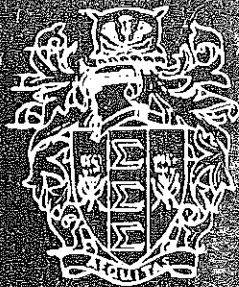


SA. 1956-62 SA. 1972-77



**THE ACTUARIAL SOCIETY
OF SOUTH AFRICA**

MORTALITY TABLES FOR ASSURED LIVES

INTRODUCTION

This booklet has been designed as a reference guide to allow for simple comparisons between the current standard SA 56-62 table of mortality and the graduation of the SA 72-77 experience. The latter is not intended to replace the former as an official standard table and for this reason a full set of tables has not been published; for the purposes of this booklet only l_x and q_x have been tabulated. Detailed information about the SA 72-77 graduation may be found in the 1981 Report of the Mortality Standing Committee.

A description of the data and graduation formulae used for the SA 72-77 experience is given with the relevant tabulated values. For the SA 56-62 values the opening paragraphs of the original introduction to the official set of tables have been reproduced.

SA 56-62

1. The S.A. 1956-62 table of mortality is based upon data collected by the Actuarial Society of South Africa for a continuous investigation into the mortality of assured lives in the Republic of South Africa and the mandated territory of South West Africa.

The data are preponderantly in respect of white male lives, although some policies on female lives and non-white lives have had to be included because it was impracticable to exclude them. The data relates to policies, not lives assured. Term assurances, double endowments and policies without death cover were excluded. The data includes policies issued both on medically examined lives and also under non-medical arrangements, but excludes policies issued without any medical evidence whatsoever, e.g. policies automatically issued in respect of salary increases under endowment assurance pension schemes.

2. The method used in the investigation was the census method, adjusted (see Haynes, "Journal of the Institute of Actuaries", volume 69, p.153) so as to become in effect a policy year method. The data related to the in force on census dates falling in the calendar years 1956 to 1962 inclusive, together with the corresponding deaths. The volume of data was as follows:

	Exposed to risk (years)	Deaths
Durations 0-2 years	1 715 585	3 497
Durations 3 years and over	4 838 343	34 879

3. The values of q_x are given by the formula

$$q_x = A + Bc^y / (Fc^{-2y} + 1 + Dc^y)$$

where $y = x - 62,5$

and $A = ,00142$

$B = ,02343257$

$D = ,02127424$

$F = ,02285556$

$c = 1,091663$

The values of the parameters were obtained by an automatic process of curve-fitting by a computer program - the method used is described in a paper entitled "An application of computer techniques to mortality graduation", which is published in the "Journal of the Institute of Actuaries Students' Society" (vol. 17, p. 407).

The S.A. 1956-62 table has a select period of three years. The select rates of mortality were derived as follows:

$$q_{(x)} = ,925 q_x \quad \text{for } x < 30$$

$$q_{(x)} = ,369 q_x + ,000028_x + ,000045 \quad \text{for } x \geq 30$$

$$q_{(x-1)+1} = ,760 q_{(x)} + ,240 q_x$$

$$q_{(x-2)+2} = ,487 q_{(x)} + ,513 q_x$$

SA 56-62

Age (x)	l_x	l_{x+1}	l_{x+2}	l_{x+3}	Age $x+3$
				999999	15
				998579	16
				997161	17
15	999759	998449	997111	995735	18
16	998339	997031	995685	994311	19
17	996921	995605	994261	992889	20
18	995495	994181	992839	991469	21
19	994071	992759	991419	990041	22
20	992649	991339	989991	988615	23
21	991230	989912	988566	987182	24
22	989803	988487	987133	985741	25
23	988378	987054	985692	984292	26
24	986944	985612	984242	982835	27
25	985504	984164	982786	981361	28
26	984055	982707	981312	979860	29
27	982590	981224	979801	978331	30
28	981105	979712	978272	976775	31
29	979594	978183	976716	975173	32
30	978066	976628	975114	973515	33
31	976491	975007	973447	971792	34
32	974851	973320	971704	969984	35
33	973124	971548	969877	968073	36
34	971324	969692	967947	966040	37
35	969400	967704	965875	963866	38
36	967355	965585	963663	961514	39
37	965139	963296	961263	958956	40
38	962735	960800	958638	956165	41
39	960115	958080	955781	953105	42
40	957236	955092	952637	949741	43
41	954067	951806	949179	946028	44
42	950575	948180	945354	941932	45
43	946724	944177	941137	937420	46
44	942472	939767	936497	932442	47
45	937778	934899	931374	926969	48
46	932609	929541	925739	920953	49
47	926918	923646	919554	914359	50
48	920659	917179	912777	907154	51
49	913816	910106	905373	899289	52
50	906328	902385	897305	890737	53
51	898167	893973	888529	881447	54
52	889288	884833	879002	871381	55
53	879651	874918	868680	860497	56
54	869201	864186	857532	848751	57
55	857920	852609	845507	836105	58
56	845752	840128	832567	822518	59
57	832657	826712	818668	807943	60
58	818597	812318	803772	792350	61
59	803510	796889	787836	775695	62
60	787372	780404	770828	757947	63
61	770160	762836	752721	739082	64

SA 56-62

Age (x)	$l(x)$	$l(x) + 1$	$l(x) + 2$	$l_x + 3$	Age $x + 3$
62	751836	744152	733488	719075	65
63	732363	724314	713094	697905	66
64	711725	703305	691532	675565	67
65	689914	681131	668809	652062	68
66	666921	657784	644911	627408	69
67	642758	633271	619871	601634	70
68	617443	607626	593717	574789	71
69	591020	580890	566513	546940	72
70	563537	553128	538326	518171	73
71	535079	524426	509249	488589	74
72	505738	494880	479390	458321	75
73	475627	464611	448884	427522	76
74	444899	433785	417908	396373	77
75	413707	402562	386633	365067	78
76	382255	371147	355273	333832	79
77	350754	339761	324057	302899	80
78	319426	308629	293216	272521	81
79	288528	278011	263018	242955	82
80	258312	248163	233715	214459	83
				187285	84
				161664	85
				137807	86
				115887	87
				96036,7	88
				78339,1	89
				62823,3	90
				49465,2	91
				38186,6	92
				28861,1	93
				21322,0	94
				15372,3	95
				10796,9	96
				7374,07	97
				4888,05	98
				3138,37	99
				1947,64	100
				1165,70	101
				671,350	102
				371,156	103
				196,490	104
				99,3532	105
				47,8545	106
				21,8958	107
				9,48986	108
				3,88429	109
				1,49689	110
				0,541380	111
				0,183138	112
				0,057743	113
				0,016907	114
				0,004579	115

SA 56-62

Age (x)	q(x)	q(x) + 1	q(x) + 2	q _x + 3	Age x + 3
				.00142	15
				.00142	16
				.00143	17
15	.00131	.00134	.00138	.00143	18
16	.00131	.00135	.00138	.00143	19
17	.00132	.00135	.00138	.00143	20
18	.00132	.00135	.00138	.00144	21
19	.00132	.00135	.00139	.00144	22
20	.00132	.00136	.00139	.00145	23
21	.00133	.00136	.00140	.00146	24
22	.00133	.00137	.00141	.00147	25
23	.00134	.00138	.00142	.00148	26
24	.00135	.00139	.00143	.00150	27
25	.00136	.00140	.00145	.00153	28
26	.00137	.00142	.00148	.00156	29
27	.00139	.00145	.00150	.00159	30
28	.00142	.00147	.00153	.00164	31
29	.00144	.00150	.00158	.00170	32
30	.00147	.00155	.00164	.00177	33
31	.00152	.00160	.00170	.00186	34
32	.00157	.00166	.00177	.00197	35
33	.00162	.00172	.00186	.00210	36
34	.00168	.00180	.00197	.00225	37
35	.00175	.00189	.00208	.00244	38
36	.00183	.00199	.00223	.00266	39
37	.00191	.00211	.00240	.00291	40
38	.00201	.00225	.00258	.00320	41
39	.00212	.00240	.00280	.00353	42
40	.00224	.00257	.00304	.00391	43
41	.00237	.00276	.00332	.00433	44
42	.00252	.00298	.00362	.00479	45
43	.00269	.00322	.00395	.00531	46
44	.00287	.00348	.00433	.00587	47
45	.00307	.00377	.00473	.00649	48
46	.00329	.00409	.00517	.00716	49
47	.00353	.00443	.00565	.00788	50
48	.00378	.00480	.00616	.00867	51
49	.00406	.00520	.00672	.00951	52
50	.00435	.00563	.00732	.01043	53
51	.00467	.00609	.00797	.01142	54
52	.00501	.00659	.00867	.01249	55
53	.00538	.00713	.00942	.01365	56
54	.00577	.00770	.01024	.01490	57
55	.00619	.00833	.01112	.01625	58
56	.00665	.00900	.01207	.01772	59
57	.00714	.00973	.01310	.01930	60
58	.00767	.01052	.01421	.02102	61
59	.00824	.01136	.01541	.02288	62
60	.00885	.01227	.01671	.02489	63
61	.00951	.01326	.01812	.02707	64

SA 56-62

Age (x)	$q(x)$	$q(x) + 1$	$q(x) + 2$	$q_x + 3$	Age $x + 3$
62	.01022	.01433	.01965	.02944	65
63	.01099	.01549	.02130	.03201	66
64	.01183	.01674	.02309	.03479	67
65	.01273	.01809	.02504	.03781	68
66	.01370	.01957	.02714	.04108	69
67	.01476	.02116	.02942	.04462	70
68	.01590	.02289	.03188	.04845	71
69	.01714	.02475	.03455	.05260	72
70	.01847	.02676	.03744	.05709	73
71	.01991	.02894	.04057	.06195	74
72	.02147	.03130	.04395	.06720	75
73	.02316	.03385	.04759	.07286	76
74	.02498	.03660	.05153	.07898	77
75	.02694	.03957	.05578	.08556	78
76	.02906	.04277	.06035	.09266	79
77	.03134	.04622	.06529	.10029	80
78	.03380	.04994	.07058	.10849	81
79	.03645	.05393	.07628	.11729	82
80	.03929	.05822	.08239	.12671	83
				.13680	84
				.14757	85
				.15906	86
				.17129	87
				.18428	88
				.19806	89
				.21263	90
				.22801	91
				.24421	92
				.26122	93
				.27904	94
				.29764	95
				.31702	96
				.33713	97
				.35795	98
				.37941	99
				.40148	100
				.42408	101
				.44715	102
				.47060	103
				.49436	104
				.51834	105
				.54245	106
				.56659	107
				.59069	108
				.61463	109
				.63833	110
				.66172	111
				.68470	112
				.70720	113
				.72917	114

SA 72-77

1. The SA 72-77 mortality table is based upon data collected by the Actuarial Society of South Africa for a continuous investigation into the mortality of assured lives in the Republic of South Africa and South West Africa.

The data are predominantly in respect of white male lives. Some contributors could not distinguish between male and female lives for the purposes of their return; the female content of the data is, however, estimated to be less than 2% of the total return.

The data relates to policies, not lives assured. Policies accepted after a medical examination and those accepted on a non-medical basis are included in the investigation. The following types of policies are specifically excluded from the investigation:

- (i) reassurances from other offices
 - (ii) policies issued subject to a loading
 - (iii) assurance policies effected by exercising an option
 - (iv) policies issued as a result of "back-to-back" arrangements with immediate annuities
 - (v) double endowments
 - (vi) policies with a sum assured of less than R200
 - (vii) policies not issued in the Rand currency area
 - (viii) joint life policies where the respective ages are not known
2. The method used in the investigation was the census method, adjusted so as to become in effect a policy year method. This is the same method as was used in the SA 56-62 investigation.

The volume of the data is as follows:

	Duration 0		Duration 1		Duration 2		Duration 3+	
	Exposed	Deaths	Exposed	Deaths	Exposed	Deaths	Exposed	Deaths
Medical	243 231	475	219 255	487	195 123	524	2 271 740	26 848
Non-Medical	606 392	1202	496 270	1021	430 997	922	4 160 592	24 154
TOTAL	849 623	1677	715 525	1508	626 120	1446	6 432 332	51 002

3. For total ultimate data (i.e. medical and non-medical combined at duration 3+) the values of q_x are given by the formula:

$$\frac{q_x}{p_x} = BC^x + De^{-E(\ln x - \ln F)^2}$$

where $B = 0,00007823$
 $C = 1,09620502$
 $D = 0,00174152$
 $E = 21,95157259$
 $F = 20,14277238$

The SA 72-77 table has a select period of three years. The select rates of mortality were derived as follows:

For $y < 30$ the following formula was used:

$$\frac{q_{(x)+t}}{p_{(x)+t}} = KBC^y + De^{-E(\ln y - \ln F)^2}$$

where $y = (x) + t$

$y < 30$:

t	0	1	2
K	0,8977307	0,91960052	0,9536428
B	0,00007823	*	*
C	1,09620502	*	*

* As for ultimate rates

For $y \geq 30$ the following formula was used:

$$\frac{q_{(x)+t}}{p_{(x)+t}} = BC^y + De^{-E(\ln y - \ln F)^2}$$

where $y = (x) + t$

$y \geq 30$:

t	0	1	2
B	0,0001338	0,0001187	0,00009906
C	1,07290250	1,07805800	1,08589312

D, E and F remain unchanged throughout.

SA 72-77

Age (x)	$l(x)$	$l(x) + 1$	$l(x) + 2$	$l(x) + 3$	Age $x + 3$
				999999	15
				999431	16
				998548	17
15	999923	999386	998531	997253	18
16	999348	998500	997234	995533	19
17	998456	997199	995512	993482	20
18	997153	995474	993460	991271	21
19	995424	993419	991247	989081	22
20	993363	991201	989054	987049	23
21	991141	989005	987020	985246	24
22	988938	986966	985213	983675	25
23	986892	985154	983639	982297	26
24	985074	983574	982258	981052	27
25	983487	982188	981010	979878	28
26	982092	980932	979831	978718	29
27	980827	979746	978667	977528	30
28	979631	978574	977473	976275	31
29	978436	977359	976202	974931	32
30	977187	976056	974838	973476	33
31	975840	974656	973360	971892	34
32	974390	973137	971751	970164	35
33	972814	971481	969994	968276	36
34	971093	969669	968072	966212	37
35	969208	967687	965970	963955	38
36	967144	965516	963670	961488	39
37	964880	963138	961153	958791	40
38	962398	960534	958401	955844	41
39	959677	957684	955391	952624	42
40	956695	954564	952101	949107	43
41	953430	951151	948506	945268	44
42	949854	947418	944579	941078	45
43	945939	943337	940290	936507	46
44	941656	938878	935609	931523	47
45	936973	934008	930503	926092	48
46	931854	928691	924935	920176	49
47	926263	922890	918868	913736	50
48	920160	916566	912261	906731	51
49	913502	909675	905070	899116	52
50	906245	902174	897252	890846	53
51	898342	894013	888758	881871	54
52	889743	885145	879538	872142	55
53	880394	875515	869539	861605	56
54	870243	865070	858708	850207	57
55	859235	853757	846992	837894	58
56	847310	841517	834333	824610	59
57	834411	828294	820675	810301	60
58	820481	814030	805965	794913	61
59	805462	798672	790148	778396	62
60	789298	782163	773171	760700	63
61	771938	764457	754990	741785	64

SA 72-77

Age (x)	l_x	l_{x+1}	l_{x+2}	l_{x+3}	Age $x+3$
62	753334	745506	735564	721614	65
63	733445	725275	714857	700160	66
64	712237	703732	692847	677406	67
65	689689	680860	669521	653349	68
66	665790	656654	644880	628000	69
67	640547	631126	618943	601390	70
68	613984	604306	591749	573570	71
69	586146	576244	563357	544613	72
70	557101	547016	533851	514618	73
71	526947	516726	503343	483713	74
72	495803	485500	471972	452051	75
73	463827	453501	439908	419818	76
74	431202	420919	407350	387228	77
75	398143	387975	374525	354520	78
76	364894	354914	341686	321958	79
77	331727	322012	309110	289826	80
78	298931	289558	277090	258419	81
79	266815	257860	245930	228039	82
80	235691	227224	215932	198980	83
				171521	84
				145914	85
				122372	86
				101060	87
				82085,0	88
				65488,6	89
				51251,4	90
				39287,6	91
				29455,1	92
				21564,2	93
				15390,5	94
				10689,9	95
				7213,06	96
				4719,35	97
				2988,38	98
				1827,80	99
				1077,68	100
				611,275	101
				332,864	102
				173,648	103
				86,6038	104
				41,2049	105
				18,6635	106
				8,03084	107
				3,27609	108
				1,26442	109
				0,460789	110
				0,158248	111
				0,051118	112
				0,015503	113
				0,004406	114
				0,001172	115

SA 72-77

7 6/10/77
0.000988 2
2.000000 22

Age (x)	q(x)	q(x) + 1	q(x) + 2	q _x + 3	Age x + 3
				.00057	15
				.00816	16
				.00130	17
15	.00054	.00086	.00128	.00172	18
16	.00085	.00127	.00171	.00206	19
17	.00126	.00169	.00204	.00223	20
18	.00168	.00202	.00220	.00221	21
19	.00201	.00219	.00218	.00205	22
20	.00218	.00217	.00203	.00183	23
21	.00216	.00201	.00180	.00159	24
22	.00199	.00178	.00156	.00140	25
23	.00176	.00154	.00136	.00127	26
24	.00152	.00134	.00123	.00120	27
25	.00132	.00120	.00115	.00118	28
26	.00118	.00112	.00114	.00122	29
27	.00110	.00110	.00116	.00128	30
28	.00108	.00113	.00123	.00138	31
29	.00110	.00118	.00130	.00149	32
30	.00116	.00125	.00140	.00163	33
31	.00121	.00133	.00151	.00178	34
32	.00129	.00142	.00163	.00195	35
33	.00137	.00153	.00177	.00213	36
34	.00147	.00165	.00192	.00234	37
35	.00157	.00177	.00209	.00256	38
36	.00168	.00191	.00226	.00281	39
37	.00181	.00206	.00246	.00307	40
38	.00194	.00222	.00267	.00337	41
39	.00208	.00239	.00290	.00369	42
40	.00223	.00258	.00314	.00404	43
41	.00239	.00278	.00341	.00443	44
42	.00256	.00300	.00371	.00486	45
43	.00275	.00323	.00402	.00532	46
44	.00295	.00348	.00437	.00583	47
45	.00316	.00375	.00474	.00639	48
46	.00339	.00404	.00515	.00700	49
47	.00364	.00436	.00558	.00767	50
48	.00391	.00470	.00606	.00840	51
49	.00419	.00506	.00658	.00920	52
50	.00449	.00546	.00714	.01007	53
51	.00482	.00588	.00775	.01103	54
52	.00517	.00633	.00841	.01208	55
53	.00554	.00683	.00912	.01323	56
54	.00594	.00735	.00990	.01448	57
55	.00637	.00792	.01074	.01585	58
56	.00684	.00854	.01165	.01735	59
57	.00733	.00920	.01264	.01899	60
58	.00786	.00991	.01371	.02078	61
59	.00843	.01067	.01487	.02273	62
60	.00904	.01150	.01613	.02487	63
61	.00969	.01238	.01749	.02719	64

SA 72-77

Age (x)	$q(x)$	$q(x) + 1$	$q(x) + 2$	$q_x + 3$	Age $x + 3$
62	.01039	.01334	.01896	.02973	65
63	.01114	.01436	.02056	.03250	66
64	.01194	.01547	.02229	.03551	67
65	.01280	.01665	.02415	.03880	68
66	.01372	.01793	.02617	.04237	69
67	.01471	.01930	.02836	.04626	70
68	.01576	.02078	.03072	.05049	71
69	.01689	.02236	.03327	.05508	72
70	.01810	.02407	.03603	.06005	73
71	.01940	.02590	.03900	.06546	74
72	.02078	.02786	.04221	.07130	75
73	.02226	.02997	.04567	.07763	76
74	.02385	.03224	.04940	.08447	77
75	.02554	.03467	.05341	.09185	78
76	.02735	.03727	.05774	.09980	79
77	.02929	.04007	.06239	.10837	80
78	.03136	.04306	.06738	.11756	81
79	.03356	.04626	.07275	.12743	82
80	.03592	.04970	.07851	.13800	83
				.14929	84
				.16134	85
				.17416	86
				.18776	87
				.20219	88
				.21740	89
				.23343	90
				.25027	91
				.26790	92
				.28629	93
				.30542	94
				.32525	95
				.34572	96
				.36678	97
				.38836	98
				.41039	99
				.43279	100
				.45546	101
				.47832	102
				.50127	103
				.52421	104
				.54706	105
				.56970	106
				.59206	107
				.61405	108
				.63557	109
				.65657	110
				.67698	111
				.69673	112
				.71578	113
				.73409	114