	43·726	79	17446	2350	·13472	5·246
25	96115	114	·00118	42·778	80	15096	2168	·14360	4·985
26	96001	112	·00117	41·829	81	12928	1977	·15295	4·737
27	95889	113	·00118	40·877	82	10951	1782	·16277	4·502
28	95776	116	·00121	39·925	83	9169	1586	·17299	4·279
29	95660	122	·00128	38·972	84	7583	1392	·18359	4·070
30	95538	129	·00135	38·022	85	6191	1204	·19449	3·872
31	95409	138	·00145	37·072	86	4987	1026	·20566	3·687
32	95271	147	·00154	36·125	87	3961	860	·21700	3·512
33	95124	157	·00165	35·180	88	3101	708	·22845	3·347
34	94967	169	·00178	34·238	89	2393	574	·23991	3·190
35	94798	183	·00193	33·298	90	1819	457	·25134	3·038
36	94615	200	·00211	32·361	91	1362	361	·26492	2·890
37	94415	221	·00234	31·429	92	1001	279	·27863	2·751
38	94194	247	·00262	30·501	93	722	211	·29240	2·620
39	93947	278	·00296	29·580	94	511	156	·30621	2·495
40	93669	314	·00335	28·666	95	355	114	·31999	2·372
41	93355	356	·00381	27·761	96	241	81	·33675	2·257
42	92999	403	·00433	26·865	97	160	57	·35371	2·144
43	92596	457	·00494	25·980	98	103	38	·37083	2·049
44	92139	519	·00564	25·107	99	65	25	·38804	1·954
45	91620	586	·00640	24·246	100	40	16	·40535	1·850
46	91034	660	·00725	23·399	101	24	10	·42277	1·750
47	90374	739	·00818	22·566	102	14	6	·44028	1·643
48	89635	825	·00921	21·748	103	8	4	·45790	1·500
49	88810	920	·01036	20·945	104	4	2	·47562	1·500
50	87890	1019	·01160	20·159	105	2	1	·49344	1·500
51	86871	1123	·01292	19·390	106	1	1	·51136	·000
52	85748	1231	·01436	18·637	107	0	0	·52938	·000
53	84517	1344	·01591	17·902					
54	83173	1461	·01757	17·183					

Table B. *Life tables for smokers among females (using ELT. 13)*

Age x	l_x	d_x	q_x	e_x	Age x	l_x	d_x	q_x	e_x
0	100000	1523	·01523	73·059	55	88722	840	·00947	22·611
1	98477	104	·00106	73·182	56	87882	894	·01018	21·822
2	98373	66	·00067	72·259	57	86988	951	·01094	21·041
3	98307	51	·00052	71·307	58	86037	1012	·01176	20·268
4	98256	40	·00041	70·343	59	85025	1080	·01271	19·503
5	98216	33	·00034	69·372	60	83945	1152	·01372	18·748
6	98183	29	·00030	68·395	61	82793	1230	·01485	18·002
7	98154	27	·00028	67·415	62	81563	1313	·01610	17·266
8	98127	26	·00026	66·433	63	80250	1404	·01749	16·540
9	98101	24	·00024	65·451	64	78846	1503	·01906	15·826
10	98077	23	·00023	64·467	65	77343	1617	·02090	15·123
11	98054	22	·00022	63·482	66	75726	1740	·02298	14·436
12	98032	21	·00021	62·496	67	73986	1870	·02528	13·763
13	98011	22	·00022	61·509	68	72116	2009	·02786	13·107
14	97989	24	·00025	60·523	69	70107	2155	·03074	12·469
15	97965	36	·00036	59·538	70	67952	2303	·03390	11·848
16	97929	43	·00044	58·559	71	65649	2453	·03737	11·246
17	97886	47	·00048	57·585	72	63196	2602	·04118	10·663
18	97839	52	·00053	56·612	73	60594	2746	·04532	10·100
19	97787	54	·00056	55·642	74	57848	2882	·04982	9·555
20	97733	54	·00055	54·673	75	54966	3005	·05466	9·030
21	97679	54	·00055	53·703	76	51961	3137	·06036	8·524
22	97625	53	·00054	52·732	77	48824	3249	·06654	8·039
23	97572	53	·00055	51·760	78	45575	3336	·07320	7·577
24	97519	54	·00055	50·788	79	42239	3396	·08041	7·135
25	97465	55	·00056	49·816	80	38843	3426	·08820	6·716
26	97410	58	·00059	48·844	81	35417	3421	·09658	6·317
27	97352	61	·00062	47·873	82	31996	3379	·10561	5·939
28	97291	65	·00067	46·902	83	28617	3299	·11529	5·581
29	97226	71	·00073	45·933	84	25318	3180	·12562	5·243
30	97155	77	·00079	44·967	85	22138	3024	·13660	4·924
31	97078	84	·00086	44·002	86	19114	2832	·14818	4·624
32	96994	91	·00094	43·040	87	16282	2611	·16035	4·342
33	96903	101	·00104	42·079	88	13671	2366	·17305	4·075
34	96802	111	·00115	41·123	89	11305	2106	·18625	3·824
35	96691	124	·00128	40·169	90	9199	1839	·19992	3·584
36	96567	137	·00142	39·220	91	7360	1576	·21413	3·355
37	96430	153	·00159	38·275	92	5784	1337	·23113	3·133
38	96277	173	·00179	37·335	93	4447	1108	·24912	2·924
39	96104	194	·00202	36·402	94	3339	895	·26817	2·729
40	95910	218	·00227	35·474	95	2444	705	·28831	2·545
41	95692	245	·00256	34·554	96	1739	538	·30954	2·374
42	95447	276	·00289	33·641	97	1201	399	·33186	2·213
43	95171	309	·00325	32·738	98	802	285	·35523	2·065
44	94862	347	·00365	31·843	99	517	196	·37957	1·926
45	94515	384	·00407	30·958	100	321	130	·40489	1·798
46	94181	423	·00450	30·082	101	191	82	·43118	1·681
47	93708	465	·00496	29·215	102	109	50	·45844	1·569
48	93243	508	·00545	28·359	103	59	29	·48668	1·475
49	92735	552	·00596	27·511	104	30	15	·51590	1·400
50	92183	597	·00648	26·673	105	15	8	·54609	1·267
51	91586	644	·00704	25·844	106	7	4	·57726	1·143
52	90942	693	·00762	25·023	107	3	2	·60940	·000
53	90249	738	·00818	24·211	108	1	1	·64251	·000
54	89511	789	·00882	23·407					

Table C. *Life tables for non-smokers among males (using ELT. 13)*

Age x	l_x	d_x	q_x	e_x	Age x	l_x	d_x	q_x	e_x
0	100000	1980	·01980	71·107	55	90193	775	·00859	20·310
1	98020	117	·00119	71·533	56	89418	870	·00973	19·481
2	97903	79	·00081	70·618	57	88548	976	·01103	18·668
3	97824	61	·00062	69·674	58	87572	1096	·01252	17·870
4	97763	51	·00052	68·717	59	86476	1227	·01419	17·090
5	97712	46	·00047	67·753	60	85249	1368	·01604	16·329
6	97666	43	·00044	66·785	61	83881	1517	·01809	15·587
7	97623	40	·00041	65·814	62	82364	1680	·02040	14·865
8	97583	38	·00039	64·841	63	80684	1852	·02296	14·164
9	97545	35	·00036	63·866	64	78832	2034	·02580	13·485
10	97510	33	·00034	62·888	65	76798	2224	·02896	12·829
11	97477	32	·00033	61·910	66	74574	2419	·03244	12·197
12	97445	32	·00033	60·930	67	72155	2617	·03627	11·589
13	97413	35	·00036	59·950	68	69538	2810	·04041	11·007
14	97378	42	·00043	58·971	69	66728	2987	·04476	10·449
15	97336	51	·00053	57·996	70	63741	3148	·04939	9·915
16	97285	67	·00069	57·026	71	60593	3288	·05426	9·404
17	97218	89	·00092	56·065	72	57305	3404	·05939	8·915
18	97129	89	·00092	55·116	73	53901	3495	·06485	8·447
19	97040	89	·00092	54·166	74	50406	3562	·07066	7·998
20	96951	85	·00088	53·216	75	46844	3601	·07688	7·568
21	96866	80	·00083	52·262	76	43243	3606	·08340	7·156
22	96786	76	·00079	51·305	77	39637	3583	·09040	6·762
23	96710	72	·00074	50·345	78	36054	3531	·09795	6·384
24	96638	68	·00070	49·382	79	32523	3450	·10608	6·023
25	96570	65	·00067	48·416	80	29073	3340	·11488	5·678
26	96505	63	·00066	47·448	81	25733	3200	·12435	5·351
27	96442	62	·00065	46·479	82	22533	3031	·13452	5·039
28	96380	62	·00065	45·509	83	19502	2835	·14537	4·745
29	96318	64	·00066	44·538	84	16667	2615	·15691	4·467
30	96254	65	·00067	43·567	85	14052	2377	·16912	4·205
31	96189	67	·00070	42·596	86	11675	2125	·18200	3·959
32	96122	70	·00072	41·625	87	9550	1867	·19550	3·729
33	96052	73	·00076	40·655	88	7683	1610	·20959	3·514
34	95979	77	·00080	39·686	89	6073	1362	·22422	3·313
35	95902	82	·00086	38·717	90	4711	1128	·23937	3·126
36	95820	89	·00093	37·750	91	3583	913	·25473	2·953
37	95731	97	·00101	36·785	92	2670	722	·27051	2·791
38	95634	107	·00112	35·821	93	1948	558	·28667	2·640
39	95527	119	·00125	34·861	94	1390	421	·30317	2·499
40	95408	133	·00140	33·904	95	969	310	·31999	2·367
41	95275	149	·00157	32·950	96	659	222	·33675	2·246
42	95126	168	·00177	32·001	97	437	155	·35371	2·133
43	94958	190	·00200	31·057	98	282	105	·37083	2·028
44	94768	215	·00226	30·118	99	177	69	·38804	1·932
45	94553	242	·00256	29·186	100	108	44	·40535	1·843
46	94311	275	·00291	28·259	101	64	27	·42277	1·766
47	94036	310	·00330	27·340	102	37	16	·44028	1·676
48	93726	349	·00373	26·429	103	21	10	·45790	1·571
49	93377	393	·00421	25·526	104	11	5	·47562	1·545
50	92984	440	·00473	24·632	105	6	3	·49344	1·333
51	92544	492	·00532	23·747	106	3	2	·51136	·000
52	92052	551	·00598	22·871	107	1	1	·52938	·000
53	91501	617	·00674	22·005					
54	90884	691	·00760	21·151					

Table D. *Life tables for non-smokers among females (using ELT. 13)*

Age x	l_x	d_x	q_x	e_x	Age x	l_x	d_x	q_x	e_x
0	100000	1523	·01523	76·021	55	92651	522	·00564	24·452
1	98477	104	·00106	76·189	56	92129	572	·00621	23·588
2	98373	66	·00067	75·269	57	91557	626	·00683	22·732
3	98307	51	·00052	74·319	58	90931	685	·00754	21·885
4	98256	40	·00041	73·357	59	90246	750	·00831	21·047
5	98216	33	·00034	72·387	60	89496	819	·00915	20·220
6	98183	29	·00030	71·411	61	88677	896	·01010	19·402
7	98154	27	·00028	70·432	62	87781	982	·01118	18·595
8	98127	26	·00026	69·451	63	86799	1077	·01241	17·799
9	98101	24	·00024	68·470	64	85722	1184	·01381	17·017
10	98077	23	·00023	67·486	65	84538	1299	·01537	16·248
11	98054	22	·00022	66·502	66	83239	1427	·01715	15·494
12	98032	21	·00021	65·517	67	81812	1567	·01915	14·755
13	98011	22	·00022	64·531	68	80245	1720	·02143	14·034
14	97989	24	·00025	63·545	69	78525	1886	·02401	13·330
15	97965	27	·00028	62·560	70	76639	2062	·02690	12·646
16	97938	33	·00033	61·578	71	74577	2247	·03014	11·982
17	97905	36	·00037	60·598	72	72330	2441	·03375	11·338
18	97869	39	·00040	59·620	73	69889	2640	·03777	10·717
19	97830	41	·00041	58·644	74	67249	2839	·04222	10·118
20	97789	40	·00041	57·668	75	64410	3035	·04712	9·542
21	97749	40	·00041	56·692	76	61375	3222	·05249	8·989
22	97709	39	·00039	55·715	77	58153	3394	·05836	8·459
23	97670	38	·00039	54·737	78	54759	3547	·06478	7·953
24	97632	38	·00039	53·758	79	51212	3677	·07179	7·469
25	97594	38	·00039	52·778	80	47535	3777	·07946	7·008
26	97556	40	·00041	51·799	81	43758	3842	·08780	6·570
27	97516	41	·00042	50·820	82	39916	3868	·09689	6·154
28	97475	43	·00044	49·841	83	36048	3848	·10675	5·761
29	97432	45	·00047	48·863	84	32200	3780	·11740	5·389
30	97387	48	·00049	47·885	85	28420	3662	·12887	5·040
31	97339	51	·00053	46·909	86	24758	3494	·14113	4·711
32	97288	55	·00056	45·933	87	21264	3279	·15418	4·403
33	97233	59	·00061	44·959	88	17985	3022	·16801	4·114
34	97174	64	·00066	43·986	89	14963	2732	·18260	3·844
35	97110	70	·00073	43·014	90	12231	2421	·19794	3·591
36	97040	78	·00080	42·045	91	9810	2101	·21413	3·354
37	96962	85	·00088	41·078	92	7709	1782	·23113	3·132
38	96877	95	·00099	40·114	93	5927	1477	·24912	2·924
39	96782	106	·00110	39·153	94	4450	1193	·26817	2·728
40	96676	118	·00122	38·195	95	3257	939	·28831	2·544
41	96558	132	·00137	37·241	96	2318	718	·30954	2·371
42	96426	148	·00154	36·292	97	1600	531	·33186	2·211
43	96278	165	·00172	35·347	98	1069	380	·35523	2·061
44	96113	185	·00192	34·406	99	689	262	·37957	1·922
45	95928	205	·00214	33·472	100	427	173	·40489	1·794
46	95723	228	·00238	32·542	101	254	110	·43118	1·673
47	95495	252	·00264	31·619	102	144	66	·45844	1·569
48	95243	278	·00292	30·701	103	78	38	·48668	1·474
49	94965	304	·00320	29·790	104	40	21	·51590	1·400
50	94661	333	·00352	28·884	105	19	10	·54609	1·368
51	94328	365	·00387	27·984	106	9	5	·57726	1·333
52	93963	398	·00424	27·091	107	4	2	·60940	·000
53	93565	437	·00467	26·204	108	2	1	·64251	·000
54	93128	477	·00513	25·324					