

Continuous Mortality Investigation
Mortality sub-committee
Working Paper 8
Considerations for the Graduation of the
CMI 1999-2002 Mortality Experience

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CMIB Mortality Graduation Working Party
Working Paper 8
Considerations for the Graduation of the 1999-2002 Mortality Experience

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Considerations for the Graduation of the CMI 1999-2002 Mortality Experience

Executive Summary

The Mortality Sub-Committee has decided that a new set of standard mortality tables, to be based on the 1999-2002 experience, should be produced. A Working Party has been set up to carry out the graduation of the new tables, to be designated the “00” Series. The members of this Working Party are Angus Macdonald (chairman), John Ellam, Richard Willets, Adrian Gallop, Joanne Wells, Simon Spencer and David Wilkie. Another Working Party is looking at the problem of how the annuitant and pensioner graduations should be projected into the future.

The first task for the graduation Working Party is to decide what tables should be produced, given the available data. This Working Paper sets out the Working Party’s initial findings and seeks feedback from the profession.

The previous set of standard tables, the “92” Series (based on the 1991-1994 experience), comprised:

Table	Investigation	Sex	Lives / Amounts	Select Period
AM92	Assured Lives	Male	Lives	2
AF92	Assured Lives	Female	Lives	2
TM92	Temporary Assured Lives	Male	Lives	5
TF92	Temporary Assured Lives	Female	Lives	5
IMA92	Immediate Annuitants	Male	Amounts	1
IML92	Immediate Annuitants	Male	Lives	1
IFA92	Immediate Annuitants	Female	Amounts	1
IFL92	Immediate Annuitants	Female	Lives	1
PMA92	Life Office Pensioners (normal/late)	Male	Amounts	None
PML92	Life Office Pensioners (normal/late)	Male	Lives	None
PFA92	Life Office Pensioners (normal/late)	Female	Amounts	None
PFL92	Life Office Pensioners (normal/late)	Female	Lives	None
RMV92	Retirement Annuitants (vested)	Male	Lives	None
RFV92	Retirement Annuitants (vested)	Female	Lives	None
WA92	Widows of Life Office Pensioners	Female	Amounts	None
WL92	Widows of Life Office Pensioners	Female	Lives	None

In addition, the following tables were graduated, although they were not designated as standard:

Table	Investigation	Sex	Lives / Amounts	Select Period
PCMA92	Life Office Pensioners (normal/late & early combined)	Male	Amounts	None
PCML92	Life Office Pensioners (normal/late & early combined)	Male	Lives	None
PCFA92	Life Office Pensioners (normal/late & early combined)	Female	Amounts	None
PCFL92	Life Office Pensioners (normal/late & early combined)	Female	Lives	None
RMD92	Retirement Annuitants (in deferment)	Male	Lives	None
RFD92	Retirement Annuitants (in deferment)	Female	Lives	None
RMC92	Retirement Annuitants (in deferment & vested combined)	Male	Lives	None
RFC92	Retirement Annuitants (in deferment & vested combined)	Female	Lives	None

This provides a starting point, and the Working Party believes that there should be good reasons for departing from this list for the new graduations.

The Working Paper has been split into three broad groupings: Assured Lives, Pensioners and Annuitants, and each is described in its own section of this paper. Each of these sections is prefaced by a “summary of issues” and the Working Party particularly asks for feedback on these sections, which can be found on the following pages.

Assured lives: Page 5
Pensioners: Page 65
Annuitants: Page 94

The Working Party notes that the availability and suitability of data is only part of the problem – the practical use of any tables produced must also be considered. This leads to two broad questions:

1. Are any of the tables we propose to produce of no practical use? For example, given the low volumes of data and, presumably, business is there a need for the IM/IF tables? Given that, at the ultimate durations, the Assured Lives and Temporary Assurances are so similar is there a need for an Assured Lives table?
2. Would there be a demand for tables from any of the experiences that we do not propose to graduate?

A draft version of this Working Paper was published in May 2004, and this provided a framework for discussion at a seminar held at Staple Inn on 4 June 2004. Written responses were also welcomed.

(i) Assured Lives Investigations

Summary issues for the Assured Lives Investigations

- We believe graduated tables for Permanent Assurances (Investigation 01) and Temporary Assurances (Investigation 02) should be produced. These would be of most use to practitioners, and improvements since the “92” Series would justify new tables.
- Low data volumes, at early durations in particular, may cause some practical problems.
- We do not feel that the other assured lives investigations should be considered further for graduation. In some cases this is due to low data volumes, but mainly we do not think there is a particular demand for such tables.
- We believe there would be considerable merit in producing separate tables for smoker and non-smoker sections (as well as the aggregate table) for each of the investigations.
- There is some evidence that Investigations 01 and 02 could be combined into one aggregate graduation for the ultimate duration. Select durations are significantly different, though.
- The observed select effects point to a two-year select period for Investigation 01 and a five-year select period for Investigation 02, as was the case with the “92” Series tables.
- We feel that production of select durations would be expected. However, low data volumes could make this difficult. We have suggested an alternative approach to produce mortality rates for the select durations.

Note

For the avoidance of doubt, the term “combined” when referring to smoker statuses includes **all** data received, whether smoker, non-smoker or undifferentiated. It therefore contains more data than simply adding the smoker and non-smoker sections together.

Investigation 01 – Permanent Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Deaths ≥ 10
0	47,633.0	44	147	17-76	no ages
1	64,948.0	107	209	17-78	no ages
2	79,879.0	157	270	18-79	no ages
3	87,121.0	204	336	19-80	71-72
4	99,292.0	254	357	20-81	77-79
5+	1,307,622.5	3,628	2,165	11-93	38-94
2+	1,573,914.5	4,243	3,128	10-93	33-94
0+	1,686,495.5	4,394	3,484	10-93	33-94

Females, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Deaths ≥ 10
0	12,728.5	32	87	20-63	no ages
1	17,857.0	70	125	20-70	single ages
2	21,654.5	103	166	21-72	71-78
3	23,120.5	127	165	22-73	61-74
4	24,892.5	123	203	23-74	65-75
5+	313,112.5	1,761	1,067	22-87	29-99
2+	382,780.0	2,114	1,601	19-87	28-99
0+	413,365.5	2,216	1,813	17-87	28-99

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Deaths ≥ 10
0	103,864.0	89	360	16-77	no ages
1	156,360.7	245	530	16-80	single ages
2	196,431.8	369	717	17-81	71-78
3	210,402.4	500	841	16-81	61-74
4	228,235.8	565	956	17-84	65-75
5+	3,490,745.1	12,589	9,552	10-98	29-99
2+	4,125,815.1	14,023	12,066	10-98	28-99
0+	4,386,039.8	14,357	12,956	10-98	28-99

Males, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	46,094.5	62	192	16-75	no ages
1	62,373.0	132	282	17-77	67
2	75,896.0	220	337	18-78	68-69
3	81,314.0	239	379	19-79	single ages
4	90,198.0	267	477	20-80	69-71
5+	1,496,980.5	5,018	3,701	11-92	32-90
2+	1,744,388.5	5,744	4,894	10-92	29-90
0+	1,852,856.0	5,938	5,368	10-92	27-90

Males, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	13,905.5	42	129	19-62	no ages
1	18,694.0	82	171	19-68	no ages
2	22,123.0	122	211	20-71	no ages
3	23,003.0	154	192	21-73	68-69
4	23,474.0	183	222	22-74	64, 69
5+	419,852.0	2,827	2,334	22-86	40-87
2+	488,452.0	3,286	2,959	19-86	39-87
0+	521,051.5	3,410	3,259	17-86	39-87

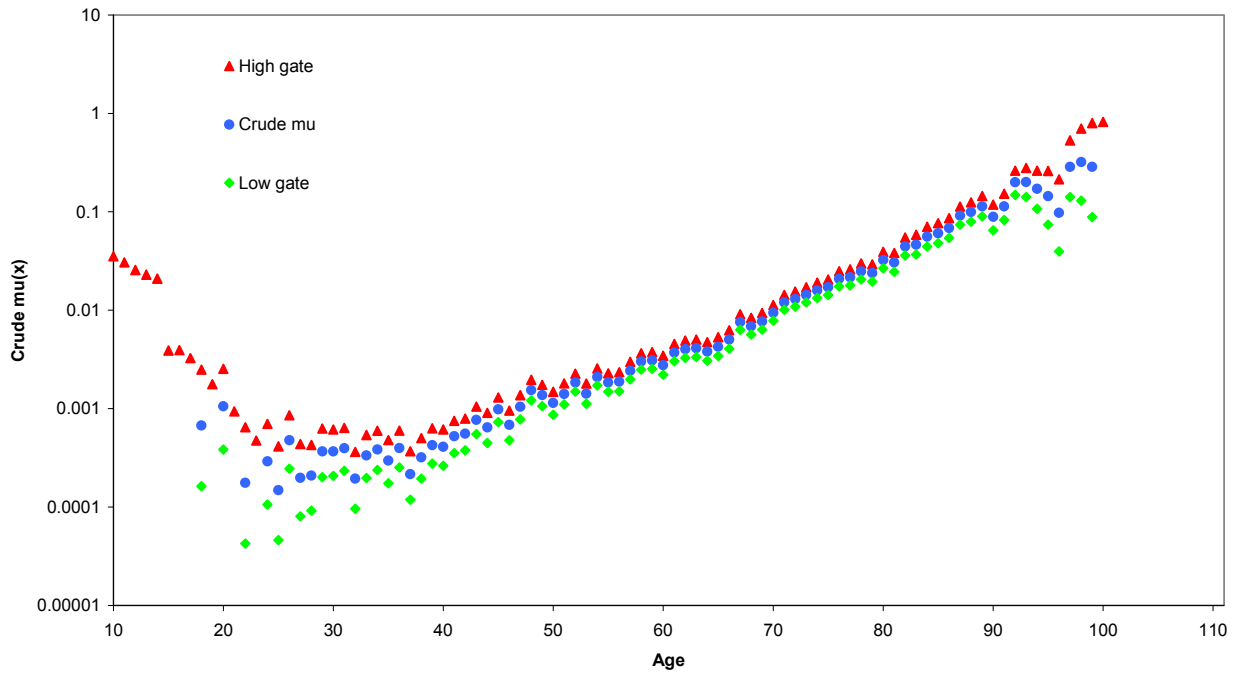
Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	106,050.1	165	578	16-76	no ages
1	161,467.4	346	840	16-78	66-69
2	203,791.8	515	1,026	17-79	64-72
3	216,722.8	647	1,207	18-80	66-78
4	228,779.6	732	1,418	19-81	51-81
5+	7,377,916.2	40,750	46,418	10-100	26-100
2+	8,027,210.4	42,644	50,069	10-100	24-100
0+	8,294,727.9	43,155	51,487	10-100	24-100

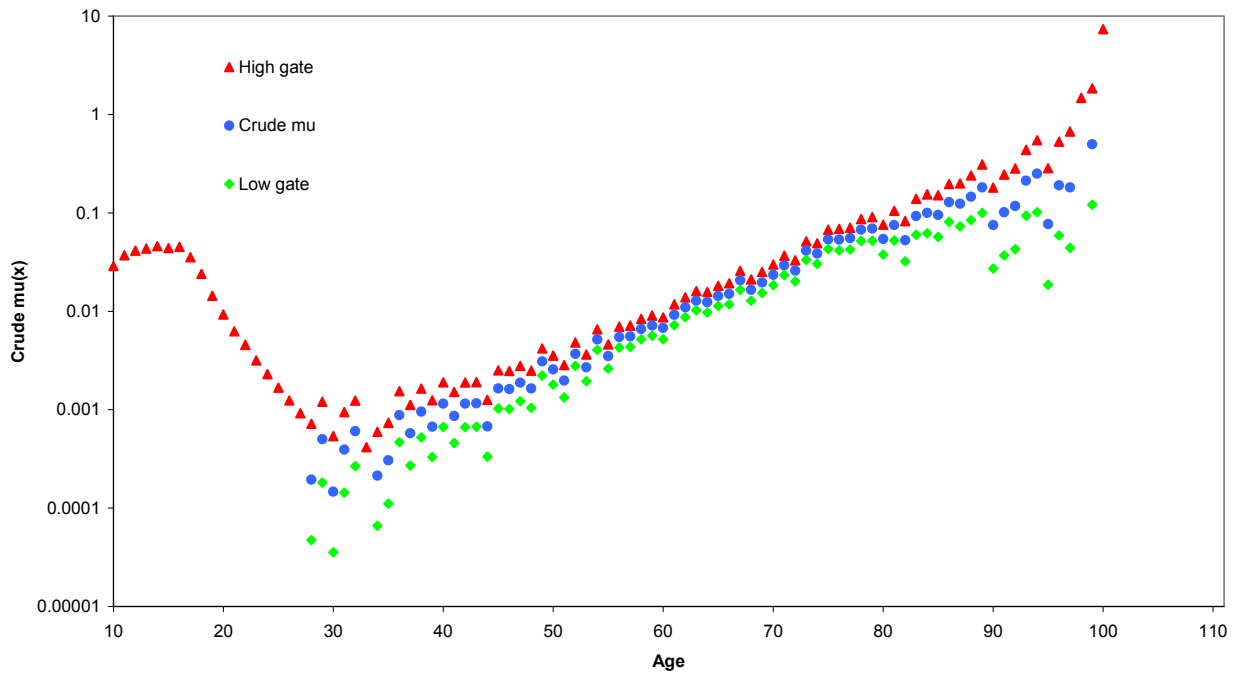
Data volumes at durations 5+ are plentiful, but less so at earlier durations – particularly for the smoker and non-smoker subsections. The above tables show the large falls in data volumes at earlier durations since the previous quadrennium. All sections of the data could therefore be candidates for graduation, though early durations could be problematic.

Crude mortality rates

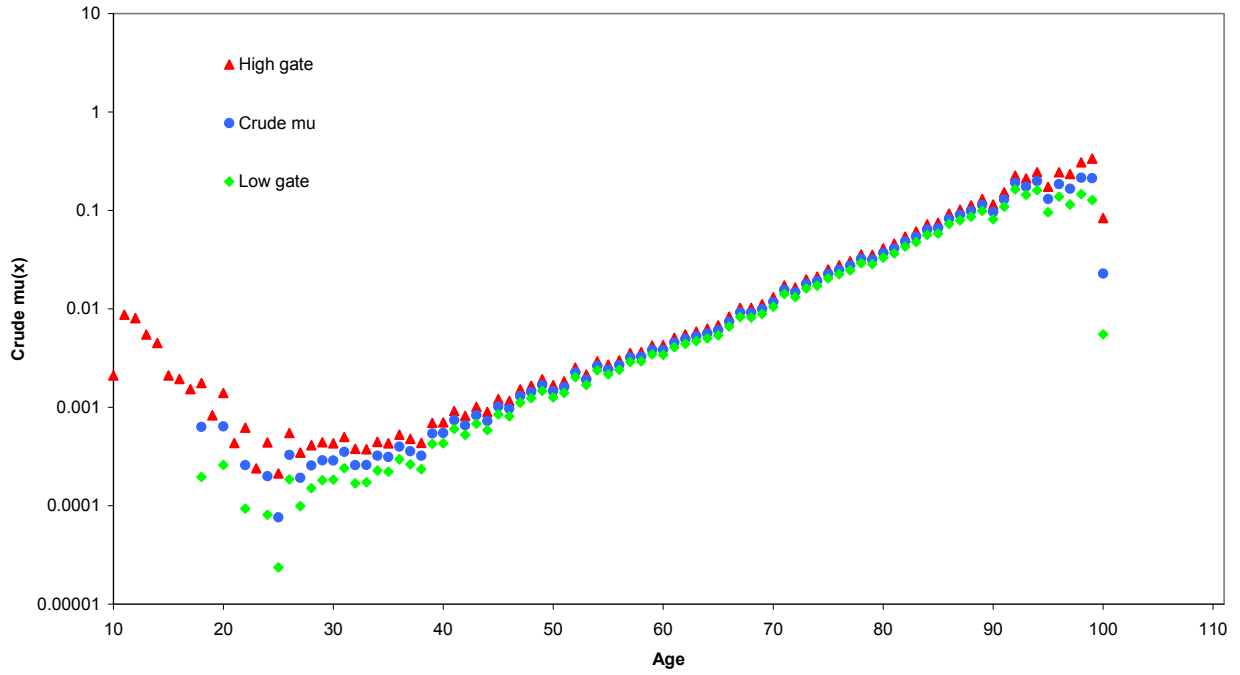
Crude Mu and Low and High Gates for Permanent Assurances, Females: Non-smokers



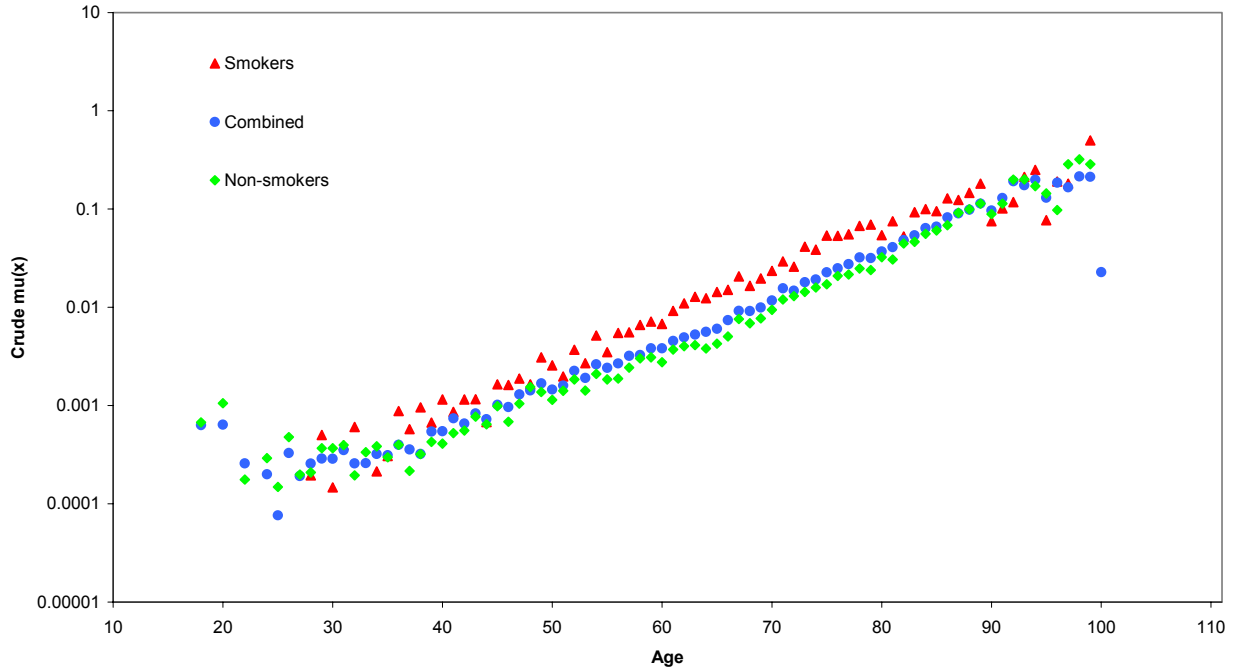
Crude Mu and Low and High Gates for Permanent Assurances, Females: Smokers



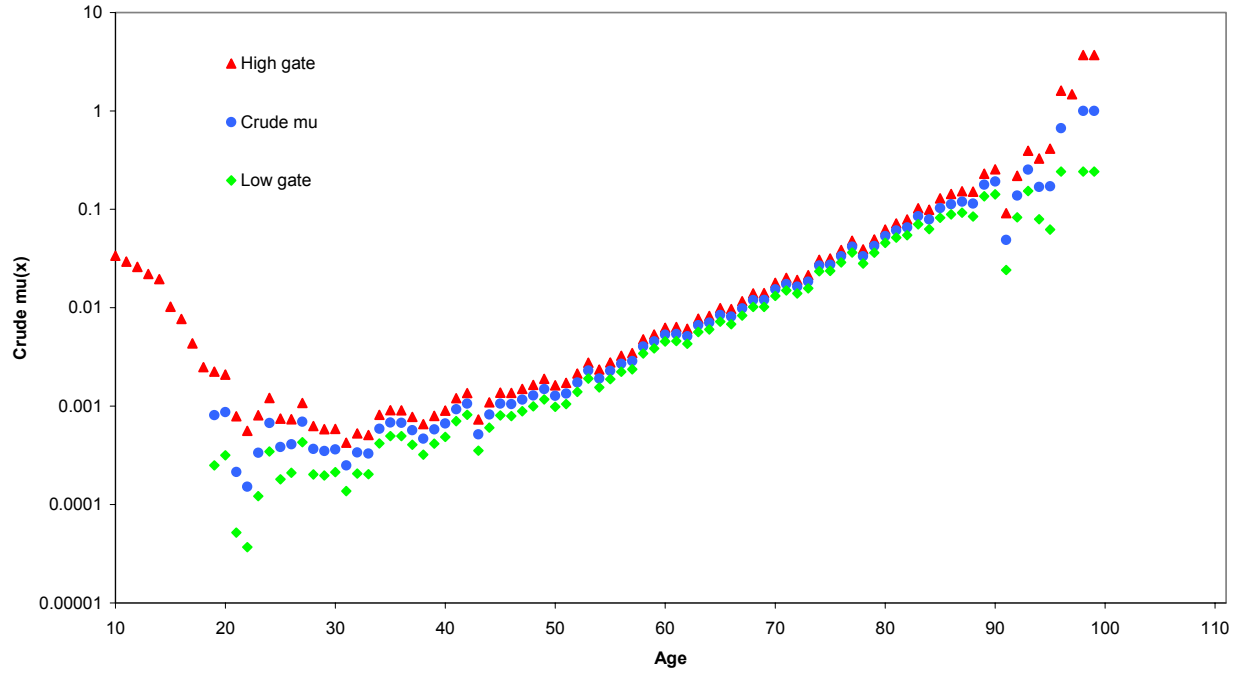
Crude Mu and Low and High Gates for Permanent Assurances, Females: Combined



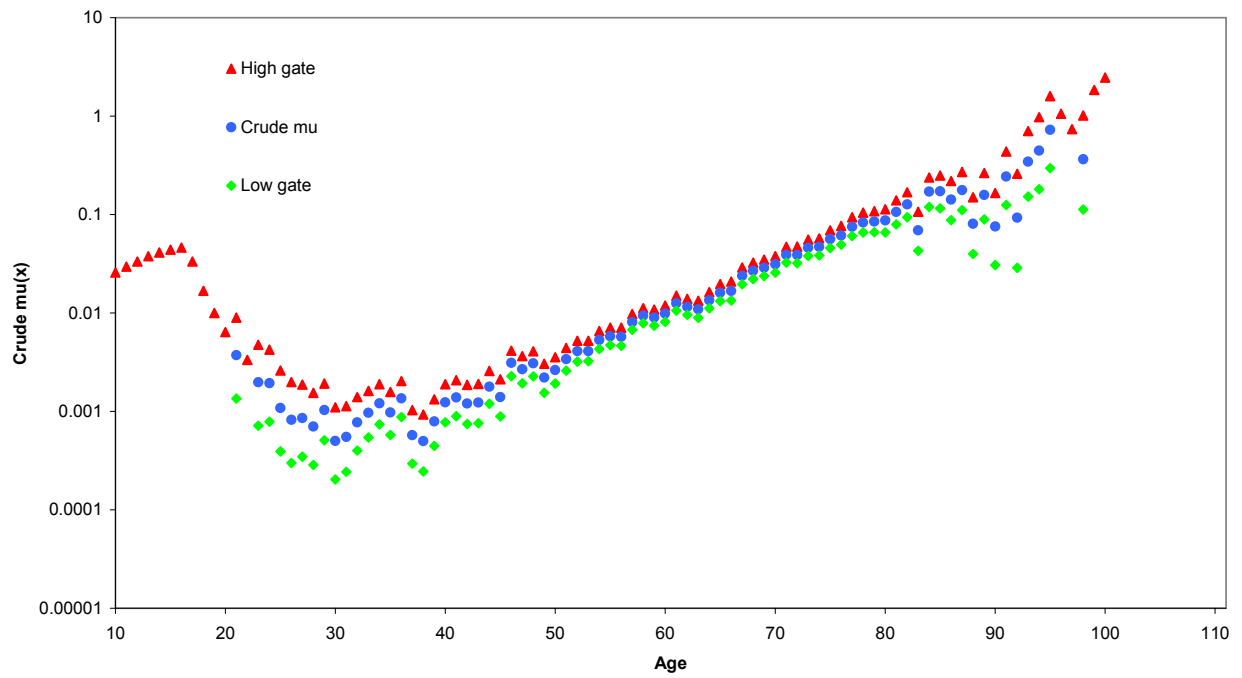
Crude Mu for Permanent Assurances, Females: Comparison of Smokers, Non-smokers and Combined



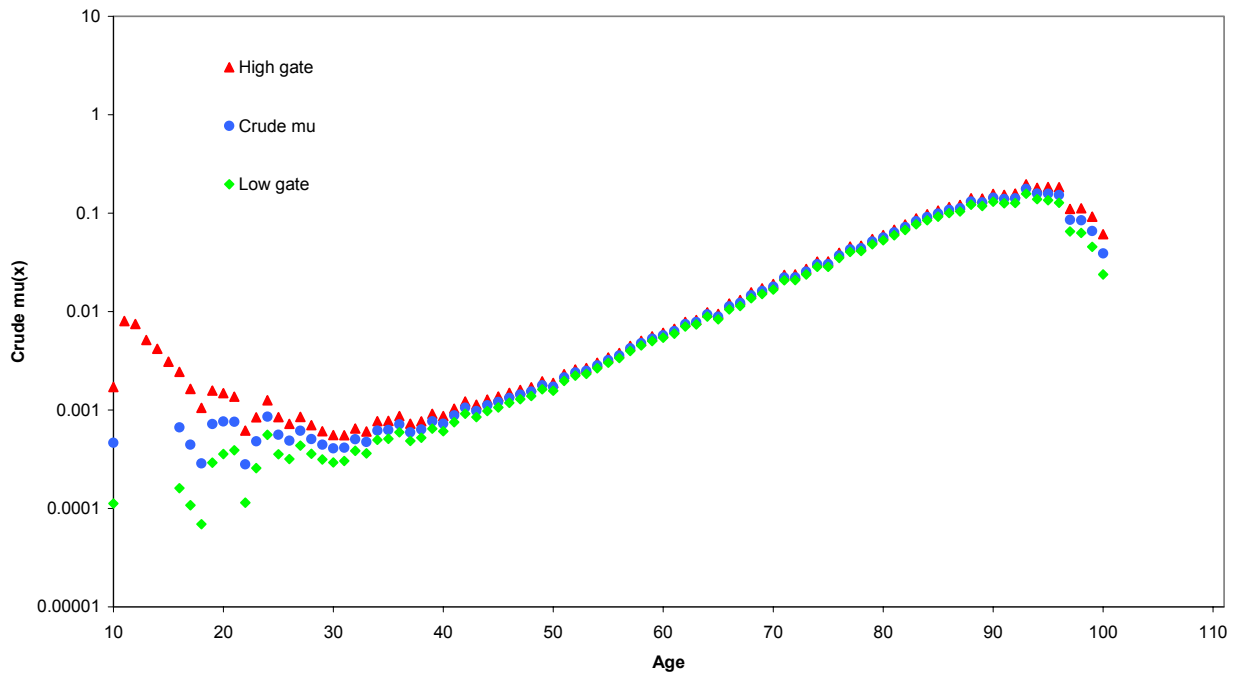
Crude Mu and Low and High Gates for Permanent Assurances, Males: Non-smokers



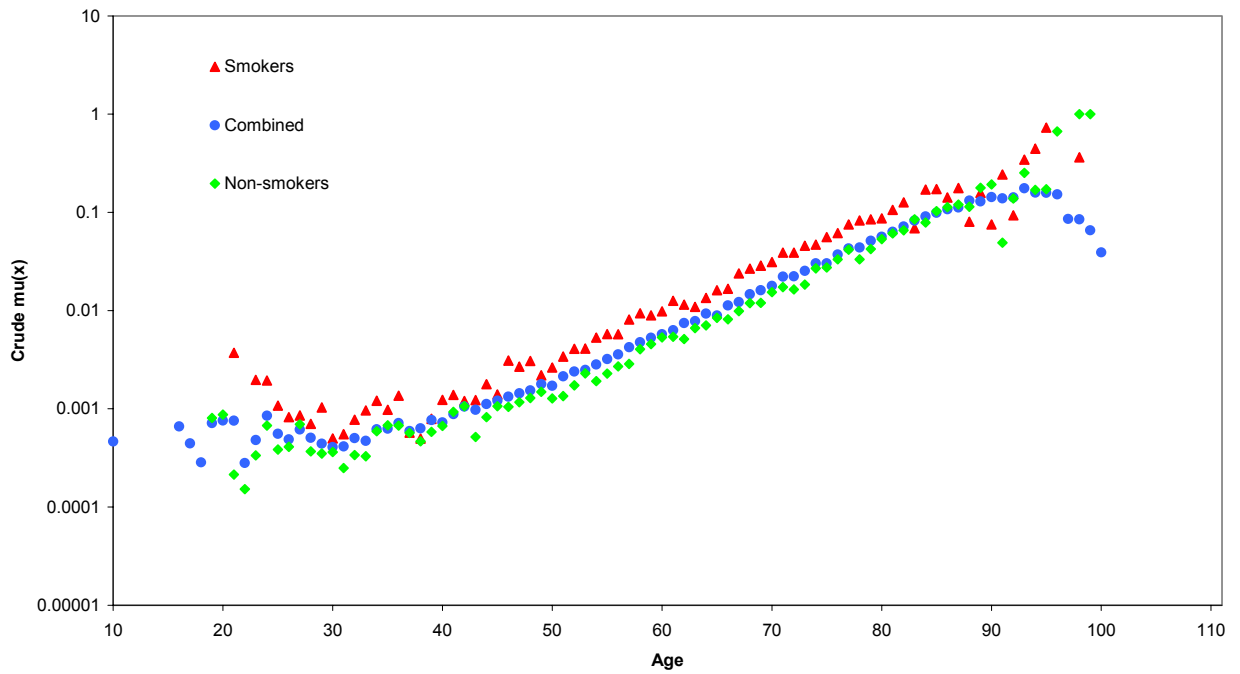
Crude Mu and Low and High Gates for Permanent Assurances, Males: Smokers



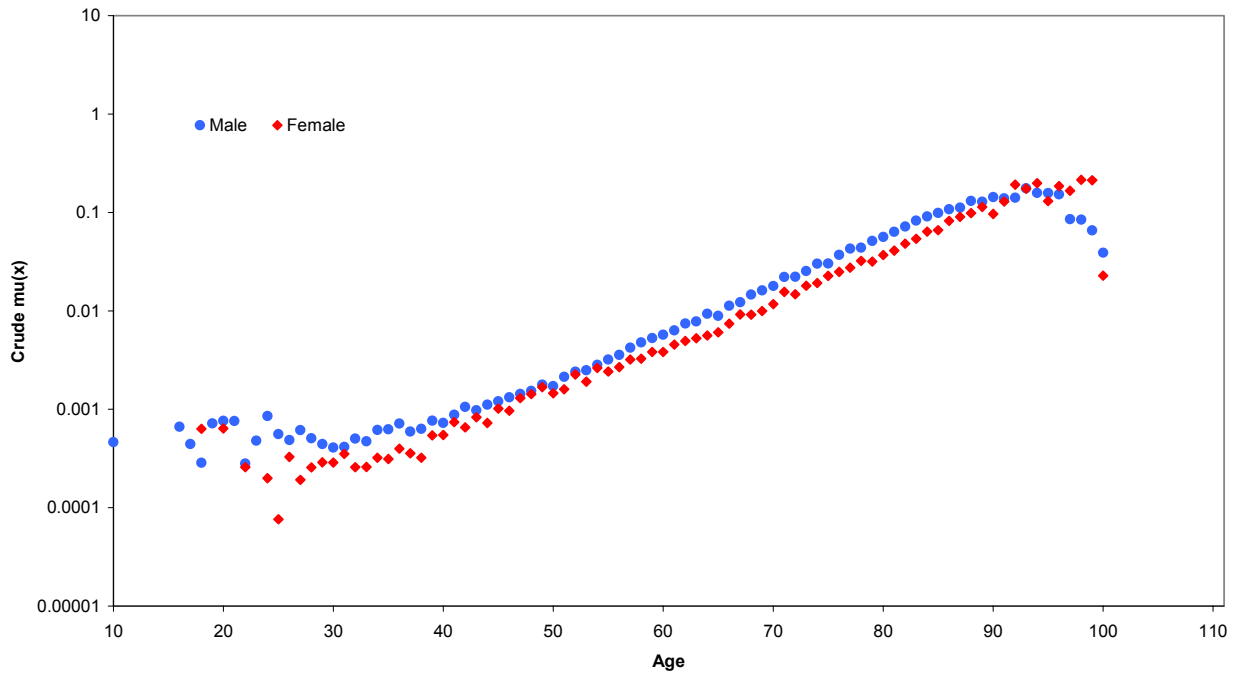
Crude Mu and Low and High Gates for Permanent Assurances, Males: Combined



Crude Mu for Permanent Assurances, Males: Comparison of Smokers, Non-smokers and Combined



Crude Mu for Permanent Assurances, Combined: Comparison of Males and Females



The above graphs are based on all durations combined and show crude values of μ_x , i.e. before any graduations are carried out. The “gates” shown on the Lives graphs are 2½% and 97½% lower and upper confidence limits of the crude values of μ_x . It should also be borne in mind that a log scale is used on the y-axis. A number of features are revealed:

- “Sensible” looking progressions of crude rates where the bulk of the data lies, i.e. from about ages 30-40 to about ages 80-90. The graduated rates at these ages are likely to correspond closely to the crude rates.
- Sparse data and unusual features at the extremes of age. A greater degree of subjectivity will be needed where the data is less credible.
- Clear differentials between smoker, non-smoker and aggregate data.
- Clear differentials between male and female data.

Comparison of 1999-2002 experience with “92” Series tables

Investigation 01, Females, Non-smokers, comparison basis AF92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	842	56	-	87	59
21	-	-	-	57	87	42	70
22	-	-	108	58	90	-	79
23	-	-	-	59	82	232	69
24	808	-	103	60	-	-	60
25	-	-	74	61	-	32	73
26	-	332	194	62	54	28	71
27	-	-	86	63	58	117	63
28	-	-	84	64	-	91	54
29	-	-	136	65	53	148	53
30	352	391	92	66	189	166	54
31	314	-	116	67	167	156	76
32	-	-	57	68	113	57	65
33	-	-	90	69	-	177	64
34	-	-	95	70	189	207	68
35	-	-	68	71	-	128	84
36	-	-	83	72	-	100	82
37	-	-	42	73	-	36	83
38	-	-	56	74	185	188	78
39	-	-	69	75	59	267	76
40	-	-	61	76	143	142	85
41	-	-	71	77	-	82	82
42	-	113	66	78	-	51	85
43	-	-	87	79	-	138	73
44	-	97	64	80	123	121	89
45	166	-	90	81	-	152	75
46	-	86	57	82	-	295	98
47	277	248	72	83	-	-	93
48	-	-	109	84	-	-	102
49	123	-	87	85	-	-	99
50	-	62	66	86	-	-	101
51	178	-	73	87	-	-	121
51	233	41	85	88	-	-	119
53	76	121	59	89	1,436	-	119
54	89	121	79	90	-	-	87
55	85	91	63	All	77	98	77

Investigation 01, Females, Smokers, comparison basis AF92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	264	-	174
21	-	-	-	57	-	263	158
22	-	-	-	58	-	283	169
23	-	-	-	59	-	-	171
24	-	-	-	60	428	135	139
25	-	-	-	61	657	310	166
26	-	-	-	62	222	223	188
27	-	-	-	63	195	112	202
28	-	-	83	64	-	427	169
29	-	-	192	65	-	-	188
30	-	-	52	66	-	207	175
31	2,410	-	43	67	270	914	197
32	-	-	179	68	246	265	152
33	-	-	-	69	-	452	162
34	-	-	53	70	817	113	173
35	-	-	70	71	-	466	198
36	-	-	186	72	-	368	159
37	-	-	112	73	323	802	220
38	-	-	170	74	470	458	188
39	-	-	109	75	363	585	237
40	905	-	158	76	464	-	222
41	-	-	118	77	1,382	259	194
42	-	-	144	78	1,174	319	219
43	-	385	121	79	-	-	209
44	638	-	60	80	-	596	144
45	-	309	148	81	-	-	183
46	1,054	-	124	82	-	-	117
47	-	259	140	83	-	-	184
48	-	-	118	84	-	-	177
49	-	208	196	85	-	-	152
50	299	352	137	86	-	-	184
51	-	282	98	87	-	-	160
51	270	267	169	88	-	-	170
53	-	260	112	89	-	-	188
54	279	141	198	90	-	-	74
55	269	547	111	All	232	255	167

Investigation 01, Females, Combined, comparison basis AF92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	502	411	56	79	37	85
21	-	-	-	57	42	74	91
22	-	-	168	58	44	81	84
23	-	-	-	59	42	144	88
24	358	-	84	60	105	78	80
25	-	-	40	61	125	97	86
26	-	137	143	62	63	73	86
27	-	-	85	63	66	125	81
28	-	97	97	64	-	145	79
29	-	-	108	65	62	98	77
30	315	164	79	66	118	117	85
31	426	75	95	67	138	250	92
32	-	-	76	68	106	67	86
33	-	65	67	69	-	202	83
34	-	63	78	70	239	154	88
35	-	-	71	71	-	157	108
36	-	-	84	72	-	152	92
37	-	-	69	73	39	131	101
38	-	-	57	74	166	173	96
39	-	49	86	75	79	250	102
40	190	95	76	76	154	93	103
41	-	-	100	77	201	110	102
42	-	84	79	78	91	66	108
43	81	41	92	79	-	87	97
44	77	77	72	80	91	235	100
45	72	71	92	81	-	221	100
46	209	101	78	82	-	238	106
47	254	192	94	83	-	-	108
48	-	29	100	84	-	197	115
49	53	52	106	85	-	-	108
50	44	71	83	86	-	336	120
51	157	115	81	87	-	-	119
51	146	101	105	88	-	-	117
53	37	136	80	89	1,231	-	121
54	81	88	101	90	-	-	95
55	80	188	82	All	84	112	94

Investigation 01, Males, Non-smokers, comparison basis AM92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	233	56	48	25	58
21	-	-	50	57	-	24	55
22	-	-	33	58	-	113	67
23	-	-	71	59	-	93	68
24	-	-	140	60	116	-	71
25	-	-	79	61	37	56	64
26	-	-	84	62	44	18	55
27	160	205	116	63	79	65	62
28	-	269	52	64	34	95	58
29	-	-	69	65	76	65	63
30	-	-	69	66	-	36	57
31	-	-	46	67	99	117	55
32	-	-	61	68	59	35	65
33	-	-	57	69	34	42	58
34	130	242	85	70	62	97	65
35	-	-	107	71	109	72	66
36	126	77	96	72	102	126	54
37	116	81	76	73	122	35	57
38	-	-	63	74	70	45	75
39	-	152	68	75	110	81	68
40	-	-	78	76	230	129	72
41	-	-	100	77	56	105	84
42	-	358	96	78	-	-	62
43	112	-	45	79	76	137	69
44	226	68	63	80	199	-	80
45	197	278	70	81	-	110	82
46	-	-	71	82	-	-	80
47	-	114	68	83	-	-	93
48	86	54	68	84	-	-	79
49	76	94	70	85	-	-	93
50	-	82	54	86	-	-	92
51	-	34	52	87	-	-	90
51	99	55	58	88	-	-	79
53	50	112	68	89	-	-	109
54	53	28	52	90	-	-	107
55	48	56	54	All	61	68	67

Investigation 01, Males, Smokers, comparison basis AM92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	227	71	121
21	-	1,075	775	57	-	247	151
22	-	-	-	58	158	74	158
23	-	1,461	164	59	315	319	129
24	-	-	460	60	191	-	131
25	-	494	170	61	98	-	152
26	-	-	188	62	138	141	120
27	471	360	95	63	301	66	101
28	-	-	153	64	295	74	110
29	482	285	152	65	136	146	119
30	-	-	99	66	-	179	110
31	-	-	105	67	279	158	138
32	-	-	142	68	-	93	144
33	-	578	138	69	110	59	138
34	435	278	176	70	223	156	130
35	925	-	132	71	-	209	147
36	-	297	196	72	345	163	130
37	867	-	62	73	162	160	139
38	-	-	68	74	-	146	129
39	-	245	91	75	192	74	139
40	-	-	145	76	-	255	135
41	-	-	150	77	-	93	151
42	-	252	112	78	549	307	143
43	-	-	112	79	437	-	137
44	-	224	141	80	-	261	126
45	-	-	105	81	-	-	140
46	-	-	210	82	-	-	150
47	310	-	159	83	-	-	76
48	-	-	169	84	-	-	163
49	-	138	105	85	-	-	150
50	197	253	107	86	-	-	114
51	172	316	123	87	-	-	129
51	145	251	135	88	-	-	56
53	-	76	126	89	-	-	98
54	-	286	140	90	-	-	45
55	284	144	135	All	143	143	131

Investigation 01, Males, Combined, comparison basis AM92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	210	56	97	65	75
21	169	108	139	57	89	72	79
22	-	92	49	58	51	63	80
23	143	164	71	59	49	104	78
24	114	-	176	60	110	80	76
25	-	113	106	61	54	25	75
26	-	94	93	62	85	64	78
27	210	161	99	63	137	88	72
28	62	211	80	64	84	91	77
29	191	66	74	65	67	62	66
30	-	66	74	66	32	55	76
31	-	63	73	67	114	109	71
32	57	-	89	68	50	70	78
33	-	93	77	69	69	73	76
34	109	119	95	70	71	69	76
35	103	60	95	71	81	79	84
36	52	116	102	72	119	103	75
37	153	88	79	73	93	57	78
38	100	58	81	74	42	69	83
39	-	169	91	75	89	89	75
40	-	28	83	76	184	128	82
41	50	55	92	77	33	92	86
42	47	214	98	78	84	53	79
43	91	52	85	79	95	126	84
44	92	74	89	80	166	56	83
45	128	149	85	81	189	114	85
46	82	88	86	82	-	-	87
47	154	83	84	83	364	-	90
48	35	38	82	84	-	-	90
49	62	84	84	85	-	-	89
50	54	75	73	86	-	-	88
51	68	89	81	87	-	-	84
51	83	81	81	88	-	-	90
53	100	79	74	89	-	-	81
54	63	78	75	90	-	-	82
55	79	98	76	All	79	81	78

The above tables show significant improvements compared to the “92” Series tables for the combined male experience, with a more moderate improvement for females. There are also clear differences between the smoker / non-smoker / combined sections.

Investigation 01 – Irish Permanent Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	12,790.0	2	1	19-56	no ages
1	13,802.0	5	1	20-57	no ages
2	4,708.0	5	3	25-44	no ages
3	886.5	3	1	no ages	no ages
4	1,043.0	1	4	no ages	no ages
5+	16,747.5	19	72	26-67	no ages
2+	23,385.0	28	80	21-67	no ages
0+	49,977.0	35	82	15-68	no ages

Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	16,629.5	12	2	19-58	no ages
1	17,246.5	14	5	20-59	no ages
2	5,931.5	5	6	23-50	no ages
3	1,276.5	2	13	no ages	no ages
4	1,372.5	3	3	no ages	no ages
5+	50,460.0	264	600	24-79	70-71
2+	59,040.5	274	622	21-79	63-65
0+	92,916.5	300	629	17-79	63-65

Data volumes for Irish permanent assurances are too low to be graduated.

Investigation 02 – Temporary Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	256,163.2	64	44	18-71	no ages
1	181,583.5	68	78	20-70	no ages
2	138,209.5	68	75	21-69	no ages
3	129,575.2	83	77	22-70	no ages
4	129,811.5	103	82	23-70	no ages
5+	787,595.0	809	425	23-80	35-63
2+	1,185,191.2	1,063	659	20-83	35-63
0+	1,622,937.9	1,195	781	18-84	35-67

Females, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	78,579.0	28	22	19-61	no ages
1	53,502.4	33	32	20-61	no ages
2	39,709.9	33	41	22-60	no ages
3	34,384.8	34	29	23-61	no ages
4	30,808.7	47	30	24-62	no ages
5+	172,629.2	336	209	25-72	54-58
2+	277,532.6	450	309	22-73	46-61
0+	409,614.0	511	363	19-74	46-61

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	351,269.0	103	72	18-71	no ages
1	254,556.5	113	135	19-71	no ages
2	199,974.5	108	138	20-70	no ages
3	186,815.4	130	137	21-71	53
4	183,031.6	174	135	22-72	57
5+	1,378,134.2	1,988	1,403	23-81	34-79
2+	1,947,955.7	2,400	1,813	20-84	33-79
0+	2,553,781.2	2,616	2,020	18-85	33-79

Males, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	327,371.6	200	152	19-76	no ages
1	255,588.7	241	183	20-77	no ages
2	197,406.1	219	196	21-76	60-61
3	170,234.1	229	176	22-75	57-60
4	157,411.0	246	166	23-74	57-59
5+	809,224.9	1,634	1,134	23-80	37-76
2+	1,334,276.1	2,328	1,672	20-82	36-80
0+	1,917,236.4	2,769	2,007	18-82	31-80

Males, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	99,253.7	81	48	19-66	no ages
1	70,061.8	90	83	21-67	no ages
2	52,323.9	106	78	22-65	52
3	43,831.6	82	97	24-65	no ages
4	37,973.6	116	81	25-65	no ages
5+	187,477.2	689	435	25-73	43-66
2+	321,606.3	993	691	22-74	37-69
0+	490,921.8	1,164	822	19-75	34-71

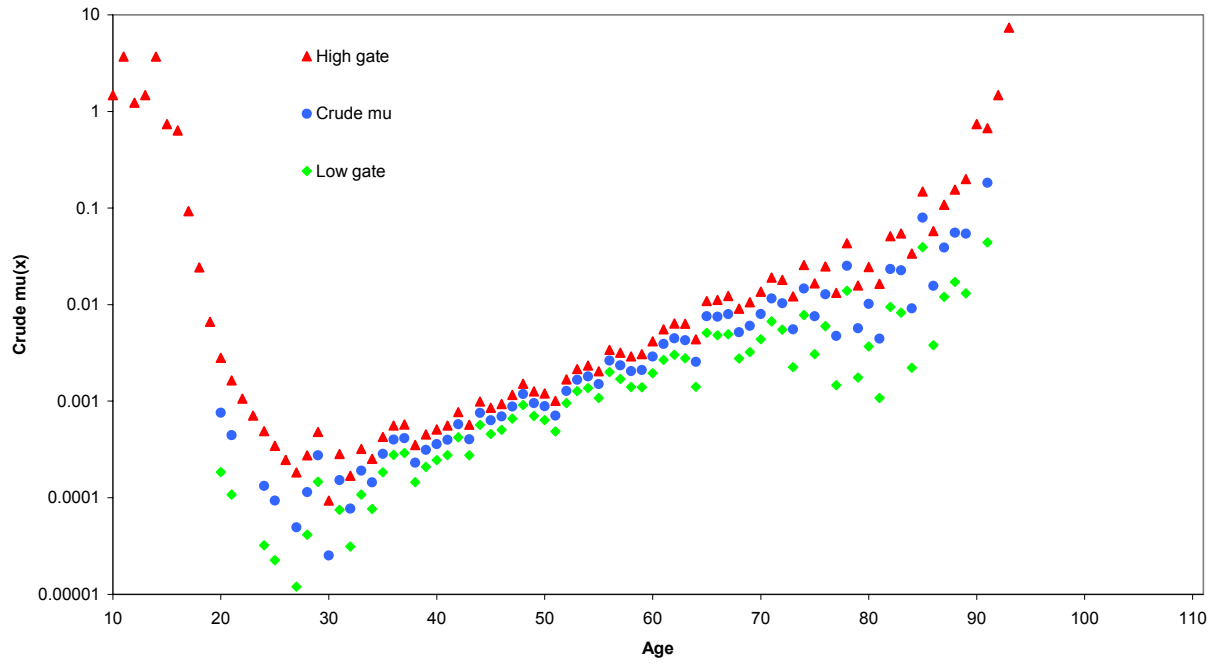
Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	449,702.5	302	246	18-77	52-54
1	350,841.2	352	323	19-77	54-59
2	277,555.3	362	345	20-78	57-61
3	242,289.2	350	347	21-76	52-60
4	222,808.9	406	313	22-76	50-59
5+	1,742,288.4	4,792	5,080	23-81	36-80
2+	2,484,941.8	5,910	6,085	20-83	31-80
0+	3,285,485.5	6,564	6,654	18-83	28-80

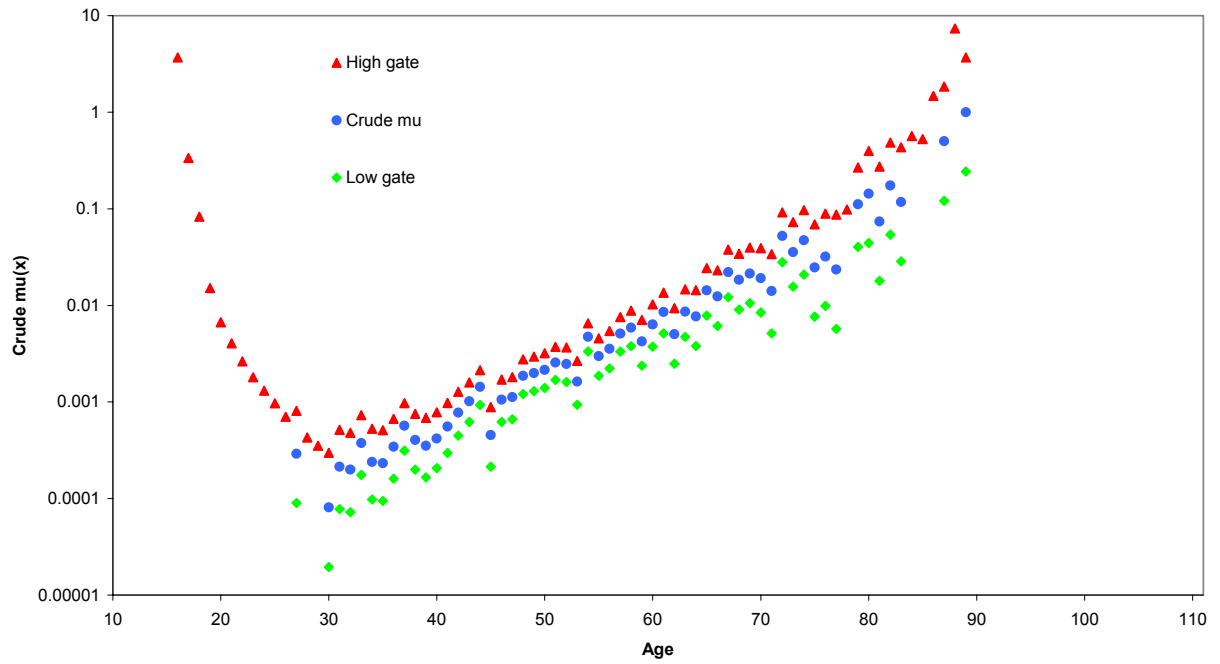
As with the permanent assurances, there is a reasonable amount of data at durations 5+ with much lower volumes at the earlier durations. However, in contrast, the volumes of data at the earliest durations have picked up a little since the last quadrennium. The 'gradable' range of data is also smaller.

Crude mortality rates

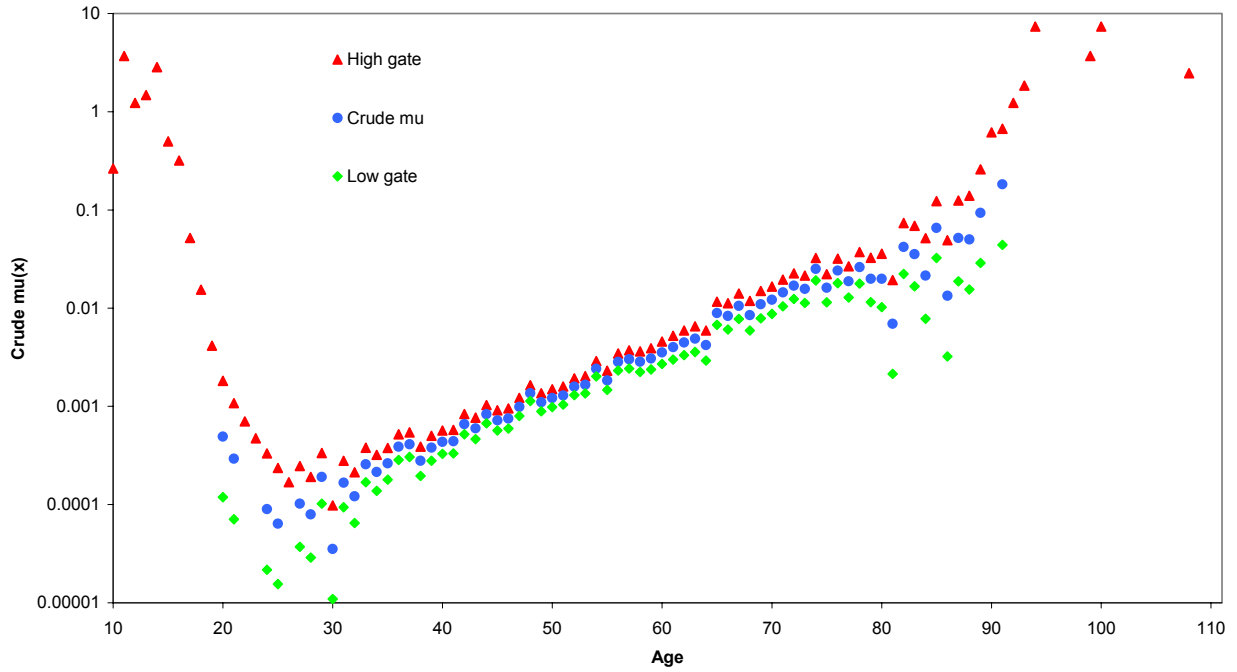
Crude Mu and Low and High Gates for Temporary Assurances, Females: Non-smokers



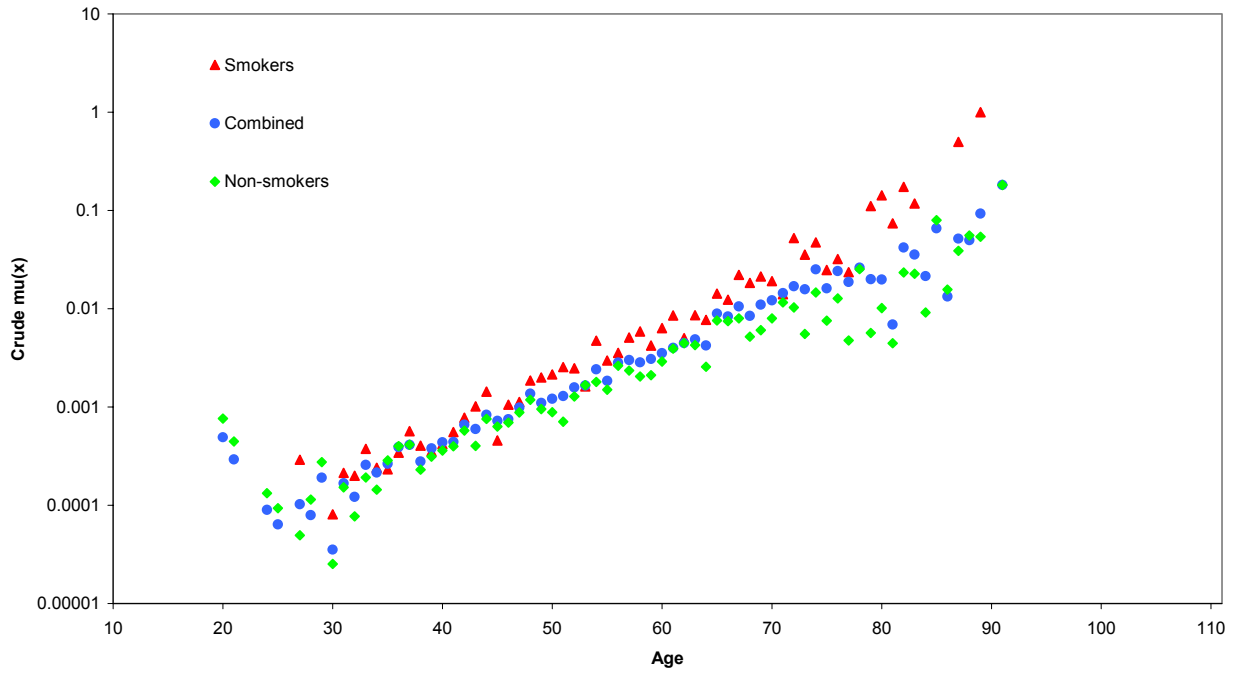
Crude Mu and Low and High Gates for Temporary Assurances, Females: Smokers



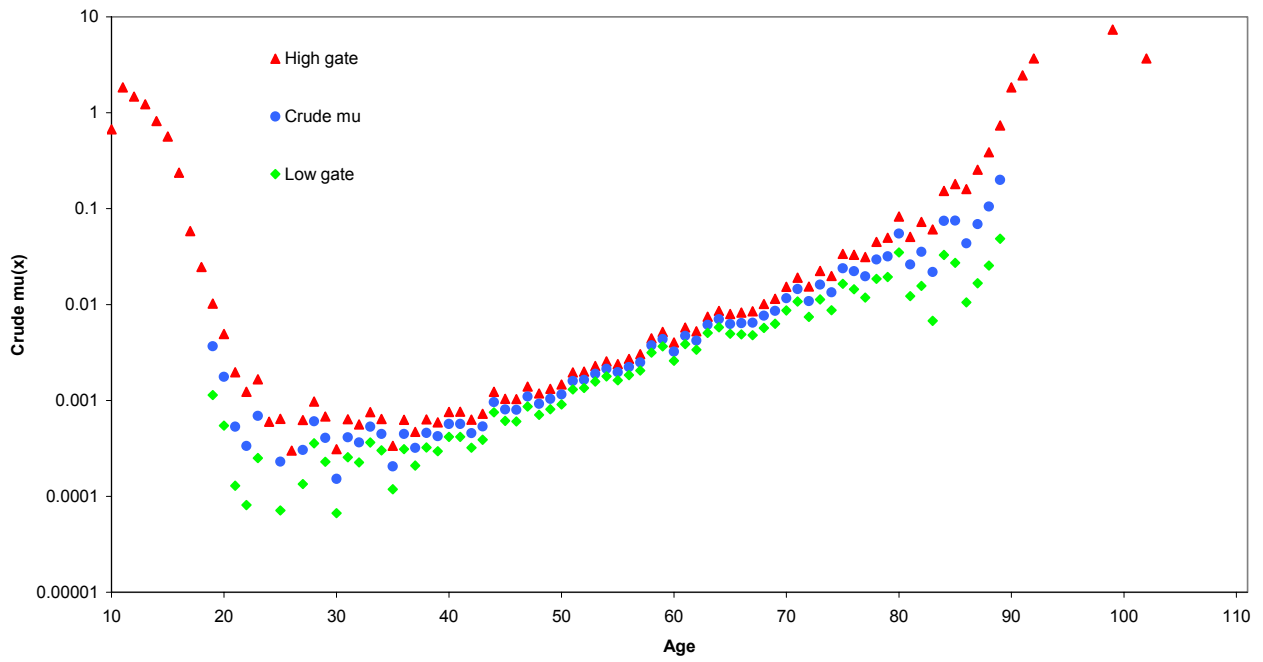
Crude Mu and Low and High Gates for Temporary Assurances, Females: Combined



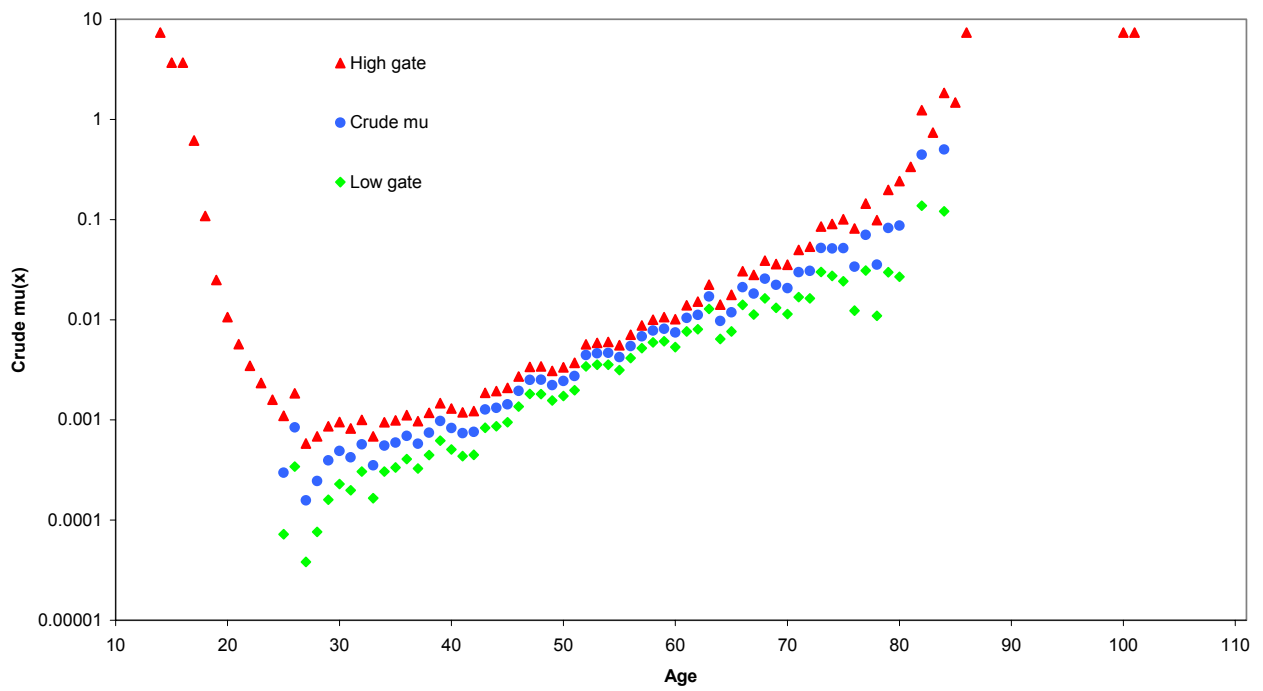
Crude Mu for Temporary Assurances, Females: Comparison of Smokers, Non-smokers and Combined



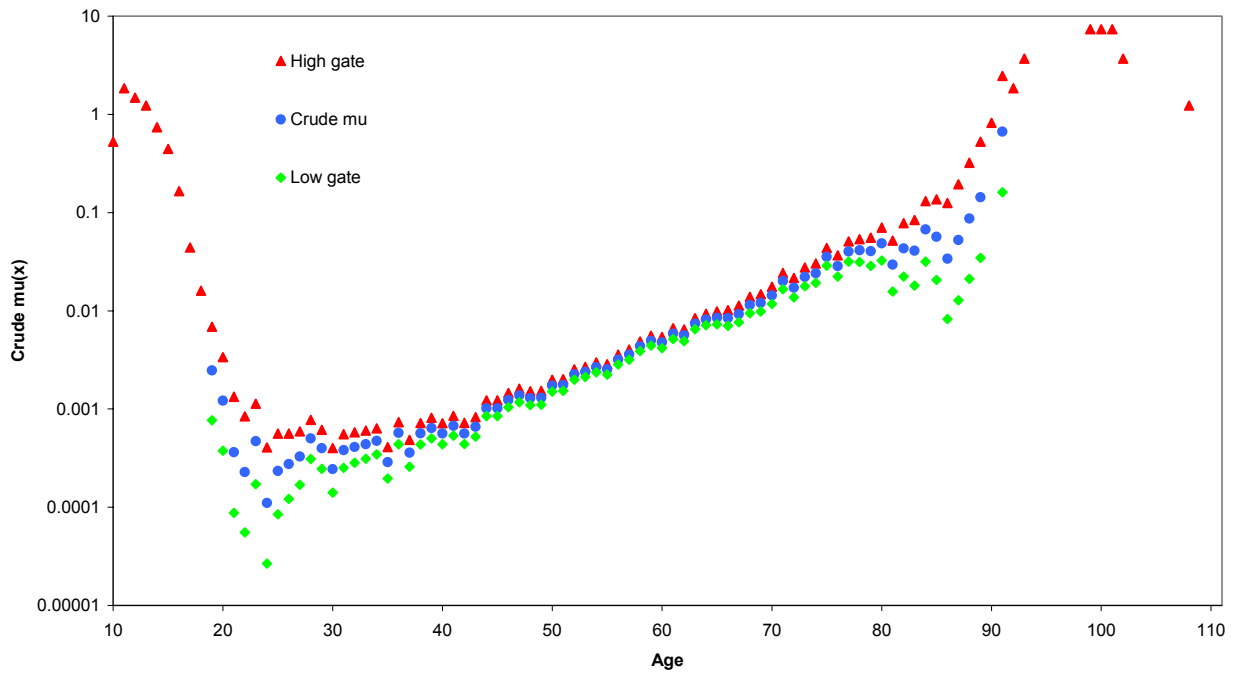
Crude Mu and Low and High Gates for Temporary Assurances, Males: Non-smokers



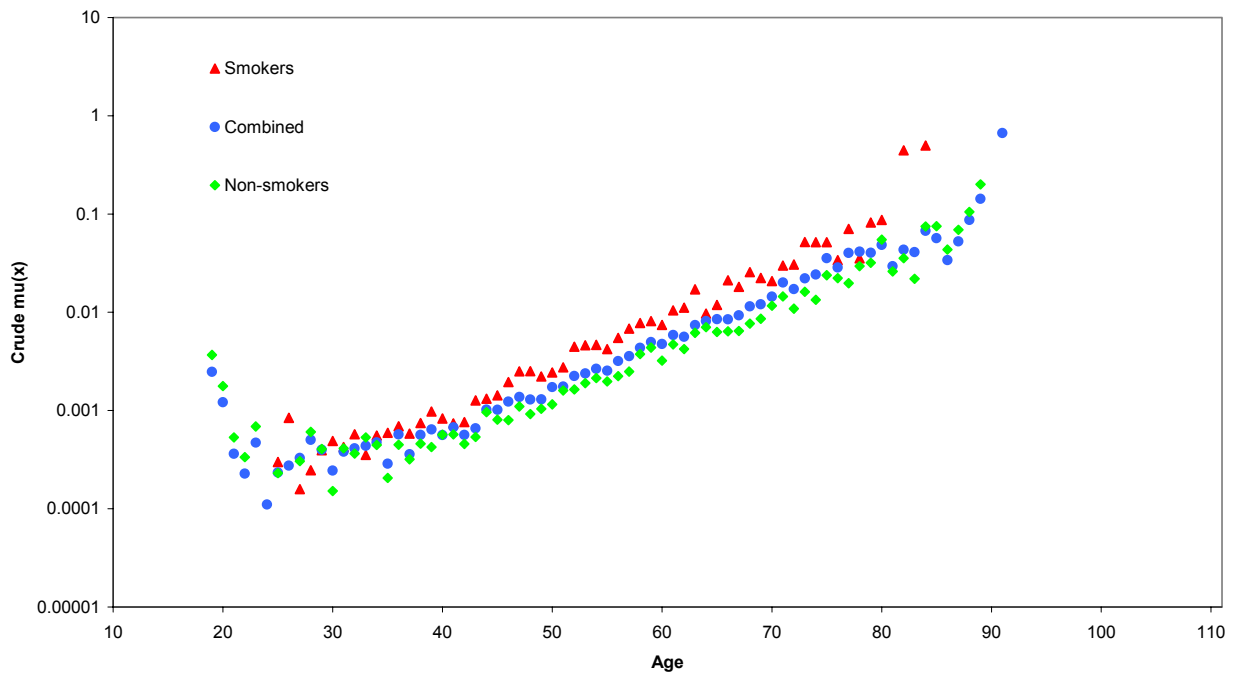
Crude Mu and Low and High Gates for Temporary Assurances, Males: Smokers



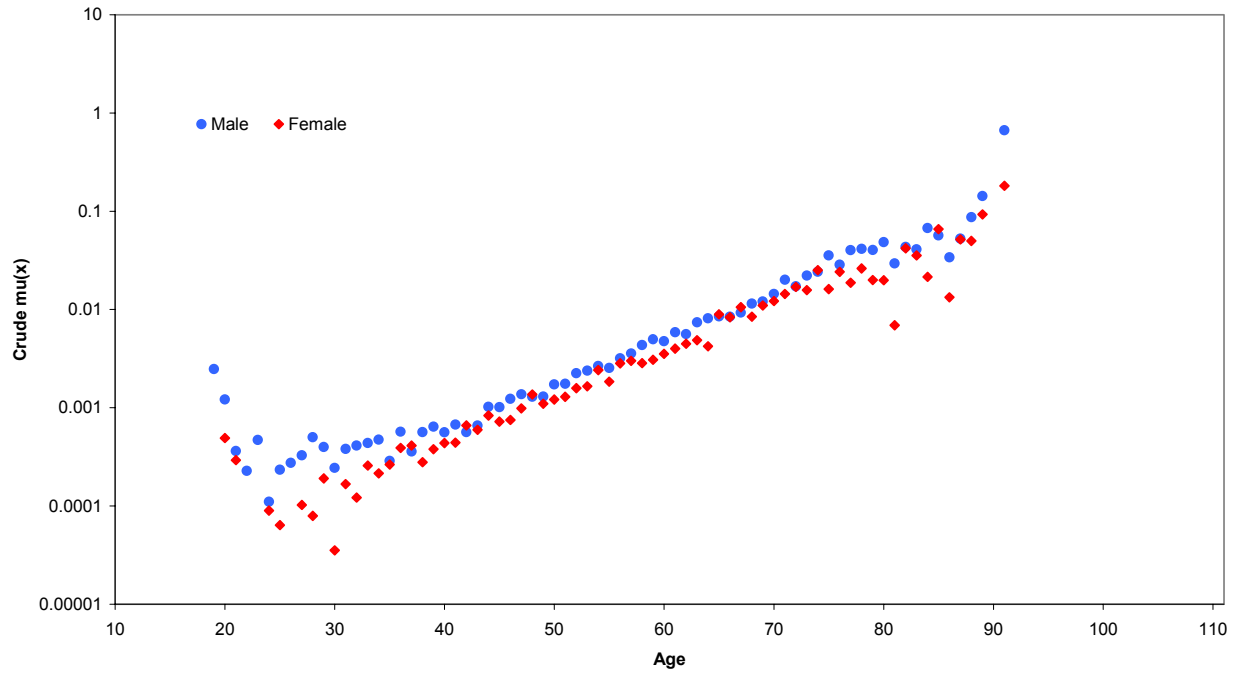
Crude Mu and Low and High Gates for Temporary Assurances, Males: Combined



Crude Mu for Temporary Assurances, Males: Comparison of Smokers, Non-smokers and Combined



Crude Mu for Temporary Assurances, Combined: Comparison of Males and Females



Similar features to the permanent assurance data are observed with the temporary assurances, although the upper age limit of more credible data is lower at around 70-80.

Comparison of 1999-2002 experience with “92” Series tables

Investigation 02, Females, Non-smokers, comparison basis TF92 sel

Age	100 A/E					
	Dur 0	Dur 1	Dur 2	Dur 3	Dur 4	Dur 5+
30	-	-	-	-	-	28
31	-	43	57	65	72	59
32	52	39	99	-	-	-
33	48	68	-	47	154	46
34	88	63	-	-	44	36
35	120	59	110	-	39	74
36	36	27	105	146	36	112
37	102	49	64	35	34	112
38	33	23	62	-	97	47
39	32	23	86	-	58	67
40	126	22	29	30	58	64
41	-	22	83	-	84	73
42	62	108	28	56	27	90
43	-	21	27	112	54	54
44	63	43	27	83	104	98
45	-	21	27	80	102	75
46	63	64	-	81	122	65
47	63	62	-	104	73	83
48	127	42	25	76	94	103
49	32	42	52	25	113	74
50	32	21	78	51	44	63
51	31	20	51	25	-	50
52	94	20	74	73	62	70
53	97	-	170	168	43	74
54	162	64	-	50	88	82
55	-	21	110	29	114	60
56	82	23	-	180	108	101
57	-	87	32	65	200	70
58	-	62	37	35	63	65
59	58	-	39	39	34	65
60	119	-	46	43	74	76
61	69	41	-	51	211	85
62	-	221	53	165	192	60
63	86	45	156	111	-	71
64	-	112	112	109	53	18
65	-	63	66	63	157	122
66	98	62	72	273	-	93
67	228	-	-	-	75	113
68	-	71	173	159	-	37
69	-	-	163	-	-	69
70	123	-	-	247	-	64
71	-	-	102	198	-	105
72	-	-	-	-	262	75
73	-	87	-	-	-	41
74	-	-	-	-	282	96
75	-	-	-	-	-	73
76	133	-	-	102	87	58
77	146	-	-	-	-	20
78	-	208	-	-	-	154
79	-	-	-	-	-	43
80	177	-	-	-	-	44
81	-	-	-	-	91	-
82	-	-	154	100	-	38
83	-	-	-	-	-	122
84	-	-	-	-	-	41
85	-	-	142	-	462	130
All	58	41	50	62	72	73

Investigation 02, Females, Smokers, comparison basis TF92 sel

Age	100 A/E					
	Dur 0	Dur 1	Dur 2	Dur 3	Dur 4	Dur 5+
30	-	146	-	-	-	-
31	171	-	-	211	-	79
32	-	-	-	-	-	183
33	149	-	-	-	401	143
34	-	-	-	-	183	119
35	-	97	124	-	170	34
36	-	94	118	-	298	58
37	-	-	115	129	286	151
38	-	-	-	-	281	113
39	-	-	112	-	272	61
40	-	80	-	-	-	110
41	333	160	-	-	-	67
42	-	-	-	-	122	172
43	-	79	210	-	-	175
44	224	76	-	228	118	196
45	-	164	-	109	119	27
46	-	-	109	-	-	153
47	108	76	99	116	329	73
48	114	150	95	213	-	165
49	106	77	289	105	102	149
50	107	146	211	302	312	100
51	530	148	-	222	191	119
52	106	285	93	-	202	124
53	115	-	-	288	91	71
54	239	238	199	-	371	202
55	248	85	303	-	98	104
56	-	-	481	110	-	135
57	173	98	128	394	109	158
58	-	-	269	142	385	167
59	-	-	-	293	556	71
60	534	-	179	-	160	147
61	291	348	-	183	180	170
62	-	-	-	200	-	118
63	-	-	-	-	183	184
64	-	-	311	254	-	116
65	511	-	731	290	-	165
66	-	-	-	372	271	155
67	-	-	-	-	-	328
68	-	-	-	-	350	218
69	-	580	538	399	-	150
70	-	-	472	432	367	88
71	936	-	-	-	399	49
72	-	-	-	-	-	496
73	-	667	-	-	-	252
74	-	-	-	544	-	292
75	-	-	-	-	-	166
76	-	-	-	-	-	189
77	-	-	-	-	-	151
78	-	-	-	-	-	-
79	-	853	-	6,824	-	167
80	-	-	-	-	-	635
81	-	-	-	-	-	324
82	-	-	-	-	-	516
83	-	-	-	-	-	439
84	-	-	-	-	-	-
85	-	-	-	-	-	-
All	98	80	101	111	153	136

Investigation 02, Females, Combined, comparison basis TF92 sel

Age	100 A/E					
	Dur 0	Dur 1	Dur 2	Dur 3	Dur 4	Dur 5+
30	-	35	-	-	-	20
31	83	30	38	89	50	56
32	37	27	67	37	-	42
33	69	72	31	33	218	64
34	64	45	-	30	63	77
35	88	62	101	-	56	67
36	27	38	95	100	77	107
37	76	35	66	48	97	104
38	25	17	42	-	115	64
39	24	16	81	21	84	81
40	95	47	20	21	41	85
41	117	47	58	-	60	70
42	70	79	39	40	39	105
43	-	31	58	98	38	85
44	94	78	19	97	111	98
45	-	47	19	76	110	82
46	47	46	19	57	106	75
47	70	75	19	92	122	85
48	165	61	53	90	68	112
49	70	46	109	52	97	77
50	46	45	91	87	79	78
51	135	44	36	52	31	80
52	92	72	68	68	89	84
53	96	-	119	164	45	76
54	170	110	38	52	122	104
55	100	32	155	39	97	67
56	60	17	83	144	93	104
57	36	104	46	136	195	88
58	-	69	79	49	131	82
59	90	27	28	109	144	77
60	185	-	66	62	107	83
61	107	91	-	71	213	78
62	-	203	37	151	167	71
63	68	72	117	77	36	85
64	-	131	128	124	112	49
65	70	48	202	91	120	128
66	158	47	54	256	92	98
67	196	-	-	-	55	142
68	-	59	124	115	53	88
69	-	62	199	126	-	104
70	109	-	143	257	58	94
71	115	-	80	143	63	110
72	-	-	-	-	195	122
73	-	146	-	-	-	101
74	-	-	-	164	324	135
75	-	-	-	-	-	88
76	126	-	-	84	69	110
77	135	-	-	-	-	82
78	-	192	-	-	-	106
79	-	68	-	73	-	82
80	175	-	-	-	81	76
81	-	-	-	-	79	19
82	-	-	139	92	201	96
83	-	-	-	-	105	133
84	-	-	-	-	83	55
85	-	-	123	-	357	100
All	71	50	57	70	88	88

Investigation 02, Males, Non-smokers, comparison basis TM92 sel

Age	100 A/E					
	Dur 0	Dur 1	Dur 2	Dur 3	Dur 4	Dur 5+
30	23	27	39	-	57	24
31	61	72	68	83	144	54
32	19	65	30	108	-	117
33	36	80	106	93	145	107
34	33	73	74	28	125	100
35	16	34	67	26	56	25
36	43	94	103	165	52	36
37	41	57	-	-	24	80
38	51	82	54	85	94	54
39	49	13	17	60	67	81
40	47	62	33	116	42	86
41	45	36	79	37	123	73
42	11	45	46	70	19	61
43	32	53	28	67	90	52
44	64	94	54	63	152	85
45	105	31	52	46	48	69
46	30	70	38	116	46	56
47	68	57	96	28	28	83
48	56	9	45	52	27	67
49	18	42	82	24	63	62
50	75	24	29	43	121	52
51	31	49	44	-	100	84
52	84	56	37	69	95	57
53	45	24	74	53	47	75
54	70	45	40	64	123	62
55	49	33	26	70	62	57
56	26	62	40	58	22	61
57	22	24	47	76	85	56
58	31	39	49	75	87	81
59	76	60	38	78	95	77
60	27	43	77	91	25	47
61	19	36	97	35	100	69
62	-	50	54	80	28	56
63	49	25	30	50	47	84
64	39	62	79	17	76	77
65	36	20	19	52	39	71
66	70	90	35	37	41	48
67	45	31	39	85	46	49
68	49	36	50	56	84	48
69	36	25	115	41	57	48
70	50	71	14	49	54	77
71	37	80	53	55	60	81
72	74	15	50	46	160	34
73	-	55	59	111	68	65
74	-	41	66	111	-	51
75	160	59	97	127	-	66
76	73	68	53	-	44	84
77	-	-	64	76	149	55
78	105	-	33	99	48	90
79	46	117	93	84	120	48
80	89	113	53	-	125	128
81	-	64	-	85	120	47
82	-	-	92	-	254	44
83	-	-	128	-	-	24
84	-	-	-	205	-	103
85	-	-	-	-	214	80
All	45	48	51	61	70	65

Investigation 02, Males, Smokers, comparison basis TM92 sel

Age	100 A/E					
	Dur 0	Dur 1	Dur 2	Dur 3	Dur 4	Dur 5+
30	229	-	-	124	-	86
31	-	62	249	104	-	63
32	-	59	75	186	355	98
33	95	-	73	-	107	81
34	94	-	66	81	96	170
35	181	52	134	76	184	29
36	43	153	136	76	88	131
37	-	-	65	235	173	117
38	123	-	61	-	89	191
39	122	93	132	70	82	175
40	82	46	124	-	396	87
41	-	-	60	-	83	172
42	39	44	238	139	-	71
43	37	178	59	71	302	129
44	111	124	59	69	157	129
45	75	80	223	-	145	126
46	146	155	160	197	69	133
47	178	154	-	180	207	181
48	69	111	146	112	63	187
49	97	71	183	266	119	100
50	93	66	84	50	268	123
51	119	155	82	270	149	88
52	56	175	358	174	91	167
53	57	28	240	151	295	165
54	121	109	105	38	230	152
55	31	148	102	37	120	128
56	-	61	107	77	326	144
57	84	167	151	197	173	137
58	85	78	164	209	81	159
59	148	161	184	91	135	132
60	59	48	275	52	248	97
61	-	110	116	-	331	152
62	-	57	120	65	216	148
63	165	354	122	372	276	149
64	99	-	154	65	-	105
65	-	99	173	92	224	91
66	-	92	-	328	227	179
67	300	160	197	279	-	101
68	-	-	95	-	417	195
69	-	294	-	94	118	137
70	-	156	558	131	197	50
71	555	165	168	-	150	110
72	-	-	-	212	179	147
73	298	201	257	-	289	185
74	397	-	-	289	541	145
75	811	-	272	-	846	44
76	-	-	461	346	256	-
77	527	-	-	484	-	176
78	770	-	-	-	-	69
79	-	-	-	-	-	263
80	-	-	-	-	-	240
81	-	-	-	-	-	-
82	-	-	-	-	-	696
83	-	-	-	-	-	-
84	-	-	-	-	-	662
85	-	-	-	-	-	-
All	81	92	134	115	176	135

Investigation 02, Males, Combined, comparison basis TM92 sel

Age	100 A/E					
	Dur 0	Dur 1	Dur 2	Dur 3	Dur 4	Dur 5+
30	77	18	25	32	38	49
31	42	65	110	81	95	49
32	26	74	39	118	82	96
33	50	54	88	61	121	86
34	47	50	65	37	105	123
35	55	35	75	35	76	32
36	41	111	99	128	107	81
37	29	41	13	61	67	73
38	65	79	50	88	98	86
39	72	47	86	82	77	100
40	52	54	47	95	101	72
41	50	26	67	26	100	102
42	16	42	75	74	40	69
43	32	72	31	70	113	64
44	71	101	49	56	144	92
45	93	38	76	55	57	89
46	68	81	64	114	44	94
47	94	71	69	49	61	96
48	63	26	57	73	29	85
49	33	50	111	68	80	66
50	81	30	35	46	135	86
51	52	68	58	48	100	74
52	80	76	104	88	88	80
53	50	22	111	60	92	82
54	84	52	45	68	127	78
55	43	52	44	63	67	70
56	20	57	45	64	65	82
57	36	51	77	95	85	75
58	43	52	58	85	103	83
59	89	75	71	94	101	79
60	29	47	96	83	56	72
61	15	47	91	27	139	81
62	-	47	55	77	58	71
63	70	57	55	86	66	80
64	44	59	88	33	58	81
65	40	26	40	60	77	79
66	61	82	40	60	55	68
67	64	40	47	115	36	69
68	42	30	50	45	118	81
69	47	43	107	41	56	72
70	44	72	48	52	72	79
71	83	80	85	61	62	97
72	65	13	41	54	180	70
73	25	64	65	90	100	83
74	25	36	55	108	49	85
75	195	54	105	98	87	101
76	66	78	69	31	65	76
77	38	-	53	125	123	100
78	145	-	28	81	39	97
79	42	109	81	71	208	72
80	85	102	47	-	105	96
81	-	60	-	71	96	56
82	-	-	84	-	192	68
83	-	-	116	-	-	61
84	-	-	-	182	-	89
85	-	-	-	-	200	58
All	53	55	64	69	85	79

As with the Permanents, there are clear improvements on the “92” Series tables, and clear differences between the smoker / non-smoker / combined sections.

Comparisons of Permanent Assurances (I) with Temporary Assurances (II)

Females, Non-smokers

Durations		I	II	Numbers		$p(+)$		runs	$p(\text{runs})$	χ^2	$p(\chi^2)$
I	v II	A/E	A/E	+	-						
0	0	131.72	85.80	4	0	0.0625	(-)	1	0.5000	4.78	0.3111
1	1	115.01	82.96	3	2	0.5000		4	0.5000	11.49	0.0425
2	2	110.03	82.61	5	2	0.2266	(-)	5	0.2857	11.07	0.1354
3	3	107.31	85.66	6	4	0.3770	(-)	5	0.4048	18.86	0.0421
4	4	105.46	88.69	7	4	0.2744	(-)	7	0.3939	11.34	0.4155
5+	5+	100.59	97.42	24	19	0.2712	(-)	23	0.4638	43.59	0.4460

Females, Smokers

Durations		I	II	Numbers		$p(+)$		runs	$p(\text{runs})$	χ^2	$p(\chi^2)$
I	v II	A/E	A/E	+	-						
0	0	217.09	61.87	2	0	0.2500	(-)	1	0.5000	29.05	0.0000
1	1	141.01	61.85	3	0	0.1250	(-)	1	0.5000	18.46	0.0004
2	2	113.82	72.51	4	1	0.1875	(-)	3	0.5000	8.93	0.1120
3	3	112.48	70.70	4	1	0.1875	(-)	3	0.5000	7.83	0.1661
4	4	106.06	86.99	4	1	0.1875	(-)	2	0.4000	3.38	0.6421
5+	5+	101.28	93.78	21	11	0.0551	(-)	13	0.2212	20.01	0.9511

Females, Combined

Durations		I	II	Numbers		$p(+)$		runs	$p(\text{runs})$	χ^2	$p(\chi^2)$
I	v II	A/E	A/E	+	-						
0	0	116.16	89.27	7	1	0.0352	(-)	3	0.5000	6.30	0.6135
1	1	111.35	81.90	9	2	0.0327	(-)	5	0.5000	15.71	0.1521
2	2	108.84	78.28	10	3	0.0461	(-)	7	0.2937	19.52	0.1080
3	3	106.46	81.08	11	6	0.1662	(-)	9	0.5000	22.96	0.1505
4	4	101.92	94.24	9	11	0.4119	(+)	13	0.2269	17.52	0.6188
5+	5+	100.61	96.33	31	20	0.0804	(-)	27	0.3659	66.29	0.0737

Males, Non-smokers

Durations		I	II	Numbers		$p(+)$		runs	$p(\text{runs})$	χ^2	$p(\chi^2)$
I	v II	A/E	A/E	+	-						
0	0	135.12	92.54	7	1	0.0352	(-)	2	0.2500	11.98	0.1519
1	1	135.43	87.47	13	1	0.0009	(-)	2	0.1429	22.04	0.0778
2	2	139.17	77.96	19	0	0.0000	(-)	1	0.5000	41.86	0.0019
3	3	119.51	85.44	12	5	0.0717	(-)	7	0.3654	28.65	0.0379
4	4	111.48	89.95	14	6	0.0577	(-)	10	0.4796	30.14	0.0677
5+	5+	99.69	100.96	23	27	0.3359	(+)	24	0.3508	60.94	0.1381

Males, Smokers

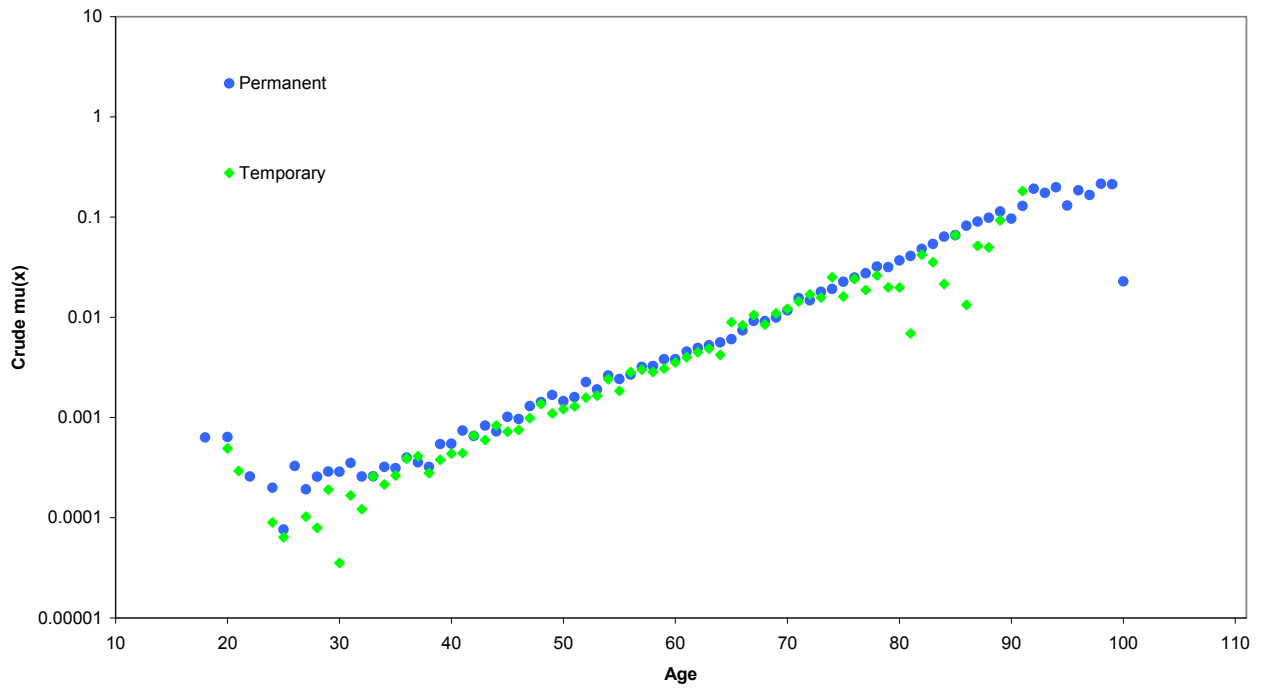
Durations		I	II	Numbers		$p(+)$		runs	$p(\text{runs})$	χ^2	$p(\chi^2)$
I	v II	A/E	A/E	+	-						
0	0	146.26	85.91	4	1	0.1875	(-)	2	0.4000	14.55	0.0125
1	1	131.35	82.14	8	0	0.0039	(-)	1	0.5000	13.92	0.0840
2	2	115.85	86.40	9	1	0.0107	(-)	3	0.5000	15.04	0.1307
3	3	118.06	77.68	8	1	0.0195	(-)	3	0.5000	12.26	0.1992
4	4	107.79	89.77	10	2	0.0193	(-)	5	0.5000	5.22	0.9503
5+	5+	99.72	101.15	16	22	0.2088	(+)	21	0.3725	22.92	0.9746

Males, Combined

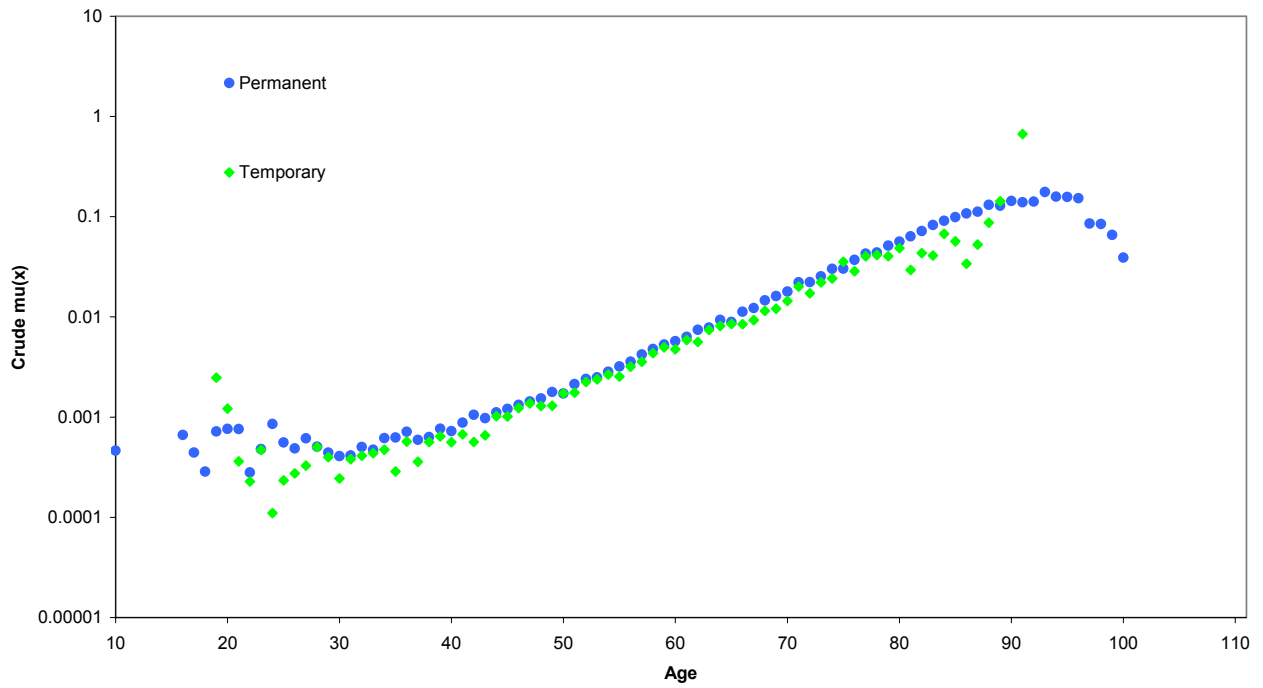
Durations		I	II	Numbers		$p(+)$		runs	$p(\text{runs})$	χ^2	$p(\chi^2)$
I	v II	A/E	A/E	+	-						
0	0	141.71	86.15	18	0	0.0000	(-)	1	0.5000	33.53	0.0144
1	1	133.20	80.32	29	1	0.0000	(-)	2	0.0667	52.05	0.0075
2	2	121.94	79.62	31	2	0.0000	(-)	5	0.5000	51.83	0.0196
3	3	116.86	78.95	28	5	0.0000	(-)	8	0.2039	55.73	0.0080
4	4	108.36	87.79	24	10	0.0122	(-)	14	0.3809	30.91	0.6200
5+	5+	100.13	98.89	28	26	0.4460	(-)	34	0.0637	52.55	0.5305

These tables show that the ultimate experience of permanents and temporaries is similar, particularly for males, but that the select durations are very different.

Crude Mu for Females, Combined: Comparison of Permanent and Temporary Assurances



Crude Mu for Males, Combined: Comparison of Permanent and Temporary Assurances



Investigation 04 – Linked Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	41,117.2	37		19-68	no ages
1	44,885.3	45		20-70	no ages
2	48,573.4	34		21-71	no ages
3	50,303.1	47		22-72	no ages
4	52,559.1	57		23-71	no ages
5+	239,544.9	330		10-83	53-54
2+	390,980.5	468		10-85	52-58
0+	476,983.0	550		10-86	52-58

Females, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	12,070.5	11		23-57	no ages
1	12,233.2	13		24-57	no ages
2	12,972.4	12		24-58	no ages
3	13,353.6	28		24-58	no ages
4	13,554.2	32		25-59	no ages
5+	57,408.1	167		25-74	no ages
2+	97,288.3	239		22-77	single ages
0+	121,592.0	263		20-78	single ages

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	76,733.8	131	31	16-77	85
1	91,282.7	272	89	16-80	83-86
2	97,278.4	334	134	17-81	78-82
3	93,099.6	395	189	16-81	82-88
4	91,205.3	305	256	17-84	85-87
5+	811,480.1	3,033	2,312	10-98	37-98
2+	1,093,063.4	4,067	2,891	10-98	37-99
0+	1,261,079.9	4,470	3,011	10-98	36-99

Males, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	52,849.3	76		18-68	no ages
1	56,964.1	81		19-69	no ages
2	61,475.3	101		20-70	no ages
3	63,301.7	88		21-71	no ages
4	64,829.7	110		22-71	no ages
5+	297,941.2	656		10-80	45-74
2+	487,547.9	955		10-81	43-74
0+	597,361.3	1,112		10-81	39-75

Males, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	16,567.6	27		22-59	no ages
1	16,043.1	30		23-59	no ages
2	16,299.7	29		24-60	no ages
3	16,309.9	36		25-59	no ages
4	16,484.5	38		26-61	no ages
5+	76,663.6	292		25-75	62-64
2+	125,757.7	395		22-76	52-56
0+	158,368.4	452		20-76	52-64

Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	88,527.0	187	62	10-88	no ages
1	101,588.2	327	144	10-87	78-79
2	107,621.8	412	248	10-89	67-69
3	104,562.7	411	373	10-90	76-83
4	105,310.4	358	436	10-89	74-75
5+	1,252,337.3	5,626	4,626	10-97	32-93
2+	1,569,832.2	6,807	5,683	10-97	31-93
0+	1,759,947.4	7,321	5,889	10-97	31-93

Data volumes for the smoker and non-smoker subsections at durations below 5+ are very low. There is a large amount of data at durations 5+ for the combined section.

Comparison of 1999-2002 experience with “92” Series tables

Investigation 04, Females, Combined, comparison basis AF92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	-	126	77
21	-	-	-	57	-	51	90
22	-	-	-	58	87	48	103
23	1,367	-	-	59	44	74	69
24	-	-	185	60	74	75	85
25	-	-	-	61	62	119	93
26	-	-	80	62	73	99	66
27	-	-	53	63	33	95	67
28	-	-	145	64	-	18	90
29	-	226	-	65	-	34	74
30	-	181	77	66	61	51	76
31	-	-	45	67	90	131	76
32	-	-	59	68	86	32	65
33	351	-	154	69	85	76	69
34	-	-	65	70	28	91	75
35	-	97	34	71	47	91	96
36	139	93	47	72	79	53	69
37	-	-	110	73	25	62	81
38	-	-	71	74	74	118	80
39	122	-	101	75	49	145	96
40	-	78	94	76	-	96	85
41	-	76	80	77	44	84	71
42	227	-	144	78	123	196	113
43	108	71	134	79	109	89	87
44	103	66	70	80	158	123	119
45	390	64	126	81	84	127	84
46	186	60	93	82	114	128	92
47	178	114	112	83	149	200	102
48	251	106	85	84	95	169	125
49	-	50	114	85	220	154	136
50	69	222	110	86	187	233	133
51	-	-	114	87	224	101	120
51	-	168	102	88	106	334	108
53	49	188	113	89	345	136	121
54	146	138	88	90	211	84	110
55	88	141	74	All	87	109	94

Investigation 04, Males, Combined, comparison basis AM92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	159	56	-	91	90
21	-	-	-	57	97	74	72
22	467	-	105	58	76	44	86
23	787	-	-	59	123	77	77
24	581	-	188	60	153	124	92
25	-	393	182	61	61	45	78
26	-	-	64	62	55	39	80
27	144	128	89	63	51	36	82
28	-	101	16	64	51	68	90
29	103	-	71	65	36	42	74
30	90	147	9	66	64	74	88
31	-	-	86	67	61	49	81
32	74	-	117	68	51	61	78
33	65	110	94	69	65	59	69
34	61	48	102	70	66	54	74
35	119	140	89	71	59	106	56
36	-	91	53	72	34	38	73
37	210	132	64	73	16	119	64
38	105	-	70	74	66	74	76
39	157	83	98	75	96	51	72
40	100	80	106	76	36	75	63
41	93	115	95	77	54	40	75
42	-	104	86	78	47	112	77
43	44	69	118	79	95	90	71
44	130	67	78	80	89	70	72
45	41	32	79	81	96	104	86
46	162	59	95	82	62	78	88
47	-	142	107	83	45	120	87
48	36	51	106	84	125	120	80
49	63	125	94	85	155	143	84
50	90	84	101	86	-	53	93
51	128	95	89	87	223	144	97
51	69	139	103	88	-	-	91
53	123	96	79	89	362	111	63
54	81	62	83	90	-	247	112
55	93	24	65	All	74	75	80

Comparisons of Permanent Assurances (I) with Linked Assurances (II)

Females, Combined

Durations		I	II	Numbers								
I	v II	A/E	A/E	+	-	p(+)		runs	p(runs)		χ^2	p(χ^2)
0	0	104.18	97.35	5	4	0.5000		3	0.0714	(+)	4.93	0.8404
1	1	112.44	90.94	12	8	0.2517	(-)	7	0.0674	(+)	22.62	0.3080
2	2	109.98	90.89	19	5	0.0033	(-)	8	0.3473	(+)	27.58	0.2780
3	3	103.49	95.91	16	10	0.1635	(-)	10	0.1180	(+)	26.37	0.4431
4	4	102.06	96.39	12	11	0.5000		8	0.0443	(+)	18.39	0.7358
5+	5+	99.64	101.54	29	39	0.1375	(+)	30	0.1735	(+)	119.47	0.0001

Males, Combined

Durations		I	II	Numbers								
I	v II	A/E	A/E	+	-	p(+)		runs	p(runs)		χ^2	p(χ^2)
0	0	104.22	96.55	10	9	0.5000		8	0.1786	(+)	12.13	0.8800
1	1	104.45	95.69	16	12	0.2858	(-)	14	0.4669	(+)	13.28	0.9916
2	2	102.35	97.21	18	16	0.4321	(-)	19	0.4211	(-)	15.67	0.9970
3	3	103.07	95.52	17	18	0.5000		15	0.1514	(+)	24.87	0.8981
4	4	100.22	99.55	18	15	0.3642	(-)	14	0.1546	(+)	11.23	0.9999
5+	5+	99.71	102.15	28	40	0.0909	(+)	24	0.0085	(+)	199.45	0.0000

The experience of linked assurances is similar to that of permanent assurances, particularly at higher durations. We do not feel that there is sufficient cause to graduate a table for this experience.

Investigation 06 – Joint-Life First-Death Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	66,598.3	18	18	19-62	no ages
1	66,378.3	21	49	20-64	no ages
2	58,401.1	27	43	22-65	no ages
3	52,616.6	31	63	23-65	no ages
4	59,760.0	39	71	24-65	no ages
5+	732,441.3	788	572	24-76	37-67
2+	903,219.0	885	749	21-76	37-67
0+	1,036,195.6	924	816	19-76	35-67

Females, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	17,871.0	3	13	20-56	no ages
1	17,658.0	11	25	21-57	no ages
2	15,239.9	12	27	23-58	no ages
3	13,605.1	13	33	25-59	no ages
4	14,933.2	19	23	26-60	no ages
5+	157,366.4	383	252	26-71	53-59
2+	201,144.6	427	335	22-72	53-59
0+	236,673.6	441	373	20-72	53-59

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0	104,628.9	28	33	19-63	no ages
1	100,381.8	33	93	20-65	no ages
2	88,644.5	44	107	21-66	no ages
3	85,063.8	52	160	22-66	no ages
4	100,807.5	66	181	23-66	no ages
5+	1,823,589.7	2,442	2,309	24-78	34-71
2+	2,098,105.5	2,604	2,757	21-79	32-71
0+	2,303,116.2	2,665	2,883	19-79	32-71

Males, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	62,760.3	35	46	21-66	no ages
1	62,909.3	68	72	22-67	no ages
2	55,144.1	70	96	23-68	no ages
3	49,201.3	59	109	25-69	no ages
4	55,754.6	75	110	26-67	no ages
5+	671,185.3	1,234	918	26-78	39-74
2+	831,285.3	1,438	1,233	23-79	39-74
0+	956,954.9	1,541	1,351	20-79	36-74

Males, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	21,936.3	15	23	22-59	no ages
1	21,675.4	27	43	23-60	no ages
2	19,059.8	35	49	25-62	no ages
3	17,470.1	50	54	26-62	no ages
4	19,283.7	60	73	27-63	no ages
5+	215,056.9	897	661	27-74	47-71
2+	270,870.5	1,042	837	24-74	43-71
0+	314,482.2	1,084	903	21-74	43-71

Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	105,405.7	70	94	20-66	no ages
1	100,930.6	104	150	21-68	no ages
2	89,131.8	114	229	23-69	no ages
3	85,413.7	127	270	24-70	no ages
4	101,047.9	176	329	25-70	60
5+	1,839,568.8	4,520	4,231	25-80	33-77
2+	2,115,162.2	4,937	5,059	22-81	32-77
0+	2,321,498.5	5,111	5,303	20-81	32-77

Data volumes at durations below 5+, particularly for the smoker and non-smoker subsections, are very low. There is a large amount of data at durations 5+ for the combined section.

Comparison of 1999-2002 experience with “92” Series tables

Investigation 06, Females, Combined, comparison basis AF92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	-	97	81
21	-	-	-	57	95	55	91
22	-	-	-	58	-	129	74
23	-	-	-	59	123	-	64
24	-	-	232	60	135	-	60
25	-	-	-	61	-	89	104
26	-	-	-	62	-	118	80
27	-	-	42	63	-	-	76
28	-	-	52	64	-	-	80
29	-	-	52	65	-	-	85
30	-	-	61	66	-	-	90
31	110	-	62	67	-	-	91
32	-	-	80	68	-	-	52
33	-	74	77	69	-	-	71
34	-	130	77	70	-	-	89
35	75	178	65	71	-	-	111
36	71	55	46	72	-	-	48
37	133	103	61	73	-	-	115
38	130	98	73	74	-	-	60
39	63	-	64	75	-	-	104
40	124	93	68	76	-	-	43
41	61	-	76	77	-	-	-
42	61	45	71	78	-	-	79
43	-	46	62	79	-	-	60
44	-	89	61	80	-	-	162
45	-	-	72	81	-	-	38
46	62	-	62	82	-	-	149
47	121	45	82	83	-	-	-
48	61	44	66	84	-	-	172
49	-	44	79	85	-	-	-
50	59	43	89	86	-	-	-
51	61	82	86	87	-	-	-
51	-	-	71	88	-	-	-
53	175	-	92	89	-	-	-
54	59	41	89	90	-	-	-
55	199	83	99	All	56	47	77

Investigation 06, Males, Combined, comparison basis AM92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	84	36	77
21	-	-	-	57	120	96	75
22	-	640	-	58	32	75	74
23	304	-	594	59	65	19	78
24	-	-	-	60	79	58	83
25	-	-	-	61	-	96	74
26	-	-	140	62	-	119	85
27	-	-	237	63	59	83	68
28	-	-	71	64	67	-	79
29	73	73	109	65	65	77	73
30	-	-	76	66	-	75	83
31	54	52	40	67	-	43	94
32	49	141	73	68	97	152	76
33	-	86	85	69	-	-	85
34	-	193	119	70	-	-	96
35	186	-	51	71	-	-	87
36	-	66	74	72	-	289	73
37	68	32	66	73	-	-	84
38	32	90	63	74	-	-	72
39	93	56	81	75	-	660	107
40	121	82	91	76	-	-	74
41	30	80	57	77	-	455	101
42	89	26	64	78	-	-	71
43	58	26	75	79	-	-	78
44	116	177	89	80	-	-	98
45	58	25	78	81	-	-	118
46	109	24	74	82	-	-	68
47	-	22	74	83	-	-	24
48	53	65	76	84	-	-	31
49	129	102	81	85	-	-	-
50	50	60	89	86	-	-	234
51	129	109	96	87	-	-	69
51	-	19	76	88	-	-	171
53	45	18	78	89	-	-	-
54	68	69	87	90	-	-	136
55	-	50	87	All	58	64	80

Comparisons of Permanent Assurances (I) with JLFD Assurances (II)

Females, Combined

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v II	A/E	A/E	+	-							
0	0	117.01	68.39	4	0	0.0625	(-)	1	0.5000		5.72	0.2209
1	1	119.14	45.60	2	2	0.5000		2	0.3333	(+)	37.37	0.0000
2	2	110.45	55.76	5	2	0.2266	(-)	2	0.0952	(+)	27.23	0.0003
3	3	106.05	64.58	6	1	0.0625	(-)	3	0.5000		12.10	0.0974
4	4	105.36	69.66	8	1	0.0195	(-)	3	0.5000		17.19	0.0458
5+	5+	101.20	94.24	29	17	0.0519	(-)	21	0.3825	(+)	73.32	0.0064

Males, Combined

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v II	A/E	A/E	+	-							
0	0	113.18	78.46	5	3	0.3633	(-)	7	0.0714	(-)	15.58	0.0488
1	1	106.02	84.12	10	4	0.0898	(-)	7	0.5000		12.04	0.6027
2	2	106.51	78.37	8	7	0.5000		9	0.4864	(-)	25.91	0.0390
3	3	103.16	86.51	10	7	0.3145	(-)	6	0.0800	(+)	16.96	0.4573
4	4	100.66	97.34	10	10	0.5000		10	0.4141	(+)	8.84	0.9847
5+	5+	99.73	102.48	26	28	0.4460	(+)	26	0.3447	(+)	96.71	0.0003

The experience of JLFD assurances is significantly lighter than that of permanent assurances at earlier durations. It is similar at durations 5+, especially for males. We do not feel that there is sufficient cause to graduate a table for this experience.

Note on the JLFD investigations

Contributing offices are issued with the following guidelines for submitting data to the joint-life-first-death investigations:

Single or joint life

Joint-life-first-death issued upon one male and one female life.

Subdivision by sex

Each policy will give rise to two data items, one each in both the male and female returns.

Subdivision by age

The age of each life should be calculated independently. It is essential that, when the first death is recorded, the remaining life is treated as a withdrawal from the in force and removed from the investigation. In the case of both lives dying simultaneously (e.g. in a road accident) each death should be included in the appropriate return of deaths.

Subdivision by declared smoking habits

Each life should be categorised independently according to its own declared smoking habits.

In theory, therefore, the male and female combined experience should contain the same amount of in force. Similarly, smoker and non-smoker volumes may vary between the sexes. In practice, data submissions tend to contain very similar, but not identical in force values for males and females in the combined experience.

Investigation 07 – Guaranteed Acceptance Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	139,103.0	2,007	102	50-81	51-82
1	128,706.5	2,440	76	51-82	51-82
2	122,813.0	2,739	93	52-83	52-83
3	111,433.0	2,727	74	53-85	54-84
4	98,674.5	2,664	32	54-86	54-86
5+	463,850.5	14,024	90	27-91	55-91
2+	796,771.0	22,154	289	27-91	52-91
0+	1,064,580.5	26,601	467	27-91	51-91

Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	124,775.5	3,399	265	50-82	50-81
1	116,454.0	3,882	140	51-82	51-82
2	110,666.5	4,124	180	52-83	52-83
3	99,267.5	4,069	210	53-85	53-85
4	88,187.0	4,004	53	54-86	54-86
5+	472,767.0	21,762	277	29-91	55-92
2+	770,888.0	33,959	720	29-91	50-92
0+	1,012,117.5	41,240	1,125	29-91	50-92

Above age 50, there appears to be a large volume of data, at all durations. In fact, volumes have increased dramatically since previous quadrennia.

Comparison of 1999-2002 experience with “92” Series tables

Investigation 07, Females, Combined, comparison basis AF92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	465	436	286
21	-	-	-	57	419	390	209
22	-	-	-	58	368	357	277
23	-	-	-	59	382	386	282
24	-	-	-	60	399	301	252
25	-	-	-	61	310	310	235
26	-	-	-	62	293	262	234
27	-	-	-	63	289	332	204
28	-	-	-	64	322	333	204
29	-	-	-	65	306	297	203
30	-	-	-	66	310	239	195
31	-	-	-	67	329	344	212
32	-	-	-	68	286	304	189
33	-	-	126	69	310	281	196
34	-	-	-	70	252	333	203
35	-	-	84	71	313	248	196
36	-	-	74	72	252	272	171
37	-	-	-	73	242	236	178
38	-	-	-	74	249	219	176
39	-	-	-	75	250	242	172
40	-	-	144	76	201	252	173
41	-	-	132	77	206	201	164
42	-	-	-	78	244	194	153
43	-	-	110	79	195	241	148
44	-	-	102	80	196	184	142
45	-	-	64	81	180	164	137
46	-	-	61	82	437	163	146
47	-	-	29	83	-	351	135
48	-	-	56	84	-	-	139
49	-	-	52	85	-	-	137
50	480	-	49	86	-	-	146
51	393	672	157	87	-	-	128
51	433	528	248	88	-	-	137
53	564	483	299	89	-	-	127
54	447	466	318	90	-	-	133
55	380	369	247	All	276	263	166

Investigation 07, Males, Combined, comparison basis AM92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	466	308	294
21	-	-	-	57	290	310	254
22	-	-	-	58	349	353	260
23	-	-	-	59	323	262	243
24	-	-	-	60	327	249	255
25	-	-	-	61	260	290	252
26	-	-	-	62	293	229	230
27	-	-	-	63	280	239	220
28	-	-	-	64	301	260	222
29	-	-	-	65	234	216	190
30	-	-	-	66	241	183	209
31	-	-	-	67	232	186	189
32	-	-	-	68	231	212	193
33	-	-	-	69	224	196	184
34	-	-	-	70	209	179	173
35	-	-	-	71	213	160	169
36	-	-	-	72	192	152	165
37	-	-	-	73	197	167	151
38	-	-	37	74	204	176	147
39	-	-	-	75	153	149	152
40	-	-	48	76	162	166	145
41	-	-	139	77	199	163	145
42	-	-	69	78	163	160	129
43	-	-	47	79	164	152	131
44	-	-	74	80	145	145	126
45	-	-	28	81	141	135	123
46	-	-	108	82	92	108	115
47	-	-	91	83	-	129	116
48	-	-	86	84	-	-	110
49	-	-	46	85	-	-	108
50	621	-	107	86	-	-	112
51	510	750	107	87	-	-	117
51	550	437	223	88	-	-	112
53	469	390	310	89	-	-	115
54	529	364	328	90	-	-	102
55	375	264	276	All	219	185	146

Comparisons of Permanent Assurances (I) with Geed Acceptance Assurances (II)

Females, Combined

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v II	A/E	A/E	+	-							
0	0	35.42	108.80	0	10	0.0010	(+)	1	0.5000		186.01	0.0000
1	1	51.26	110.56	2	20	0.0001	(+)	4	0.2597	(+)	391.54	0.0000
2	2	53.57	113.22	0	26	0.0000	(+)	1	0.5000		457.96	0.0000
3	3	60.79	113.41	1	29	0.0000	(+)	3	0.5000		300.42	0.0000
4	4	62.05	114.90	0	31	0.0000	(+)	1	0.5000		446.36	0.0000
5+	5+	82.25	124.04	6	38	0.0000	(+)	5	0.0006	(+)	2,083.32	0.0000

Males, Combined

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v II	A/E	A/E	+	-							
0	0	38.45	108.43	0	16	0.0000	(+)	1	0.5000		389.22	0.0000
1	1	47.34	111.00	0	27	0.0000	(+)	1	0.5000		658.32	0.0000
2	2	51.94	113.06	1	27	0.0000	(+)	2	0.0714	(+)	643.28	0.0000
3	3	57.80	113.14	0	30	0.0000	(+)	1	0.5000		747.86	0.0000
4	4	58.30	115.05	0	30	0.0000	(+)	1	0.5000		639.24	0.0000
5+	5+	86.79	139.84	6	43	0.0000	(+)	6	0.0016	(+)	5,758.07	0.0000

The guaranteed acceptance experience is significantly heavier than the permanent assurance experience. On data volumes alone, a ‘higher age’ graduation is clearly possible. However, closer inspection of the data has revealed that the data is dominated by two offices, new to this investigation, with one of them contributing the lion’s share. We therefore do not deem it appropriate to graduate this investigation.

Investigation 29 – Pensions Temporary Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	3,426.0	0	1	28-44	no ages
1	4,927.5	3	1	28-47	no ages
2	6,123.5	6	0	27-52	no ages
3	6,924.5	0	2	28-54	no ages
4	7,126.0	7	2	29-55	no ages
5+	49,911.5	46	5	27-63	no ages
2+	70,085.5	59	9	24-64	no ages
0+	78,439.0	62	11	23-64	no ages

Females, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	1,088.5	0	0	no ages	no ages
1	1,352.0	1	5	no ages	no ages
2	1,442.5	0	1	no ages	no ages
3	1,486.0	0	3	no ages	no ages
4	1,896.0	0	3	37-38	no ages
5+	21,300.0	27	11	29-60	no ages
2+	26,124.5	27	18	27-60	no ages
0+	28,565.0	28	23	26-60	no ages

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	15,684.8	3	10	21-59	no ages
1	14,661.5	8	17	22-57	no ages
2	16,064.8	16	16	24-57	no ages
3	17,590.9	10	16	24-58	no ages
4	18,562.5	13	23	25-59	no ages
5+	132,996.9	155	42	25-65	52-53
2+	185,215.1	194	97	22-65	52-54
0+	215,561.4	205	124	20-65	52-56

Males, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	10,569.0	7	6	25-57	no ages
1	14,565.5	16	9	25-58	no ages
2	17,820.0	13	4	26-60	no ages
3	20,606.0	27	14	26-61	no ages
4	21,828.5	30	18	27-62	no ages
5+	185,566.0	285	40	26-69	58-61
2+	245,820.5	355	76	23-69	45-61
0+	270,955.0	378	91	22-69	45-61

Males, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	3,501.0	1	1	27-42	no ages
1	4,205.0	6	3	27-47	no ages
2	4,370.0	3	9	28-48	no ages
3	4,335.5	4	17	29-49	no ages
4	5,090.5	13	10	30-53	no ages
5+	71,968.0	154	44	27-65	single ages
2+	85,764.0	174	80	25-65	55-57
0+	93,470.0	181	84	23-65	55-57

Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	36,221.9	32	39	20-63	no ages
1	37,921.0	49	48	22-63	no ages
2	42,023.9	46	50	23-63	no ages
3	45,885.1	54	77	24-64	no ages
4	48,651.3	73	78	25-65	no ages
5+	500,891.6	970	258	25-70	39-65
2+	637,451.9	1,143	463	21-71	39-65
0+	711,594.8	1,224	550	19-71	38-65

There is insufficient data to merit a graduation.

Investigation 81 – Minimum Evidence Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	3,418.5	4	1	23-33	no ages
1	3,770.5	0	1	23-37	no ages
2	3,919.5	0	0	25-38	no ages
3	3,319.5	0	1	26-39	no ages
4	2,667.5	0	3	27-34	no ages
5+	51,796.0	63	33	25-63	no ages
2+	61,702.5	63	37	23-63	no ages
0+	68,891.5	67	39	20-64	no ages

Females, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	964.0	0	0	no ages	no ages
1	1,191.5	0	3	no ages	no ages
2	1,219.5	0	1	no ages	no ages
3	991.5	0	1	no ages	no ages
4	792.0	1	2	no ages	no ages
5+	16,468.5	39	18	27-60	no ages
2+	19,471.5	40	22	25-60	no ages
0+	21,627.0	40	25	23-60	no ages

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	187,819.5	106	3	18-67	no ages
1	180,071.6	128	9	19-67	no ages
2	159,456.9	177	8	20-70	51
3	126,512.4	177	22	21-78	47
4	95,466.5	153	39	23-78	51, 53
5+	1,225,229.6	12,732	1,066	24-96	34-97
2+	1,606,665.4	13,239	1,135	20-96	34-97
0+	1,974,556.5	13,473	1,147	18-96	33-97

Males, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	4,045.5	8	1	23-37	no ages
1	4,930.5	0	0	23-41	no ages
2	5,328.5	0	7	24-42	no ages
3	4,696.0	0	10	26-43	no ages
4	3,876.5	1	9	27-40	no ages
5+	88,562.5	162	82	25-64	51, 60
2+	102,463.5	163	108	22-64	51, 60
0+	111,439.5	171	109	20-65	51, 60

Males, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	1,273.0	0	0	no ages	no ages
1	1,585.5	0	3	26-28	no ages
2	1,608.5	0	2	27-29	no ages
3	1,348.0	0	6	no ages	no ages
4	1,071.5	1	7	no ages	no ages
5+	24,054.0	59	52	27-62	no ages
2+	28,082.0	60	67	25-62	no ages
0+	30,940.5	60	70	23-62	no ages

Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	130,071.9	159	7	20-66	no ages
1	118,976.5	200	21	21-68	single ages
2	104,214.1	248	32	23-69	single ages
3	83,042.9	270	77	24-70	51-54
4	64,549.8	226	122	25-70	single ages
5+	2,390,121.6	23,883	3,842	25-80	31-97
2+	2,641,928.4	24,627	4,073	22-81	31-97
0+	2,890,976.8	24,986	4,101	20-81	29-97

Data volumes for the smoker and non-smoker subsections are very low. There is a large amount of data at durations 5+ for the combined section.

Comparison of 1999-2002 experience with "92" Series tables

Investigation 81, Females, Combined, comparison basis AF92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	99	37	100
21	971	820	-	57	150	80	103
22	476	301	-	58	104	-	87
23	-	431	-	59	52	130	91
24	-	169	-	60	99	86	81
25	-	-	224	61	85	165	117
26	384	119	50	62	-	36	115
27	116	-	142	63	87	71	89
28	101	87	102	64	134	38	103
29	-	75	130	65	181	79	136
30	159	-	69	66	118	42	130
31	71	118	64	67	166	57	115
32	132	-	26	68	-	208	110
33	-	49	61	69	461	-	126
34	57	134	127	70	-	-	138
35	109	83	128	71	-	241	129
36	102	39	58	72	-	-	115
37	141	73	87	73	173	-	136
38	175	33	59	74	341	-	121
39	83	62	71	75	-	-	124
40	38	119	122	76	-	305	120
41	37	248	92	77	-	-	118
42	68	26	98	78	-	-	113
43	99	48	124	79	-	-	113
44	130	71	134	80	173	813	111
45	63	23	88	81	-	-	116
46	88	153	108	82	-	821	115
47	28	20	103	83	-	-	119
48	133	155	99	84	-	-	116
49	50	128	105	85	-	-	121
50	144	139	96	86	-	-	116
51	102	115	93	87	-	-	117
51	129	105	100	88	-	-	128
53	145	90	100	89	-	-	111
54	74	215	101	90	-	-	122
55	131	119	101	All	99	94	116

Investigation 81, Males, Combined, comparison basis AM92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	54	85	93
21	151	-	-	57	61	215	94
22	-	-	111	58	157	103	91
23	-	114	84	59	150	52	87
24	-	96	126	60	176	176	96
25	-	-	-	61	214	127	105
26	-	275	61	62	26	157	109
27	65	-	62	63	102	146	101
28	-	222	57	64	201	129	123
29	220	51	160	65	191	63	112
30	50	94	49	66	159	206	99
31	92	43	91	67	-	89	120
32	44	-	117	68	171	113	120
33	86	-	54	69	96	203	114
34	41	195	63	70	95	-	114
35	40	76	79	71	-	-	112
36	111	73	99	72	88	-	114
37	71	67	81	73	78	111	106
38	100	65	82	74	-	-	111
39	128	122	84	75	251	-	113
40	61	174	85	76	-	-	99
41	145	110	101	77	107	469	102
42	27	131	124	78	156	354	99
43	164	72	108	79	-	-	103
44	52	48	85	80	-	-	105
45	101	45	80	81	106	-	98
46	23	66	102	82	-	-	104
47	155	227	110	83	-	-	97
48	63	54	83	84	-	-	96
49	99	119	122	85	-	-	95
50	51	122	93	86	-	-	100
51	151	77	97	87	-	-	102
51	62	75	95	88	-	-	98
53	42	109	87	89	-	-	102
54	67	164	90	90	-	-	94
55	172	129	108	All	95	107	100

Comparisons of Permanent Assurances (I) with Minimum Evidence Assurances (II)

Females, Combined

Durations		I	II	Numbers								
I	v II	A/E	A/E	+	-	p(+)		runs	p(runs)		χ^2	p(χ^2)
0	0	90.95	109.12	2	7	0.0898	(+)	4	0.5000		3.14	0.9583
1	1	100.29	99.44	5	6	0.5000		4	0.1104	(+)	12.09	0.3567
2	2	95.73	110.24	6	13	0.0835	(+)	11	0.2566	(-)	12.80	0.8488
3	3	98.75	103.72	10	12	0.4159	(+)	13	0.3950	(-)	8.63	0.9951
4	4	98.71	105.08	6	11	0.1662	(+)	12	0.0577	(-)	11.58	0.8250
5+	5+	94.07	106.65	12	55	0.0000	(+)	18	0.1609	(+)	262.26	0.0000

Males, Combined

Durations		I	II	Numbers								
I	v II	A/E	A/E	+	-	p(+)		runs	p(runs)		χ^2	p(χ^2)
0	0	90.57	112.12	5	11	0.1051	(+)	7	0.4066	(+)	9.99	0.8672
1	1	91.79	118.31	7	16	0.0466	(+)	9	0.2670	(+)	23.31	0.4427
2	2	90.85	126.45	3	25	0.0000	(+)	4	0.0379	(+)	48.05	0.0106
3	3	91.86	126.97	5	24	0.0003	(+)	10	0.7167	(-)	38.36	0.1145
4	4	94.11	125.44	4	21	0.0005	(+)	6	0.1514	(+)	36.56	0.0635
5+	5+	93.74	112.87	11	59	0.0000	(+)	9	0.0000	(+)	857.53	0.0000

The experience of minimum evidence assurances is significantly heavier than that of permanent assurances, other than at duration 1 for females. We do not feel that there is sufficient cause to graduate a table for this experience.

Investigation 86 – Minimum Evidence Joint-Life First-Death Assurances

Summaries of the data – 1999-2002, all ages combined

Females, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	0.0	0		no ages	no ages
1	0.0	0		no ages	no ages
2	0.0	0		no ages	no ages
3	51.0	0		no ages	no ages
4	171.0	0		no ages	no ages
5+	22,757.0	14		28-60	no ages
2+	22,979.0	14		28-60	no ages
0+	22,979.0	14		28-60	no ages

Females, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	0.0	0		no ages	no ages
1	0.0	0		no ages	no ages
2	0.0	0		no ages	no ages
3	9.5	0		no ages	no ages
4	36.5	0		no ages	no ages
5+	5,644.5	15		32-56	no ages
2+	5,690.5	15		32-56	no ages
0+	5,690.5	15		32-56	no ages

Females, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	67.3	0	2	no ages	no ages
1	120.3	0	2	no ages	no ages
2	236.6	0	18	no ages	no ages
3	513.4	0	24	no ages	no ages
4	1,740.8	0	51	35	no ages
5+	1,747,362.6	2,101	1,590	25-70	33-64
2+	1,749,853.4	2,101	1,683	25-70	33-64
0+	1,750,041.0	2,101	1,687	25-70	33-64

Males, Non-smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	0.0	0		no ages	no ages
1	0.0	0		no ages	no ages
2	0.0	0		no ages	no ages
3	46.5	0		no ages	no ages
4	158.0	0		no ages	no ages
5+	23,189.5	34		30-63	no ages
2+	23,394.0	34		29-63	no ages
0+	23,394.0	34		29-63	no ages

Males, Smokers

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	0.0	0		no ages	no ages
1	0.0	0		no ages	no ages
2	0.0	0		no ages	no ages
3	14.0	0		no ages	no ages
4	48.5	0		no ages	no ages
5+	6,429.5	12		33-58	no ages
2+	6,492.0	12		32-58	no ages
0+	6,492.0	12		32-58	no ages

Males, Combined

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	68.8	0	7	no ages	no ages
1	120.3	0	13	no ages	no ages
2	235.6	0	34	no ages	no ages
3	515.8	1	64	no ages	no ages
4	1,746.5	2	123	37	no ages
5+	1,745,476.6	3,521	2,901	26-71	33-67
2+	1,747,974.5	3,524	3,122	26-71	33-67
0+	1,748,163.6	3,524	3,142	26-71	33-67

Data volumes for the smoker and non-smoker subsections, and at durations below 5+ for all sections, are very low. There is a large amount of data at durations 5+ for the combined section.

Comparison of 1999-2002 experience with "92" Series tables

Investigation 86, Females, Combined, comparison basis AF92 sel

Age	Dur 0	100 A/E		Age	Dur 0	100 A/E	
		Dur 1	Dur 2+			Dur 1	Dur 2+
20	-	-	-	56	-	-	88
21	-	-	-	57	-	-	76
22	-	-	-	58	-	-	92
23	-	-	-	59	-	-	82
24	-	-	-	60	-	-	81
25	-	-	-	61	-	-	77
26	-	-	-	62	-	-	54
27	-	-	-	63	-	-	60
28	-	-	-	64	-	-	93
29	-	-	46	65	-	-	46
30	-	-	130	66	-	-	114
31	-	-	47	67	-	-	98
32	-	-	70	68	-	-	58
33	-	-	115	69	-	-	198
34	-	-	87	70	-	-	61
35	-	-	65	71	-	-	176
36	-	-	72	72	-	-	-
37	-	-	115	73	-	-	207
38	-	-	99	74	-	-	-
39	-	-	83	75	-	-	-
40	-	-	58	76	-	-	-
41	-	-	81	77	-	-	-
42	-	-	81	78	-	-	-
43	-	-	92	79	-	-	611
44	-	-	74	80	-	-	-
45	-	-	67	81	-	-	-
46	-	-	92	82	-	-	-
47	-	-	93	83	-	-	-
48	-	-	93	84	-	-	-
49	-	-	92	85	-	-	-
50	-	-	86	86	-	-	-
51	-	-	104	87	-	-	-
51	-	-	90	88	-	-	-
53	-	-	79	89	-	-	-
54	-	-	86	90	-	-	683
55	-	-	92	All	-	-	85

Investigation 86, Males, Combined, comparison basis AM92 sel

Age	100 A/E			Age	100 A/E		
	Dur 0	Dur 1	Dur 2+		Dur 0	Dur 1	Dur 2+
20	-	-	-	56	-	-	92
21	-	-	-	57	-	-	86
22	-	-	-	58	-	-	89
23	-	-	-	59	-	-	81
24	-	-	-	60	-	-	95
25	-	-	-	61	-	-	89
26	-	-	-	62	-	-	81
27	-	-	-	63	-	-	81
28	-	-	-	64	-	-	79
29	-	-	120	65	-	-	75
30	-	-	63	66	-	-	99
31	-	-	55	67	-	-	104
32	-	-	57	68	-	-	62
33	-	-	83	69	-	-	76
34	-	-	83	70	-	-	87
35	-	-	79	71	-	-	49
36	-	-	86	72	-	-	69
37	-	-	68	73	-	-	89
38	-	-	83	74	-	-	-
39	-	-	93	75	-	-	154
40	-	-	82	76	-	-	126
41	-	-	73	77	-	-	314
42	-	-	87	78	-	-	-
43	-	-	91	79	-	-	-
44	-	-	79	80	-	-	-
45	-	-	71	81	-	-	275
46	-	-	68	82	-	-	-
47	-	-	77	83	-	-	-
48	-	-	86	84	-	-	-
49	-	-	86	85	-	-	-
50	-	-	83	86	-	-	-
51	-	-	81	87	-	-	-
51	-	-	91	88	-	-	-
53	-	-	80	89	-	-	-
54	-	-	92	90	-	-	-
55	-	-	88	All	-	-	84

Comparisons of Permanent Assurances (I) with Min Evidence JLFD Assurances (II)

Females, Combined

Durations		I	II	Numbers								
I	v II	A/E	A/E	+	-	p(+)	runs	p(runs)	χ^2	p(χ^2)		
5+	5+	100.37	97.84	24	14	0.0717	(-)	21	0.2658	(-)	40.49	0.3611

Males, Combined

Durations		I	II	Numbers								
I	v II	A/E	A/E	+	-	p(+)	runs	p(runs)	χ^2	p(χ^2)		
5+	5+	99.55	105.47	17	23	0.2148	(+)	9	0.0001	(+)	55.49	0.0525

The experience of minimum evidence JLFD assurances is similar to that of permanent assurances at durations 5+. There is virtually no data at earlier durations. We do not feel that there is sufficient cause to graduate a table for this experience.

Conclusions from inspection of data volumes

Our initial conclusions are that we should concentrate our efforts on Investigations 01 (Permanent Assurances) and 02 (Temporary Assurances), as was the case with the “80” Series and “92” Series graduations. Data volumes for some of the other investigations are too low, and we also question whether there would be a particular demand for any tables produced from them.

We also believe that practitioners would find separate smoker/non-smoker tables very useful. Certainly, the current practice of making fairly crude adjustments to aggregate tables cannot be ideal, and so we hope any information we can give would be well received. This would lead to twelve possible tables:

Permanent Assurances	Non-smoker	Male Female
	Smoker	Male Female
	Combined	Male Female
Temporary Assurances	Non-smoker	Male Female
	Smoker	Male Female
	Combined	Male Female

The ability to produce all of these tables may be constrained by low data volumes at earlier durations. This might lead to the need to consider some alternative methods of producing some of these tables.

Conclusions from comparison of investigations

It can be seen from the above tables that the experiences of Investigations 01 and 02 are very similar at durations 5+, particularly so for males. At earlier durations, the mortality experience for Investigation 01 is significantly heavier than that for Investigation 02.

A possible suggestion, therefore, is that the ultimate (5+) experience of the combined 01/02 experience, for each sub-section, is graduated, with separate Permanent/Temporary tables then produced for the select durations.

Comparison of durations

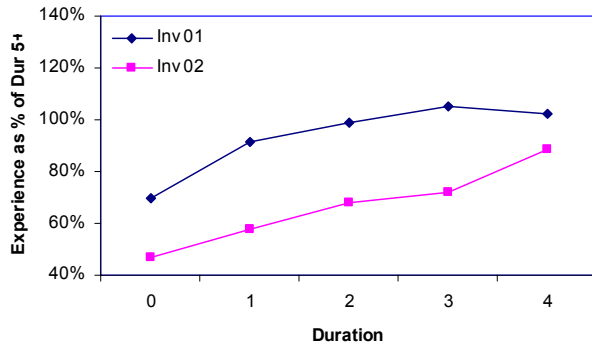
Tables have been produced that show how the data for different durations within a subsection compare, for Investigations 01 and 02. These tables are voluminous and are not reproduced here, however they are available on request.

Conclusions from durational comparisons

The above-mentioned tables show that, notwithstanding low volumes at the earlier durations, selection effects appear to exist. For Investigation 01, a two-year select period looks reasonable, whereas a five-year select period looks more appropriate for Investigation 02. This can be seen in the following tables and graphs where total 100A/Es for each of the durations 0 to 4 are expressed as a percentage of the duration 5+ 100A/E.

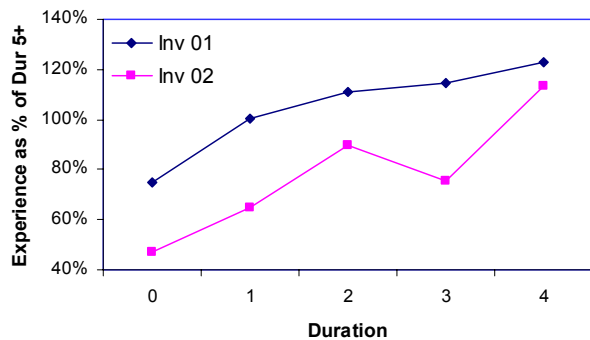
Males, Combined

Duration	100A/E as % of Dur 5+	
	Inv 01	Inv 02
0	69.9%	46.8%
1	91.6%	57.8%
2	99.1%	67.8%
3	105.0%	72.1%
4	102.2%	88.4%



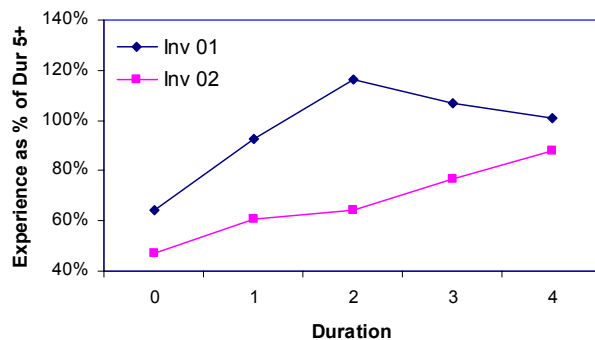
Males, Smokers

Duration	100A/E as % of Dur 5+	
	Inv 01	Inv 02
0	75.0%	47.0%
1	100.5%	64.8%
2	111.1%	89.9%
3	114.4%	75.3%
4	122.6%	113.6%



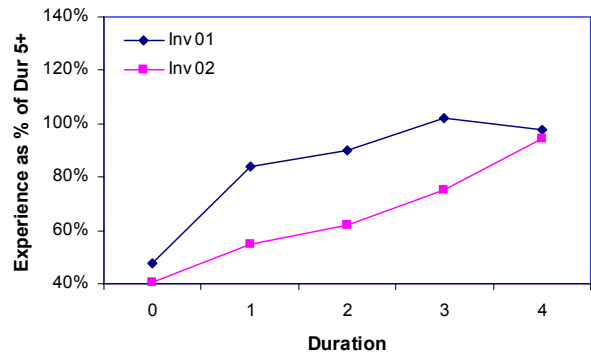
Males, Non-smokers

Duration	100A/E as % of Dur 5+	
	Inv 01	Inv 02
0	64.3%	47.3%
1	92.9%	60.5%
2	116.2%	64.5%
3	106.9%	76.5%
4	101.0%	87.8%



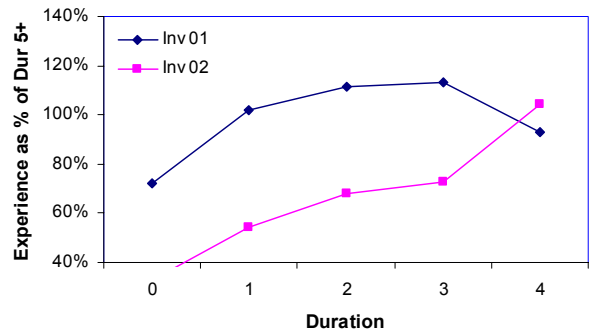
Females, Combined

Duration	100A/E as % of Dur 5+	
	Inv 01	Inv 02
0	47.8%	40.5%
1	83.9%	54.7%
2	89.9%	62.0%
3	102.3%	75.2%
4	97.7%	94.4%



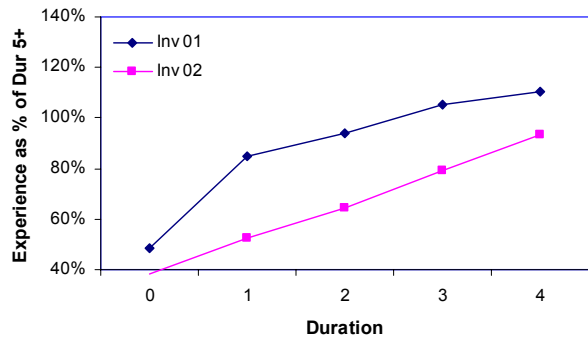
Females, Smokers

Duration	100A/E as % of Dur 5+	
	Inv 01	Inv 02
0	72.2%	33.1%
1	101.7%	54.5%
2	111.4%	67.7%
3	113.2%	72.8%
4	93.1%	104.1%



Females, Non-smokers

Duration	100A/E as % of Dur 5+	
	Inv 01	Inv 02
0	48.4%	38.4%
1	84.8%	52.7%
2	94.0%	64.2%
3	105.3%	78.9%
4	110.4%	93.3%



Ultimate durations

The suggestion was made earlier that a combined Permanent/Temporary Assurance ultimate (5+) could table be produced. The above sections appears to suggest that this should be modified so that the ultimate experience comprises Permanents at durations 2+ and Temporaries at durations 5+.

Select durations

As noted earlier, we believe there are strong reasons to consider producing 12 separate tables (01/02, M/F, N/S/C) – though possibly with combined 01/02 at ultimate durations. However, there is limited early duration data for most of these categories. Past practice has been to fit a curve to the full age range for the data for each separate duration. This quadrennium may require a different approach. A possibility for an alternative approach might be:

1. Graduate the ultimate duration data only (5+?, 2+?).
2. Define the select period mortality rates to be a function of the ultimate rates, i.e. $q_{[x]+t} = q_{x+t} * f(x,t)$.
3. Instead of graduating the mortality rates for each duration, we fit a smoothed surface $f(x,t)$. The advantage of this approach is that we directly borrow the properties of the curve fitted to the ultimate rates and we can make sure that the values of $f(x,t)$ are intuitively reasonable.

We do not consider the possibility of using the lack of data at low durations as an excuse to produce tables with no select period should be entertained. Practitioners would expect a select period for assured lives tables.

(ii) Pensioner Investigations

Summary of issues for the Pensioner Investigations

Potential Graduations

An all duration graduation is possible for each of these investigations except for male spouses. Based on the results of the comparisons by duration the following graduations also seem possible. Alternative groupings by duration are viable for some investigations.

Investigation(s)	Grouping by Duration
Normal/Late	0-1 ,2+
Early	0, 1+
Spouses (females only)	0+
Normal/Late and Early combined	0, 1+

Key Issues Raised

Investigations to graduate

- Should the standard table be based on the Normal/Late retirements experience (as has been the case previously) or should the Combined experience be used instead? Should the Early retirements experience also be graduated?

Select period

- Would select pensioner tables be of any practical use?

Reverse Selection

- Is reverse selection, with mortality experience at early durations being heavier than that at later durations, acceptable at ages less than the early 60s for Normal/Late retirements?
- If so, does the age at which the short duration mortality first becomes less than ultimate mortality need to be identical for the amounts and lives investigations?
- Is reverse selection acceptable for Early retirements at duration 0?

Shape of mortality curve at younger ages

At the younger ages the crude mortality curve is u-shaped. The feature is noted in both the Normal/Late and Early retirement investigations for males and females on a lives and amounts basis.

- Should this feature be retained in the graduation?

Investigation 31 – Life Office Pensioners (Normal & Late)

Summaries of the data – 1999-2002, all ages combined

Females, Amounts

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Average Amount	
				Central EtR	Actual Deaths
0	48,310,818	237,885	102,545	1,175	948
1	49,439,446	250,218	128,143	1,259	1,143
2	46,441,955	263,514	66,222	1,429	1,344
3	41,830,641	326,163	124,975	1,550	2,001
4	35,012,678	222,458	118,303	1,541	1,324
5	28,602,194	453,578	271,282	1,475	3,024
6	24,803,257	268,774	305,089	1,481	1,554
7	23,315,869	259,380	374,267	1,553	1,441
8	24,926,816	301,165	410,185	1,736	1,381
9	27,923,861	461,544	292,895	1,937	1,678
10+	240,164,858	8,969,237	4,602,016	1,084	728
0+	590,772,390	12,013,916	6,795,922	1,273	839

Females, Lives

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	41,121.5	251	83	47-80	60-62
1	39,278.5	219	109	48-77	60-63
2	32,505.5	196	85	49-75	62-63
3	26,981.5	163	124	52-75	63-64
4	22,721.5	168	128	54-75	64-65
5	19,388.0	150	184	55-76	65-66
6	16,746.5	173	210	56-77	66-67
7	15,015.0	180	265	58-78	67-68
8	14,362.0	218	282	61-79	68-69
9	14,416.5	275	279	62-80	68-70
10+	221,619.0	12,324	10,576	53-101	66-103
0+	464,155.5	14,317	12,325	38-101	54-103

Males, Amounts

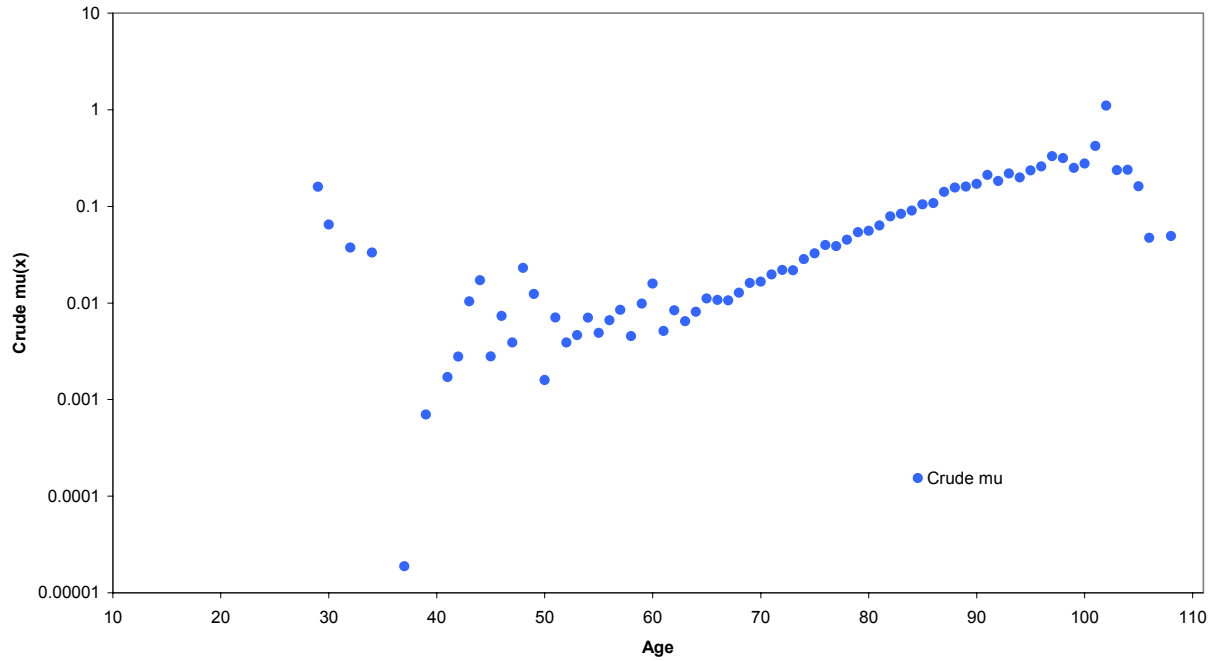
Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Average Amount	
				Central EtR	Actual Deaths
0	188,152,654	1,931,487	865,946	2,194	1,720
1	179,710,400	2,027,432	913,686	2,226	1,817
2	165,310,779	1,762,440	1,203,296	2,550	1,991
3	165,729,281	2,428,946	925,647	2,879	2,494
4	154,685,848	2,341,591	1,493,907	2,859	2,504
5	131,213,716	2,058,857	1,819,440	2,664	2,063
6	116,669,286	2,082,763	2,289,003	2,604	2,001
7	110,922,701	2,554,754	2,943,235	2,625	2,249
8	118,103,344	2,452,199	2,753,621	2,846	1,986
9	129,858,818	3,561,420	2,618,612	3,121	2,360
10+	1,034,931,540	62,568,692	29,872,943	2,146	1,468
0+	2,495,288,365	85,770,581	47,699,336	2,389	1,601

Males, Lives

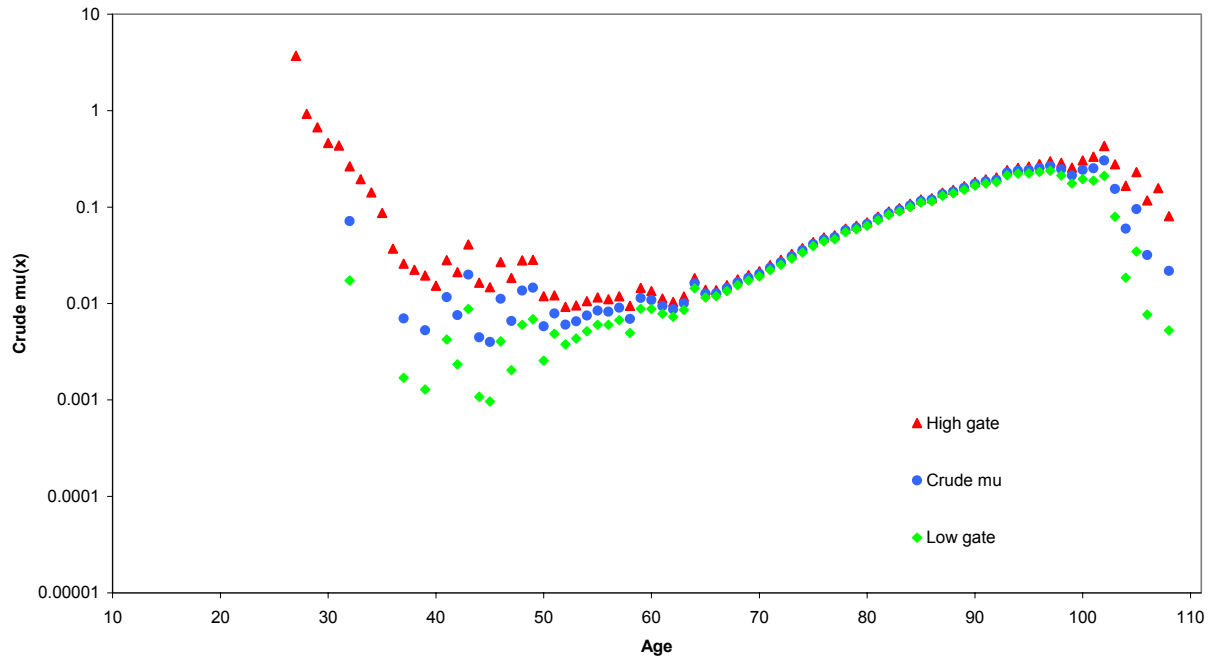
Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	85,762.0	1,123	602	50-80	58-78
1	80,747.0	1,116	624	51-81	60-73
2	64,822.5	885	747	52-80	61-72
3	57,556.0	974	748	53-80	63-80
4	54,107.5	935	947	54-80	64-71
5	49,254.0	998	1,136	55-81	64-73
6	44,810.0	1,041	1,394	56-81	65-77
7	42,258.5	1,136	1,376	57-80	67-79
8	41,497.5	1,235	1,600	59-84	68-79
9	41,612.5	1,509	1,695	60-85	68-80
10+	482,234.5	42,619	37,744	61-101	64-102
0+	1,044,662.0	53,571	48,613	37-101	51-102

Crude mortality rates

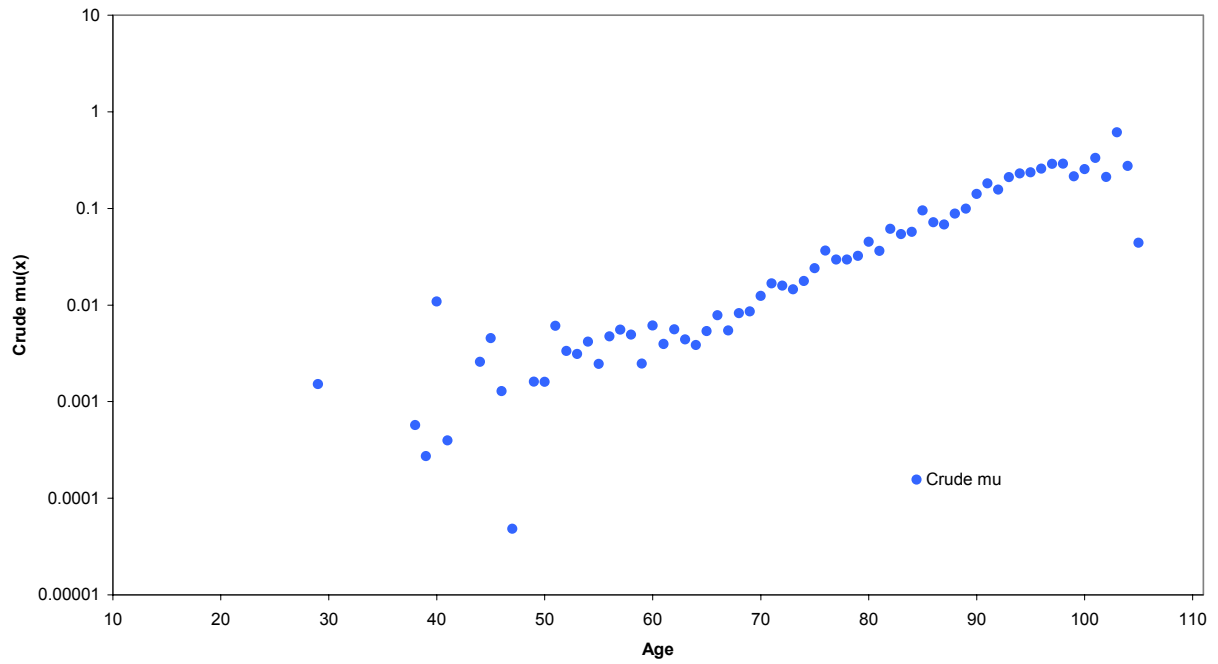
Crude Mu for Normal/Late Pensioners, Males, Amounts



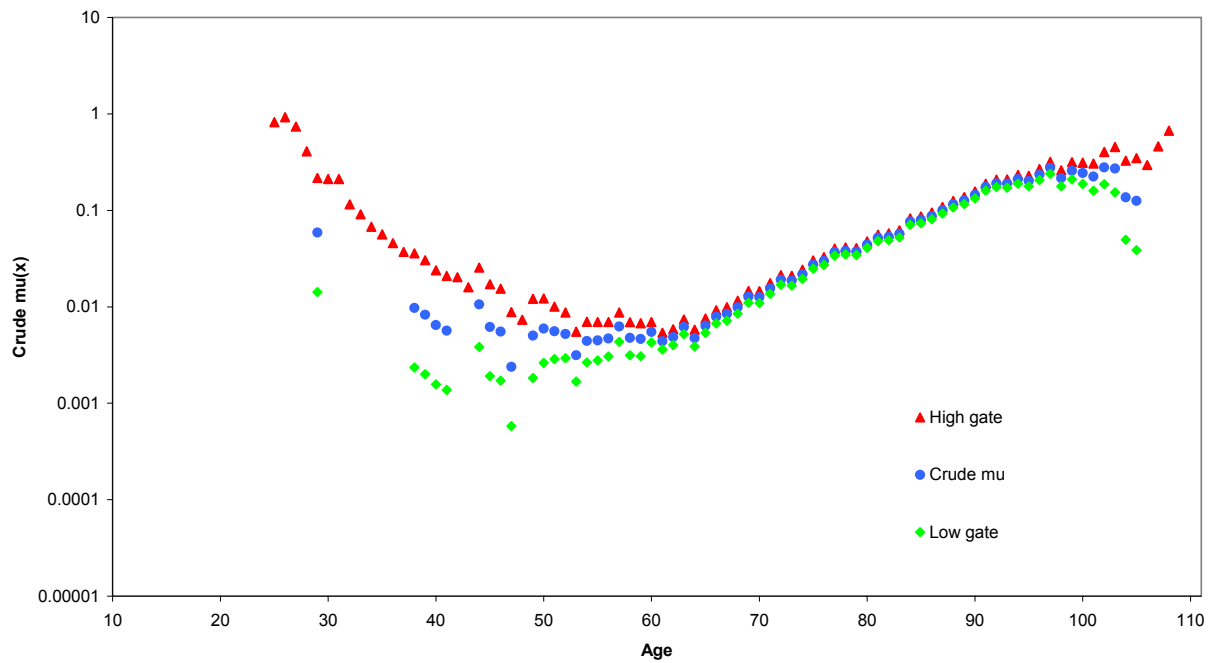
Crude Mu and Low and High Gates for Normal/Late Pensioners, Males, Lives



Crude Mu for Normal/Late Pensioners, Females, Amounts



Crude Mu and Low and High Gates for Normal/Late Pensioners, Females, Lives



Comparison of 1999-2002 experience with “92” Series tables

Investigation 31, Females, comparison bases PFA92 (amounts) and PFL92 (lives)

Age	Amounts			Lives		
	100 A/E using PFA92 (C=yyyy)			100 A/E using PFL92 (C=yyyy)		
	C=2020	C=2000	C=1992	C=2020	C=2000	C=1992
55	252	137	104	381	207	158
56	421	229	174	348	189	144
57	431	235	179	405	220	168
58	333	181	138	271	147	112
59	147	80	61	232	126	96
60	318	173	132	241	131	100
61	172	96	74	164	92	70
62	207	119	92	153	88	68
63	138	81	64	166	98	77
64	103	62	49	108	65	52
65	122	75	60	125	77	62
66	152	96	78	132	83	67
67	91	59	48	121	78	64
68	118	78	64	123	81	66
69	106	71	59	136	91	76
70	132	91	75	117	80	67
71	155	108	90	125	87	73
72	127	90	76	133	94	80
73	102	73	62	114	82	70
74	108	79	68	116	85	73
75	129	95	82	129	96	83
76	171	129	112	123	93	81
77	122	93	82	134	102	89
78	108	83	73	122	94	83
79	105	82	73	106	83	74
80	129	103	91	111	88	79
81	93	75	67	116	93	84
82	138	112	101	106	86	78
83	110	90	82	102	84	76
84	104	87	79	121	101	92
85	153	128	117	114	96	87
86	106	90	82	112	95	87
87	91	78	72	115	99	91
88	106	91	85	120	103	96
89	108	94	88	118	103	96
90	137	120	113	122	107	100
91	158	140	132	132	117	110
92	126	113	107	131	118	111
93	152	137	130	120	108	103
94	152	138	131	121	110	105
95	143	131	125	107	98	94
96	143	132	127	114	105	101
97	148	137	132	122	113	109
98	137	129	124	90	84	82
99	98	93	90	99	93	90
100	107	101	99	88	83	81
All	124	95	83	119	96	85

Investigation 31, Males, comparison bases PMA92 (amounts) and PML92 (lives)

Age	Amounts			Lives		
	100 A/E using PMA92 (C=yyyy)			100 A/E using PML92 (C=yyyy)		
	C=2020	C=2000	C=1992	C=2020	C=2000	C=1992
55	459	250	190	428	233	177
56	534	290	221	366	199	152
57	586	319	243	351	191	145
58	269	146	111	236	128	98
59	499	271	207	340	185	141
60	692	377	287	285	155	118
61	186	104	80	209	117	90
62	253	145	113	164	94	73
63	163	96	76	161	95	75
64	171	103	82	222	134	106
65	196	121	97	149	92	74
66	160	101	82	130	82	66
67	134	87	70	126	82	66
68	136	90	74	125	83	68
69	147	98	81	121	81	67
70	129	88	73	116	79	66
71	131	91	76	117	82	68
72	126	89	75	117	83	70
73	108	78	66	118	85	72
74	121	89	76	120	88	75
75	121	90	77	123	91	78
76	128	97	84	121	91	79
77	109	84	73	113	86	76
78	112	86	76	119	92	81
79	117	92	81	113	89	79
80	107	85	76	110	87	78
81	108	86	77	113	91	81
82	118	96	87	115	93	84
83	112	92	83	112	92	83
84	108	90	82	112	93	85
85	112	94	86	113	95	87
86	104	89	81	106	90	82
87	122	104	96	110	94	87
88	122	105	98	106	92	85
89	114	99	92	106	92	86
90	110	97	91	107	94	88
91	123	109	102	104	93	87
92	99	89	84	100	90	85
93	108	97	92	108	98	93
94	92	83	80	105	96	91
95	100	91	87	100	92	88
96	101	93	90	97	90	86
97	117	109	105	96	89	86
98	106	99	96	84	79	76
99	81	76	74	69	65	63
100	84	80	77	74	70	68
All	119	92	81	113	90	81

Investigation 33 – Life Office Pensioners (Early)

Summaries of the data – 1999-2002, all ages combined

Females, Amounts

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Average Amount	
				Central EtR	Actual Deaths
0	16,898,267	120,505	41,113	1,130	1,057
1	17,026,087	87,074	24,229	1,088	1,193
2	15,477,086	89,174	15,086	1,064	1,013
3	16,724,809	73,959	20,028	1,081	850
4	16,116,154	97,877	53,538	1,085	1,064
5	13,596,830	66,233	46,042	1,081	818
6	11,084,565	61,594	62,548	1,042	855
7	9,735,280	77,507	74,128	1,087	981
8	9,505,002	66,858	60,458	1,231	1,078
9	9,530,918	87,490	65,595	1,435	1,306
10+	78,523,232	1,878,699	1,423,549	1,025	670
0+	214,218,227	2,706,970	1,886,314	1,079	748

Females, Lives

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	14,952.0	114	58	50-66	no ages
1	15,644.5	73	46	50-67	no ages
2	14,542.0	88	31	50-67	62
3	15,467.5	87	46	51-68	63
4	14,860.0	92	38	53-69	62-64
5	12,573.5	81	49	54-70	65
6	10,633.0	72	49	56-71	66-67
7	8,958.0	79	44	57-72	62-63
8	7,723.5	62	59	58-72	no ages
9	6,639.5	67	51	59-73	67
10+	76,573.0	2,806	2,601	55-94	62-96
0+	198,566.5	3,621	3,072	37-94	52-96

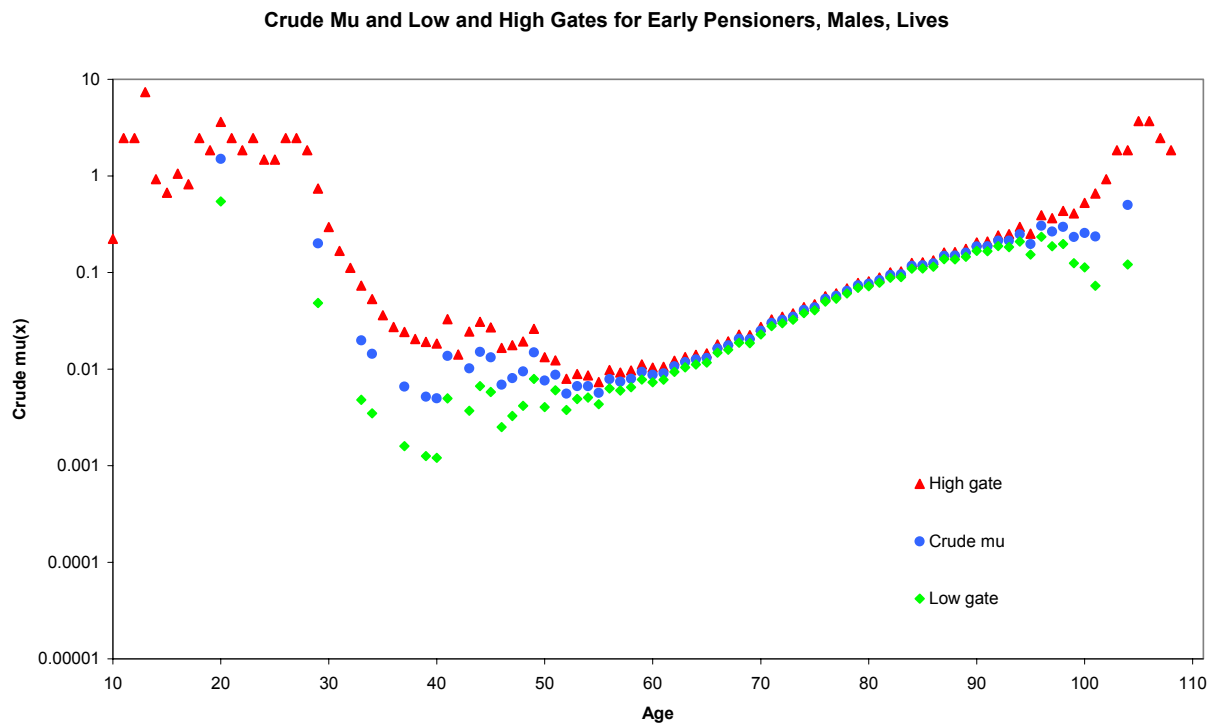
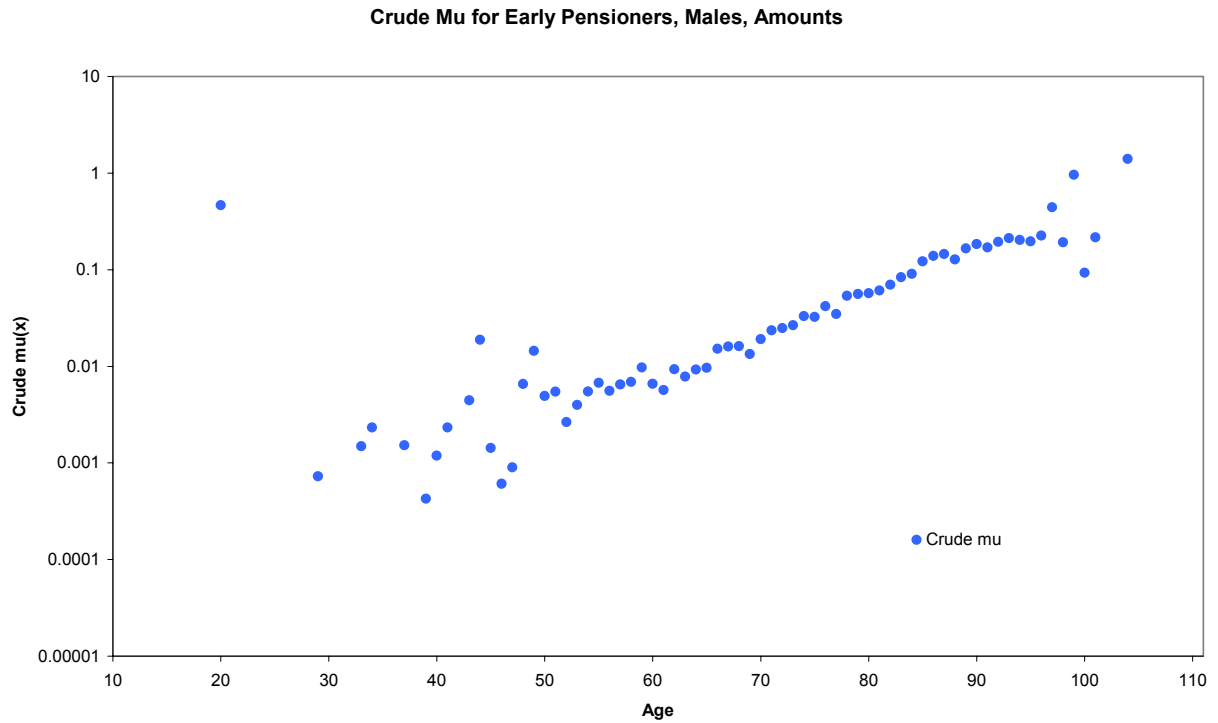
Males, Amounts

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Average Amount	
				Central EtR	Actual Deaths
0	87,285,178	860,604	294,116	2,566	2,084
1	88,609,870	654,017	292,019	2,535	2,063
2	73,801,423	458,801	361,610	2,313	1,490
3	73,889,969	627,407	427,861	2,361	1,925
4	75,418,834	634,054	414,558	2,507	2,013
5	72,308,173	898,509	772,894	2,560	2,620
6	66,279,690	804,376	900,834	2,447	2,047
7	68,340,207	1,047,727	1,116,214	2,542	2,187
8	77,953,801	1,597,724	1,064,265	2,934	2,868
9	86,343,353	1,836,748	1,383,117	3,464	3,082
10+	629,040,582	25,325,316	15,390,348	2,537	1,564
0+	1,399,271,076	34,745,283	22,417,836	2,573	1,717

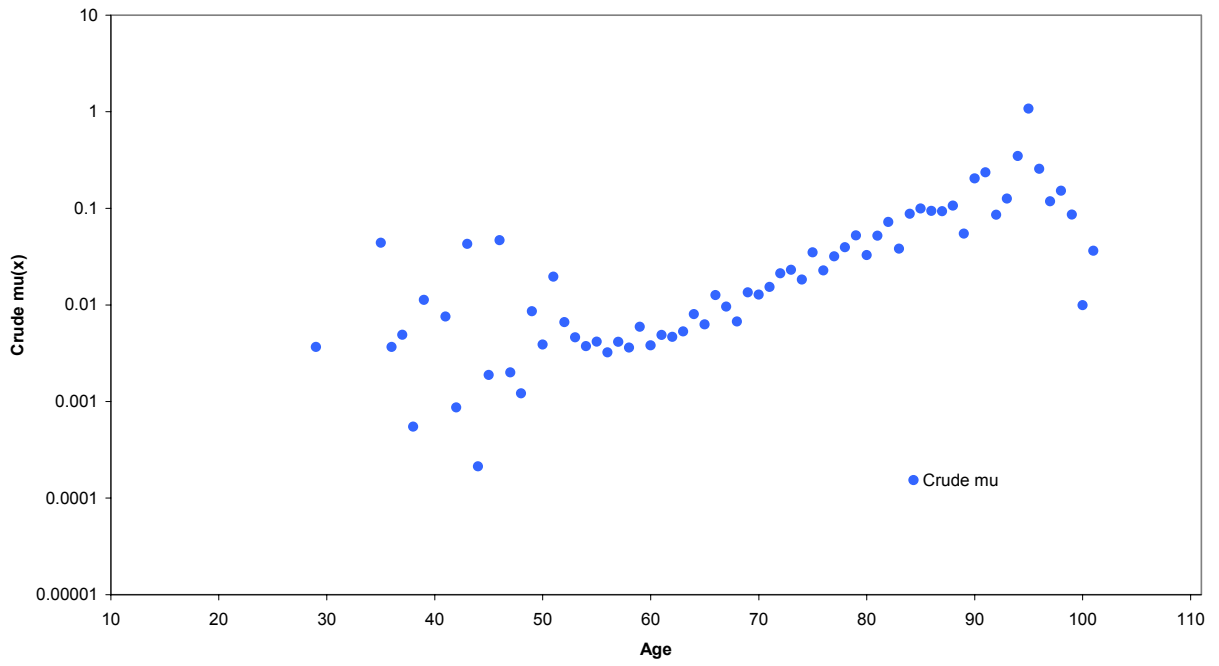
Males, Lives

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	34,011.0	413	241	50-78	54-66
1	34,950.0	317	227	51-79	61-66
2	31,905.5	308	271	51-68	60-67
3	31,302.5	326	283	50-69	59-68
4	30,078.5	315	302	52-70	59-69
5	28,249.5	343	398	54-71	62-70
6	27,091.5	393	449	55-72	59-71
7	26,888.5	479	430	57-73	60-72
8	26,573.0	557	466	58-74	59-74
9	24,924.0	596	609	59-75	63-74
10+	247,954.5	16,192	16,310	56-97	62-98
0+	543,928.5	20,239	19,986	35-97	51-98

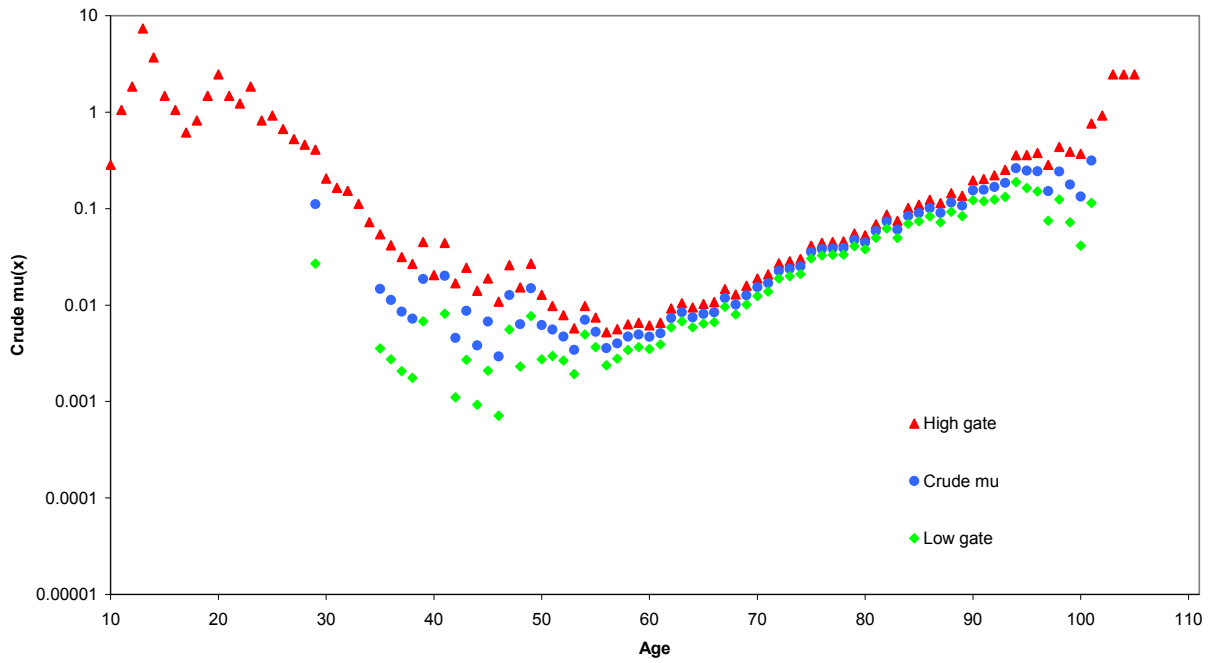
Crude mortality rates



Crude Mu for Early Pensioners, Females, Amounts



Crude Mu and Low and High Gates for Early Pensioners, Females, Lives



Comparison of 1999-2002 experience with “92” Series tables

Investigation 33, Females, comparison bases PFA92 (amounts) and PFL92 (lives)

Age	Amounts			Lives		
	100 A/E using PFA92 (C=yyyy)			100 A/E using PFL92 (C=yyyy)		
	C=2020	C=2000	C=1992	C=2020	C=2000	C=1992
55	425	231	176	448	243	186
56	288	156	119	266	144	110
57	322	175	133	260	142	108
58	245	133	101	268	146	111
59	352	191	146	247	134	102
60	198	108	82	206	112	85
61	214	119	92	190	106	82
62	173	99	77	231	133	103
63	166	98	77	226	133	105
64	213	129	102	170	103	81
65	143	88	70	159	98	78
66	245	155	125	142	89	72
67	159	103	83	171	110	89
68	96	63	52	126	83	68
69	166	112	92	136	91	75
70	136	93	77	142	97	81
71	141	98	82	137	95	80
72	170	120	102	159	112	95
73	161	116	98	146	105	89
74	112	82	70	135	99	84
75	186	138	119	166	123	106
76	107	81	70	157	118	102
77	132	100	88	140	107	94
78	144	111	98	125	97	85
79	168	132	117	134	105	93
80	94	75	67	113	90	80
81	132	106	95	131	105	94
82	162	132	119	145	118	106
83	78	64	58	108	89	80
84	158	131	119	133	110	100
85	160	134	123	128	107	98
86	137	116	107	129	109	100
87	122	105	97	105	90	83
88	126	109	101	120	103	96
89	61	53	49	101	88	82
90	192	169	158	130	115	107
91	200	178	167	120	107	100
92	72	64	60	117	104	99
93	95	86	81	117	106	100
94	218	198	189	148	134	128
95	476	436	417	129	118	113
All	160	113	96	144	108	93

Investigation 33, Males, comparison bases PMA92 (amounts) and PML92 (lives)

Age	Amounts			Lives		
	100 A/E using PMA92 (C=yyyy)			100 A/E using PML92 (C=yyyy)		
	C=2020	C=2000	C=1992	C=2020	C=2000	C=1992
55	632	344	262	289	157	120
56	449	244	186	349	190	145
57	449	244	186	289	157	120
58	408	222	169	271	147	112
59	494	269	205	279	152	116
60	290	157	120	229	124	95
61	207	116	89	201	113	87
62	281	161	125	202	116	90
63	197	116	91	190	112	88
64	195	118	93	173	104	83
65	171	106	84	154	95	76
66	225	142	115	166	105	84
67	202	130	106	153	99	81
68	173	114	93	156	103	84
69	122	82	68	134	90	74
70	149	102	85	143	98	81
71	156	109	91	150	104	87
72	142	101	85	140	99	84
73	131	94	80	134	96	82
74	141	103	88	137	100	86
75	120	89	77	130	96	83
76	135	102	88	140	105	91
77	98	75	66	133	101	89
78	132	102	90	133	103	90
79	122	96	85	135	106	94
80	110	87	78	126	100	89
81	103	83	74	123	99	88
82	105	86	77	125	101	91
83	112	92	83	115	94	85
84	108	90	82	126	105	95
85	130	109	100	116	97	89
86	132	112	103	110	93	86
87	125	107	99	119	102	94
88	101	87	81	110	95	88
89	117	102	95	107	94	87
90	118	104	97	114	100	94
91	101	90	84	105	94	88
92	105	94	89	110	99	93
93	105	95	90	103	93	88
94	94	85	81	110	100	95
95	84	77	74	83	76	73
All	135	101	87	132	101	89

Investigation 34 – Spouses of Life Office Pensioners

Summaries of the data – 1999-2002, all ages combined

Females, Amounts

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Average Amount	
				Central EtR	Actual Deaths
0+	450,522,129	14,237,681	6,972,071	1,805	1,385

Females, Lives

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0+	249,605.0	10,282	6,687	38-100	57-100

Males, Amounts

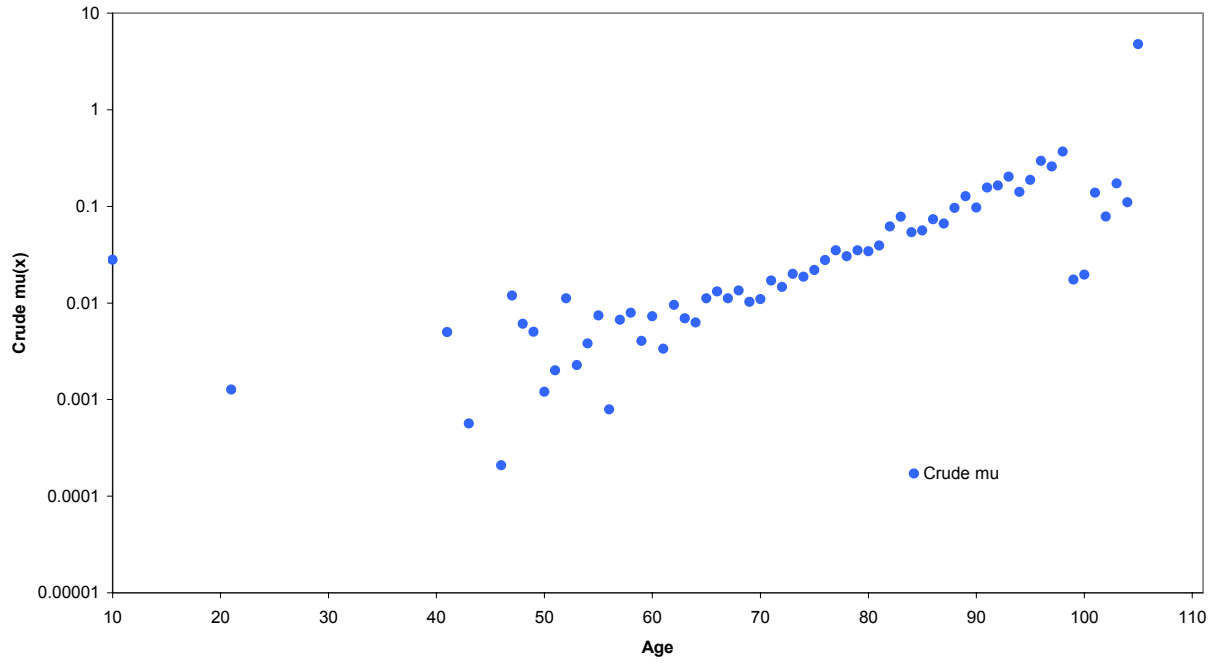
Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Average Amount	
				Central EtR	Actual Deaths
0+	10,011,300	370,126	162,451	1,237	1,386

Males, Lives

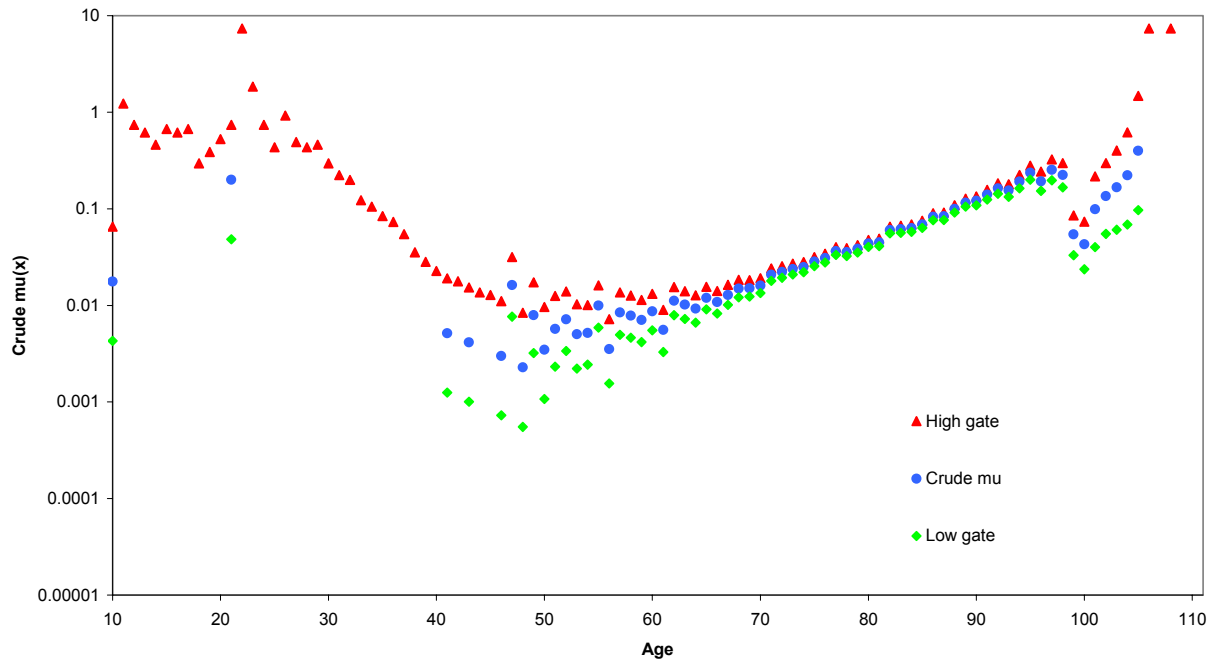
Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0+	8,095.5	267	152	59-88	75-83

Crude mortality rates

Crude Mu for Spouses, Females, Amounts



Crude Mu and Low and High Gates for Spouses, Females, Lives



Comparison of 1999-2002 experience with “92” Series tables

Investigation 34, Females, Amounts, comparison bases PFA92 and WA92 (C=yyyy)

Age	100 A/E using PFA92			100 A/E using WA92		
	C=2020	C=2000	C=1992	C=2020	C=2000	C=1992
60	377	205	156	211	115	88
61	147	82	63	86	48	37
62	351	202	157	215	124	96
63	216	128	100	139	82	64
64	167	101	80	111	67	53
65	252	156	125	175	108	87
66	255	161	130	184	116	94
67	185	119	97	139	89	73
68	193	127	104	149	98	81
69	127	85	70	102	68	56
70	117	80	66	97	66	55
71	157	110	92	134	93	78
72	118	83	70	103	73	62
73	140	101	86	126	90	77
74	114	84	72	105	77	66
75	118	87	75	111	82	71
76	131	98	85	126	94	82
77	145	110	97	142	108	95
78	111	86	76	111	86	75
79	114	89	79	115	90	80
80	98	78	69	101	80	71
81	100	81	72	104	83	75
82	140	114	102	146	119	107
83	157	129	116	165	135	123
84	99	82	75	104	87	79
85	93	78	71	98	83	76
86	108	92	84	115	98	90
87	88	76	70	94	81	75
88	115	99	92	122	106	98
89	136	119	111	144	126	117
90	96	84	79	101	89	83
91	137	122	115	144	128	120
92	132	118	112	137	123	116
93	148	133	126	152	137	130
94	97	88	84	99	90	85
95	117	107	102	117	107	103
All	120	96	86	119	95	84

Investigation 34, Females, Lives, comparison bases PFL92 and WL92 (C=yyyy)

Age	100 A/E using PFL92			100 A/E using WL92		
	C=2020	C=2000	C=1992	C=2020	C=2000	C=1992
60	381	207	158	217	118	90
61	207	116	89	123	69	53
62	351	202	157	218	125	97
63	273	161	126	177	104	82
64	212	128	101	143	86	68
65	233	144	115	164	101	81
66	182	115	93	133	84	68
67	185	119	97	140	90	73
68	185	122	100	145	96	78
69	161	108	89	130	88	72
70	149	102	85	125	85	71
71	167	116	98	144	100	84
72	156	110	93	138	98	83
73	146	105	89	133	96	81
74	133	97	84	125	91	78
75	133	99	85	128	95	82
76	127	96	83	125	94	82
77	133	101	88	133	101	89
78	115	89	78	117	91	80
79	110	86	76	114	89	79
80	110	88	78	117	93	82
81	101	81	72	108	87	78
82	120	98	88	130	106	95
83	109	90	81	120	99	89
84	101	84	76	111	93	84
85	99	83	76	110	93	85
86	106	90	83	119	101	93
87	97	83	77	109	93	86
88	104	90	83	117	102	94
89	109	95	88	123	107	100
90	103	91	85	117	103	96
91	108	96	90	122	108	102
92	113	101	96	128	114	108
93	99	90	85	111	100	95
94	111	101	96	123	112	107
95	124	114	109	137	126	120
All	114	93	83	120	96	86

Each of these three investigations has experience for lives and amounts. Each has experience by duration up to duration 10+ except for the spouses data where no durational split is available.

If graduations are not required by duration then there is sufficient data to perform graduations for each of the investigations except for male spouses where there are only 267 deaths.

One of the features noted in the crude mortality rates, illustrated in the graphs throughout this section, is the u-shaped mortality curve. Retaining this feature in any graduation would mean that it would not be possible to merge in pensioner mortality rates with those of assured lives at younger ages.

For the purposes of carrying out the comparisons described in the following sections, data for duration 0 at ages 76 and over, for duration 1 at ages 77 and over, and so on up to duration 9 at ages 85 and over were excluded since it was thought unlikely that there would be any new pensioners at these ages and durations.

Comparison of Lives (I) with Amounts (II)

We can speculate that the differences between some investigations may be accounted for, at least in part, by an amounts effect. The average amounts for each investigation (excluding the data for ages 76 and over for duration 0 etc described earlier) are shown in the table below.

Average Amount on Death Per Annum

Investigation	Gender	Duration					
		0	1	2	3	4	5+
Normal/Late	Males	1,692	1,784	2,036	2,522	2,496	1,548
Normal/Late	Females	968	1,141	1,242	1,509	1,352	798
Early	Males	1,971	2,054	1,504	1,929	2,019	1,698
Early	Females	1,128	1,217	1,025	860	1,080	707
Spouses	Males						1,401
Spouses	Females						1,385

For all durations combined, the average amount per annum on death for retirements generally increases up to ages around 70 and then reduces with increasing age.

Lives experience is generally heavier than amounts experience. Exceptions are:

- Male spouses experience
- Duration 0 and 1 for early retirement females

The significance of the differences is reduced when individual durations are considered. There is some indication for males normal/late retirements and females spouses that the experience for lives and amounts appears to be converging at the oldest ages but there is only limited data at these ages.

Males, Normal and Late Retirements

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v	A/E	A/E	+	-							
0	0	115.91	83.88	18	4	0.0022	(-)	6	0.1913	(+)	81.52	0.0000
1	1	111.53	87.93	17	7	0.0320	(-)	14	0.0793	(-)	128.08	0.0000
2	2	110.45	90.08	12	5	0.0717	(-)	7	0.3654	(+)	46.74	0.0001
3	3	107.15	94.10	16	5	0.0133	(-)	11	0.1476	(-)	72.81	0.0000
4	4	104.23	96.30	13	6	0.0835	(-)	5	0.0217	(+)	29.94	0.0526
5+	5+	105.04	93.16	30	14	0.0113	(-)	11	0.0014	(+)	579.75	0.0000

Females, Normal and Late Retirements

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v	A/E	A/E	+	-							
0	0	112.09	87.63	13	2	0.0037	(-)	5	0.5000		22.71	0.0904
1	1	106.14	93.97	9	3	0.0730	(-)	7	0.2545	(-)	18.62	0.0981
2	2	111.04	90.79	9	3	0.0730	(-)	5	0.4909	(+)	18.81	0.0932
3	3	108.83	93.63	9	5	0.2120	(-)	8	0.4895	(-)	8.29	0.8738
4	4	111.29	91.33	7	4	0.2744	(-)	8	0.1667	(-)	29.22	0.0021
5+	5+	103.44	94.99	30	17	0.0395	(-)	18	0.0895	(+)	170.52	0.0000

Males, Early Retirements

Durations		I	II	Numbers		p(+)		runs	p(runs)	χ^2	p(χ^2)
I v II	A/E	A/E	+	-							
0	0	118.76	82.99	18	2	0.0002	(-)	5	0.5000	29.39	0.0803
1	1	113.55	87.07	13	1	0.0009	(-)	3	0.5000	24.36	0.0414
2	2	120.20	77.78	13	1	0.0009	(-)	3	0.5000	27.41	0.0170
3	3	113.69	86.24	10	4	0.0898	(-)	9	0.1259	28.33	0.0129
4	4	114.64	86.08	10	3	0.0461	(-)	7	0.2937	22.93	0.0425
5+	5+	109.15	88.79	37	8	0.0000	(-)	8	0.0033	479.76	0.0000

Females, Early Retirements

Durations		I	II	Numbers		p(+)		runs	p(runs)	χ^2	p(χ^2)
I v II	A/E	A/E	+	-							
0	0	98.48	101.50	6	4	0.3770	(-)	6	0.5000	7.19	0.7077
1	1	92.41	107.83	2	5	0.2266	(+)	4	0.5000	10.55	0.1597
2	2	103.32	96.73	6	3	0.2539	(-)	5	0.5000	7.55	0.5799
3	3	112.32	87.93	4	3	0.5000		3	0.2000	4.56	0.7132
4	4	102.07	98.02	6	4	0.3770	(-)	6	0.5000	7.29	0.6978
5+	5+	103.76	94.77	27	14	0.0298	(-)	19	0.5000	75.58	0.0008

Males, Spouses

Durations		I	II	Numbers		p(+)		runs	p(runs)	χ^2	p(χ^2)
I v II	A/E	A/E	+	-							
0+	0+	88.81	112.69	12	11	0.5000		12	0.5000	77.82	0.0000

Females, Spouses

Durations		I	II	Numbers		p(+)		runs	p(runs)	χ^2	p(χ^2)
I v II	A/E	A/E	+	-							
0+	0+	104.55	94.66	37	12	0.0002	(-)	15	0.0859	169.64	0.0000

Comparison of Males (I) with Females (II)

Female experience is lighter than for males for all investigations except for male spouses on a lives basis where female mortality rates are generally higher than for males at ages over 80.

Normal and Late Retirements, Lives

Durations		I	II	Numbers		p(+)		runs	p(runs)	χ^2	p(χ^2)
I v II	A/E	A/E	+	-							
0	0	116.82	59.25	19	1	0.0000	(-)	3	0.5000	131.85	0.0000
1	1	114.63	59.74	16	2	0.0007	(-)	5	0.5000	107.43	0.0000
2	2	108.50	72.49	12	2	0.0065	(-)	3	0.1538	44.31	0.0001
3	3	110.87	62.20	14	1	0.0005	(-)	3	0.5000	63.76	0.0000
4	4	106.68	74.05	12	2	0.0065	(-)	4	0.3956	35.13	0.0014
5+	5+	108.03	78.64	40	8	0.0000	(-)	11	0.0841	1,283.02	0.0000

Normal and Late Retirements, Amounts

Durations		I	II	Numbers		p(+)		runs	p(runs)	χ^2	p(χ^2)
I v II	A/E	A/E	+	-							
0	0	114.56	63.79	14	1	0.0005	(-)	3	0.5000	60.74	0.0000
1	1	118.12	59.61	11	1	0.0032	(-)	3	0.5000	119.53	0.0000
2	2	112.01	68.71	10	3	0.0461	(-)	6	0.5000	105.16	0.0000
3	3	114.70	58.49	13	3	0.0106	(-)	7	0.3929	120.49	0.0000
4	4	109.66	67.28	9	2	0.0327	(-)	5	0.5000	78.83	0.0000
5+	5+	107.83	78.44	39	5	0.0000	(-)	9	0.4019	882.33	0.0000

Early Retirements, Lives

Durations		I	II	Numbers			p(+)	runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0	0	110.53	73.41	9	7	0.4018	(-)	3	0.0014	(+)	32.63	0.0083
1	1	113.10	67.13	8	3	0.1133	(-)	6	0.4667	(-)	23.10	0.0171
2	2	109.56	76.58	9	3	0.0730	(-)	7	0.2545	(-)	12.43	0.4119
3	3	113.42	69.11	9	3	0.0730	(-)	3	0.0545	(+)	21.37	0.0452
4	4	110.54	75.03	8	3	0.1133	(-)	7	0.2121	(-)	21.57	0.0280
5+	5+	106.95	72.42	44	2	0.0000	(-)	3	0.0444	(+)	463.49	0.0000

Early Retirements, Amounts

Durations		I	II	Numbers			p(+)	runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0	0	104.06	90.17	6	3	0.2539	(-)	3	0.1071	(+)	34.01	0.0001
1	1	107.19	83.23	2	4	0.3438	(+)	4	0.5000		31.90	0.0000
2	2	100.61	98.71	6	3	0.2539	(-)	5	0.5000		16.41	0.0589
3	3	113.73	69.90	5	2	0.2266	(-)	5	0.2857	(-)	21.61	0.0030
4	4	104.45	89.53	7	3	0.1719	(-)	6	0.4167	(-)	9.48	0.4868
5+	5+	105.10	77.68	32	9	0.0002	(-)	13	0.2450	(+)	318.55	0.0000

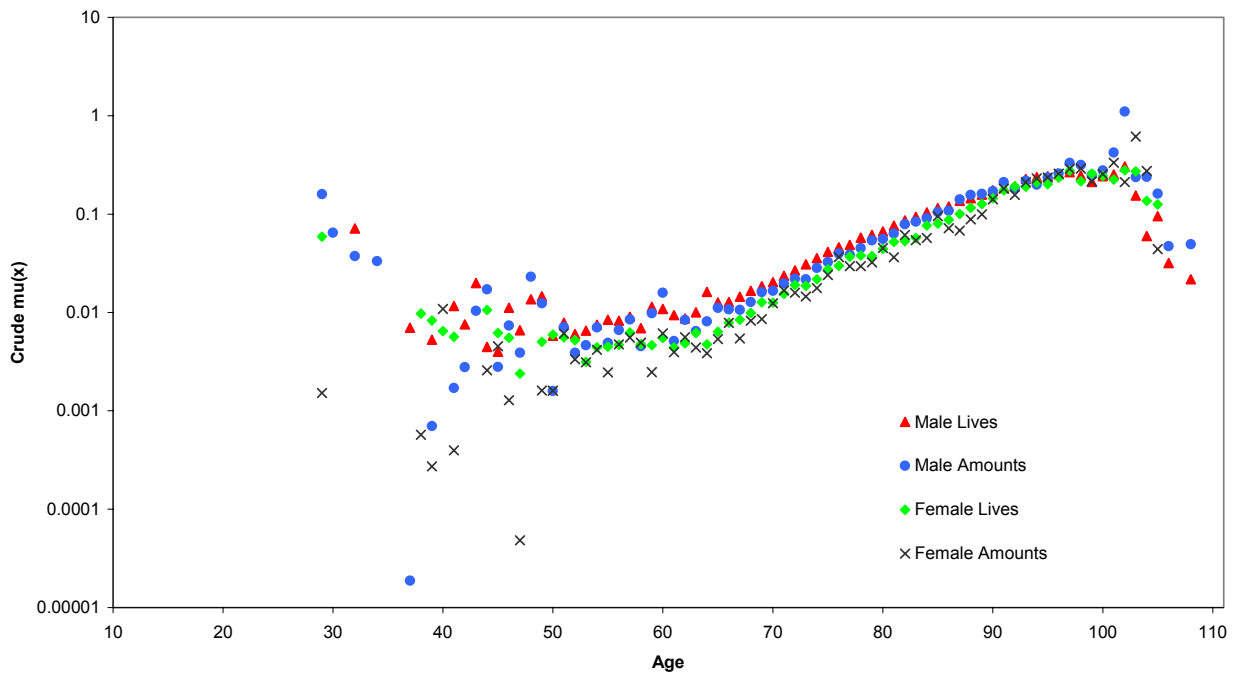
Spouses, Lives

Durations		I	II	Numbers			p(+)	runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0+	0+	98.49	100.04	15	12	0.3506	(-)	8	0.0096	(+)	59.11	0.0003

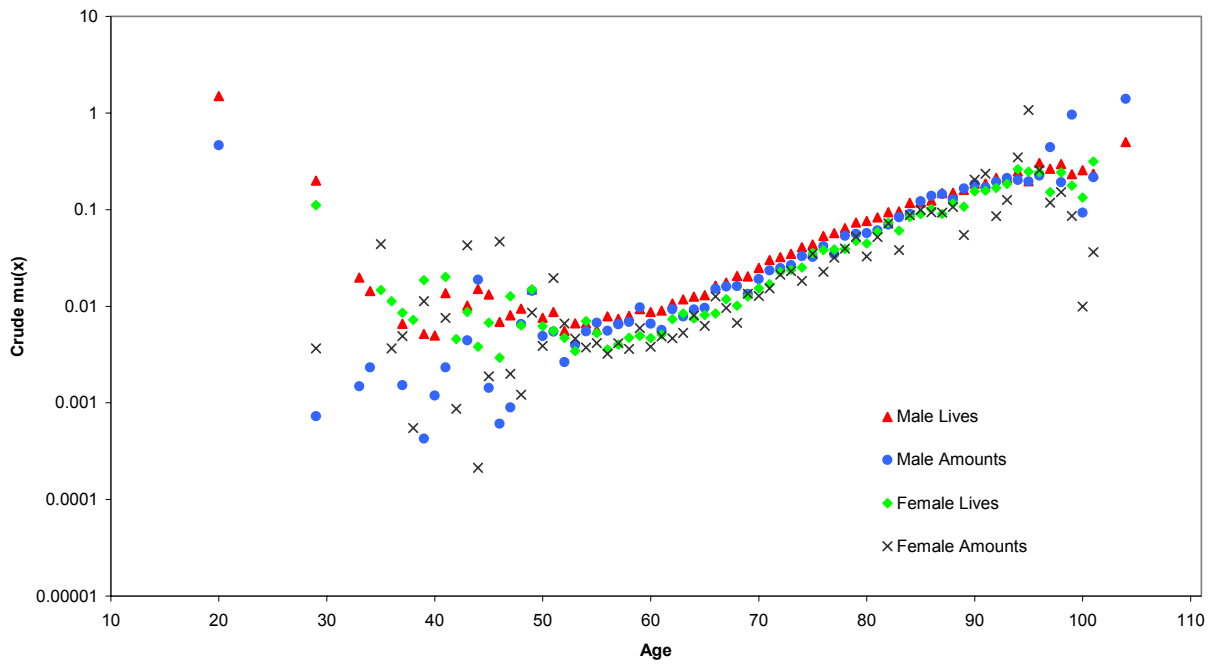
Spouses, Amounts

Durations		I	II	Numbers			p(+)	runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0+	0+	135.17	99.03	16	8	0.0758	(-)	12	0.5000		378.75	0.0000

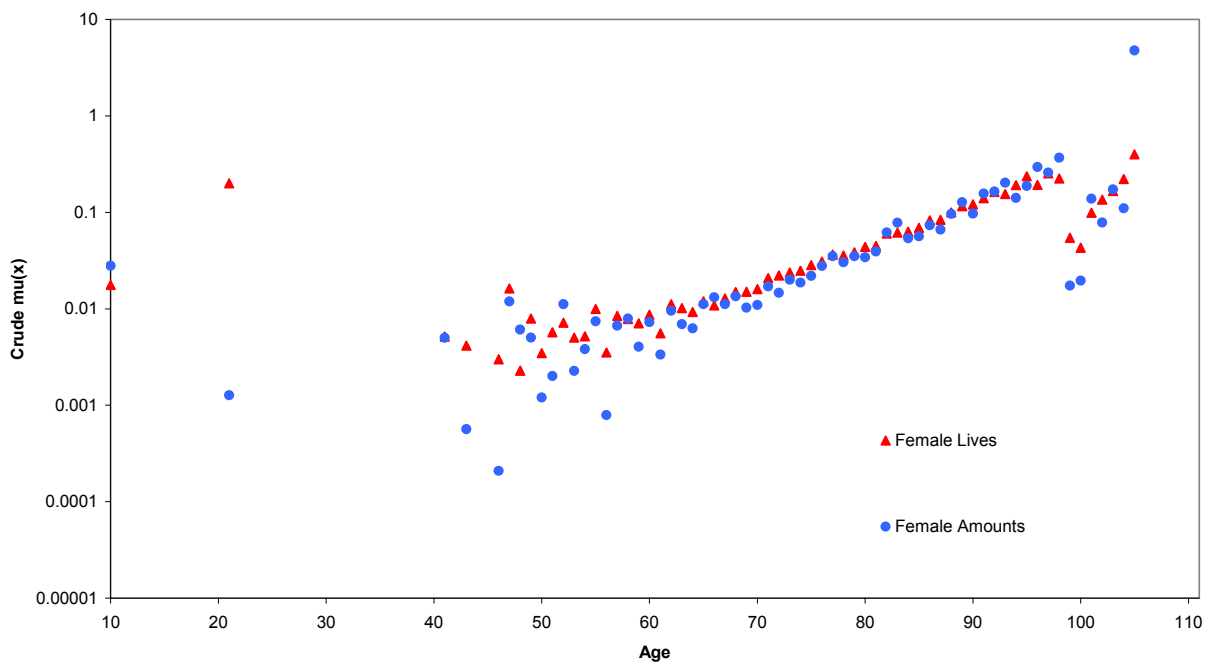
Crude Mu for Normal/Late Pensioners: Comparison of Amounts, Lives, Males and Females



Crude Mu for Early Pensioners: Comparison of Amounts, Lives, Males and Females



Crude Mu for Spouses, Females: Comparison of Amounts and Lives



Comparison of Normal and Late Retirements (I) with Early Retirements (II)

Normal/late experience is generally lighter than that of early retirements. The major exceptions are for male lives less than age 61 for all durations combined and for all lives combined at short durations. These are largely driven by the heavy experience for younger males at durations 0 and 1. A similar feature is shown in the male amounts data.

For females normal/late retirement experience is generally lighter than early retirement experience, although the difference is not very significant on a lives basis. Looking at the comparison by age shows, however, that apart from at age 60 normal/late retirement experience is heavier than early retirement experience for female lives aged 53 to 65 at duration 0 and at ages 56 to 65 at duration 1.

The incorrect inclusion of early retirements could explain high mortality at early durations and younger ages in the normal/late investigation.

For continuity with previous series of standard tables it is likely that a graduation of the normal/late investigation will be requested. Apart from the complication of the durational effects early retirement experience does appear significantly heavier than normal/late experience. This suggests a separate table for early retirements. The treatment of younger males and females at short durations will be problematic.

Males, Lives

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v II	A/E	A/E	+	-							
0	0	103.48	91.07	15	9	0.1537	(-)	8	0.0478	(+)	52.96	0.0006
1	1	107.02	80.87	14	6	0.0577	(-)	8	0.2990	(+)	53.70	0.0001
2	2	98.88	103.22	7	10	0.3145	(+)	9	0.5000		36.16	0.0044
3	3	102.25	94.09	8	6	0.3953	(-)	6	0.2261	(+)	34.35	0.0018
4	4	101.94	94.77	5	10	0.1509	(+)	7	0.4545	(+)	55.22	0.0000
5+	5+	97.60	106.84	6	38	0.0000	(+)	12	0.4528	(-)	194.78	0.0000

Females, Lives

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v II	A/E	A/E	+	-							
0	0	95.97	110.80	7	6	0.5000		5	0.1212	(+)	20.26	0.0890
1	1	104.68	88.57	5	4	0.5000		3	0.0714	(+)	4.69	0.8608
2	2	93.78	115.29	2	7	0.0898	(+)	5	0.4167	(-)	4.58	0.8691
3	3	97.02	105.66	3	4	0.5000		4	0.5000		5.34	0.6190
4	4	97.30	105.30	2	6	0.1445	(+)	5	0.3571	(-)	2.49	0.9621
5+	5+	98.47	106.95	14	30	0.0113	(+)	22	0.3071	(-)	62.22	0.0364

Males, Amounts

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I	v II	A/E	A/E	+	-							
0	0	100.83	97.83	11	7	0.2403	(-)	11	0.3179	(-)	42.98	0.0008
1	1	109.99	76.51	10	4	0.0898	(-)	5	0.2028	(+)	123.68	0.0000
2	2	102.34	91.55	5	5	0.5000		4	0.1667	(+)	26.91	0.0027
3	3	106.25	80.82	8	3	0.1133	(-)	6	0.4667	(-)	39.08	0.0001
4	4	104.09	86.79	6	5	0.5000		4	0.1104	(+)	108.69	0.0000
5+	5+	98.38	104.42	14	26	0.0403	(+)	20	0.4578	(-)	316.85	0.0000

Females, Amounts

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0	0	89.32	125.38	3	5	0.3633	(+)	5	0.5000		32.36	0.0001
1	1	100.76	98.30	1	4	0.1875	(+)	2	0.4000	(+)	13.42	0.0198
2	2	95.26	111.40	4	4	0.5000		6	0.3714	(-)	22.88	0.0035
3	3	104.98	89.03	4	1	0.1875	(-)	3	0.5000		7.11	0.2126
4	4	93.34	115.92	1	5	0.1094	(+)	2	0.3333	(+)	7.59	0.2700
5+	5+	97.96	109.14	15	25	0.0769	(+)	21	0.4043	(-)	163.35	0.0000

Comparison of Normal and Late Retirements (I) with Spouses (II)

A significant runs test is obtained when comparing these two investigations on a lives basis for all durations combined. Normal/late experience is generally lighter than spouses up the late 70s and then heavier for older ages. For all ages combined normal/late lives experience is heavier than spouses.

On an amounts basis normal/late experience for females is lighter than for spouses for all ages combined with no clear pattern by age. The average annuity per annum is higher for female spouses than normal/late and some of the differences between the investigations may be due to an amounts effect.

Separate graduations are suggested.

Males, Lives

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0+	0+	100.23	68.54	17	10	0.1239	(-)	11	0.1893	(+)	88.94	0.0000

Females, Lives

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0+	0+	101.06	98.58	22	31	0.1358	(+)	14	0.0002	(+)	254.51	0.0000

Males, Amounts

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0+	0+	100.04	95.01	11	13	0.4194	(+)	12	0.4334	(+)	296.88	0.0000

Females, Amounts

Durations		I	II	Numbers		p(+)		runs	p(runs)		χ^2	p(χ^2)
I v II		A/E	A/E	+	-							
0+	0+	99.59	100.48	21	28	0.1958	(+)	26	0.4423	(-)	349.11	0.0000

Comparison of Early Retirements (I) with Spouses (II)

For all ages combined on both an amounts and a lives basis the early retirement experience is heavier than spouses. Again on a lives basis there is a significant pattern by age. Early retirements start lighter than spouses and it is not until the early 70s when early retirement experience becomes heavier.

Males, Lives

Durations		I	II	Numbers		p(+)	runs	p(runs)	χ^2	p(χ^2)		
I v II		A/E	A/E	+	-							
0+	0+	100.77	63.32	21	6	0.0030	(-)	7	0.0624	(+)	97.27	0.0000

Females, Lives

Durations		I	II	Numbers		p(+)	runs	p(runs)	χ^2	p(χ^2)		
I v II		A/E	A/E	+	-							
0+	0+	104.43	98.54	29	23	0.2442	(-)	17	0.0044	(+)	104.12	0.0000

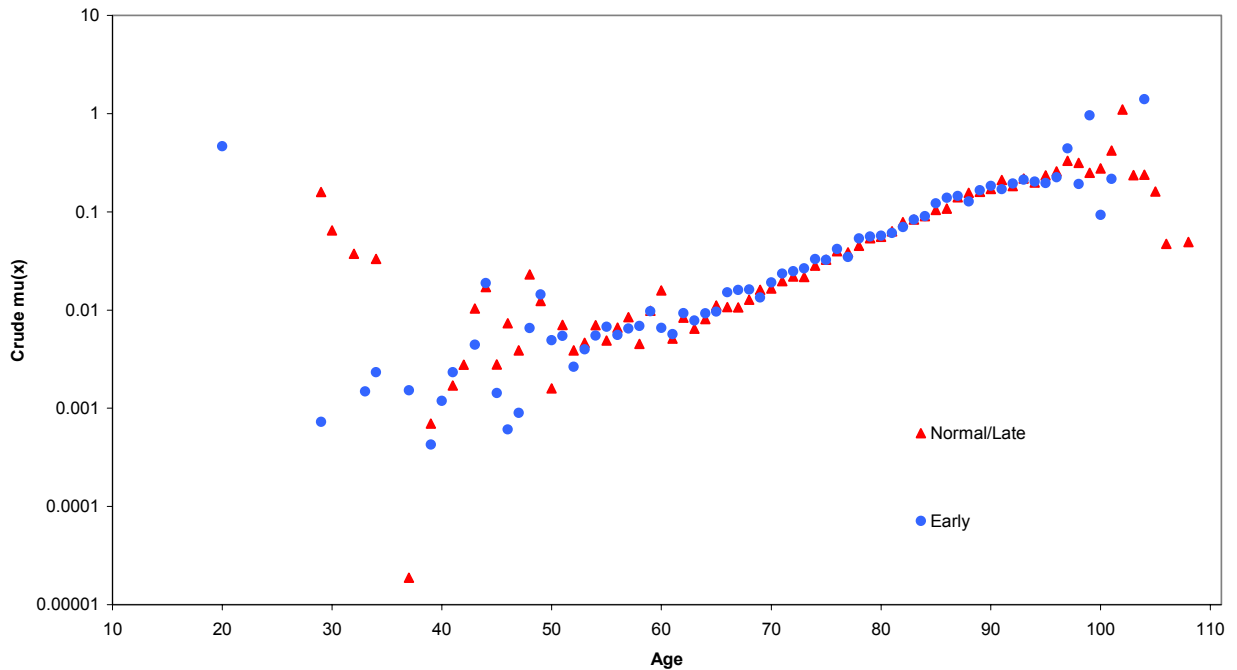
Males, Amounts

Durations		I	II	Numbers		p(+)	runs	p(runs)	χ^2	p(χ^2)		
I v II		A/E	A/E	+	-							
0+	0+	100.14	93.94	13	11	0.4194	(-)	14	0.4067	(-)	337.92	0.0000

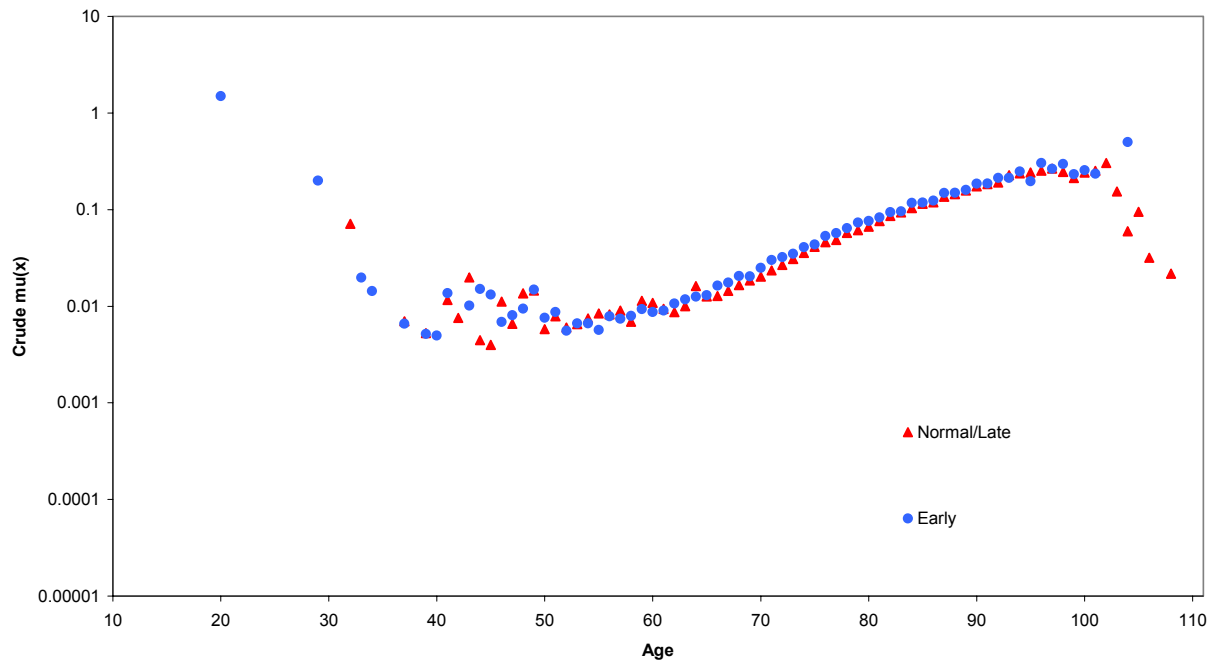
Females, Amounts

Durations		I	II	Numbers		p(+)	runs	p(runs)	χ^2	p(χ^2)		
I v II		A/E	A/E	+	-							
0+	0+	105.40	98.41	25	19	0.2257	(-)	23	0.5000	(-)	227.55	0.0000

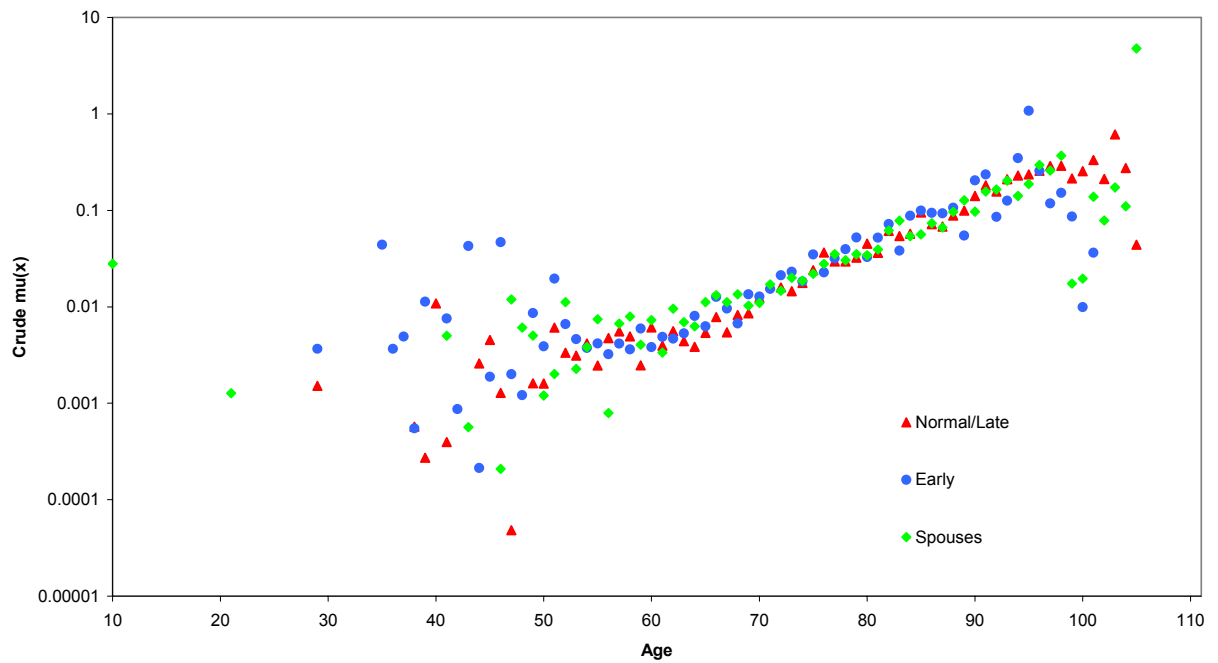
Crude Mu for Males, Amounts: Comparison of Normal/Late and Early



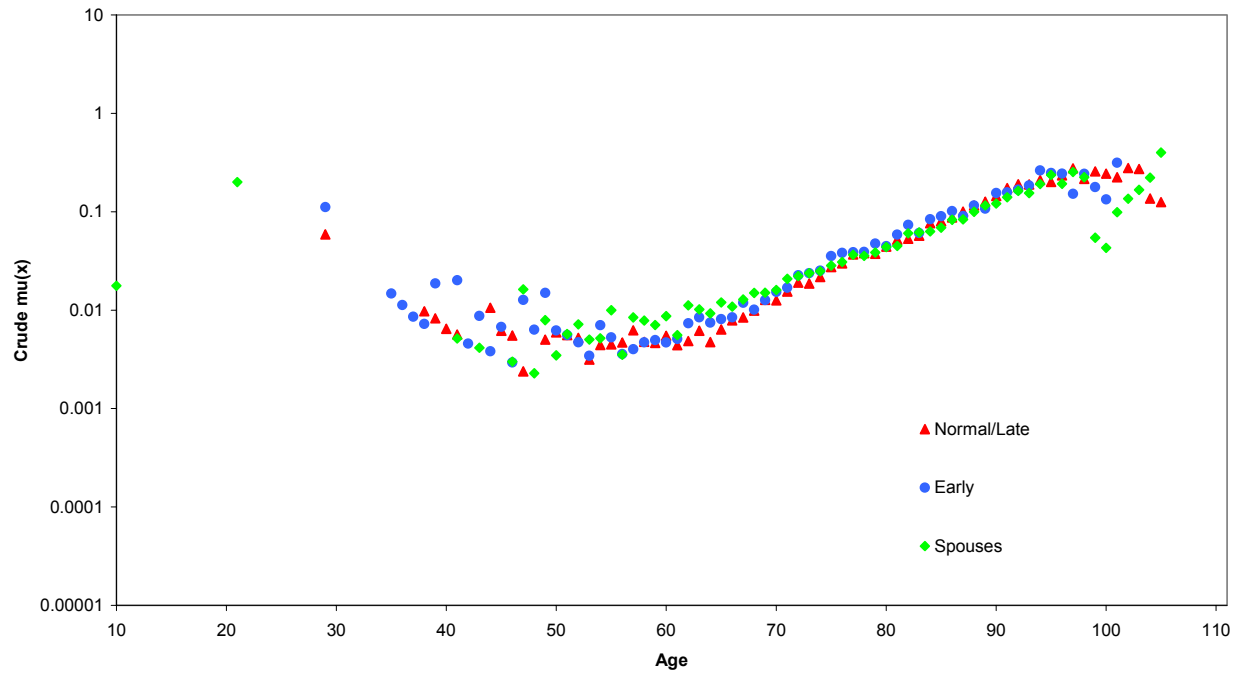
Crude Mu for Males, Lives: Comparison of Normal/Late and Early



Crude Mu for Females, Amounts: Comparison of Normal/Late, Early and Spouses



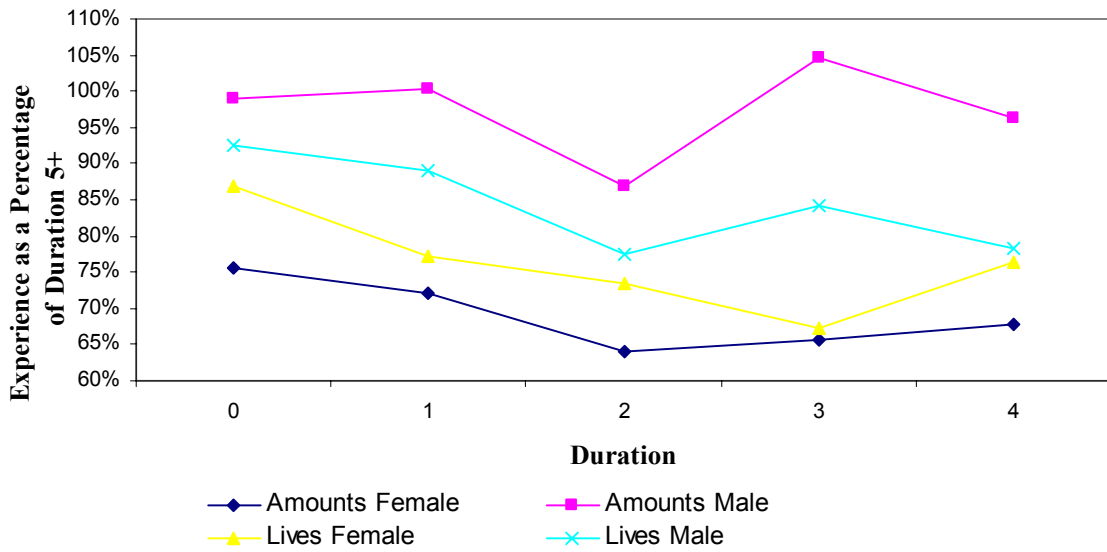
Crude Mu for Females, Lives: Comparison of Normal/Late, Early and Spouses



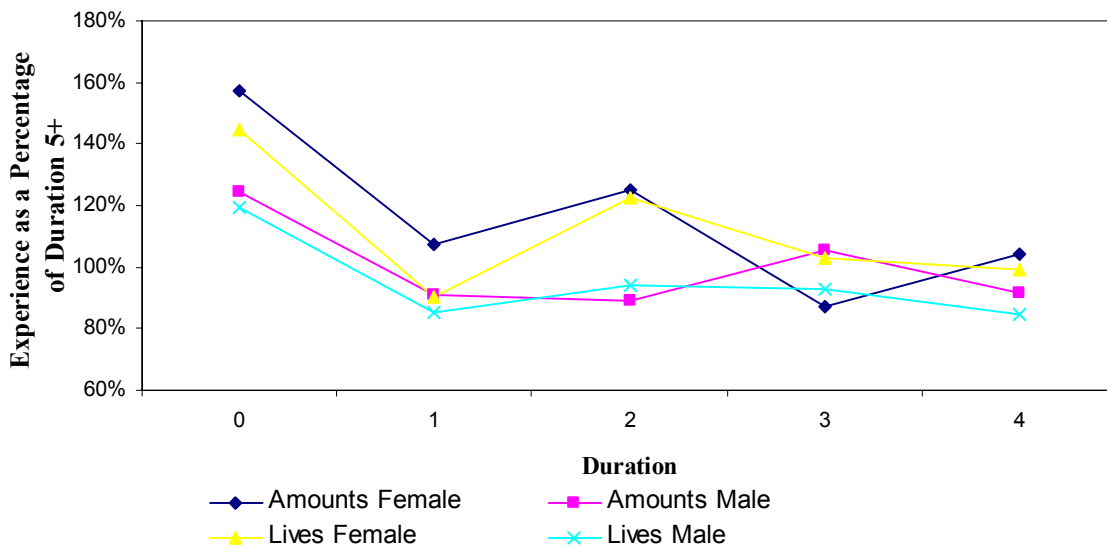
Comparison of Durations

Tests show that there are statistically significant differences between the experience of different durations for many of the investigations. The graphs illustrate the selection effect for durations 0 to 4 compared to 5+. After duration 5+ the patterns by duration are not as clear.

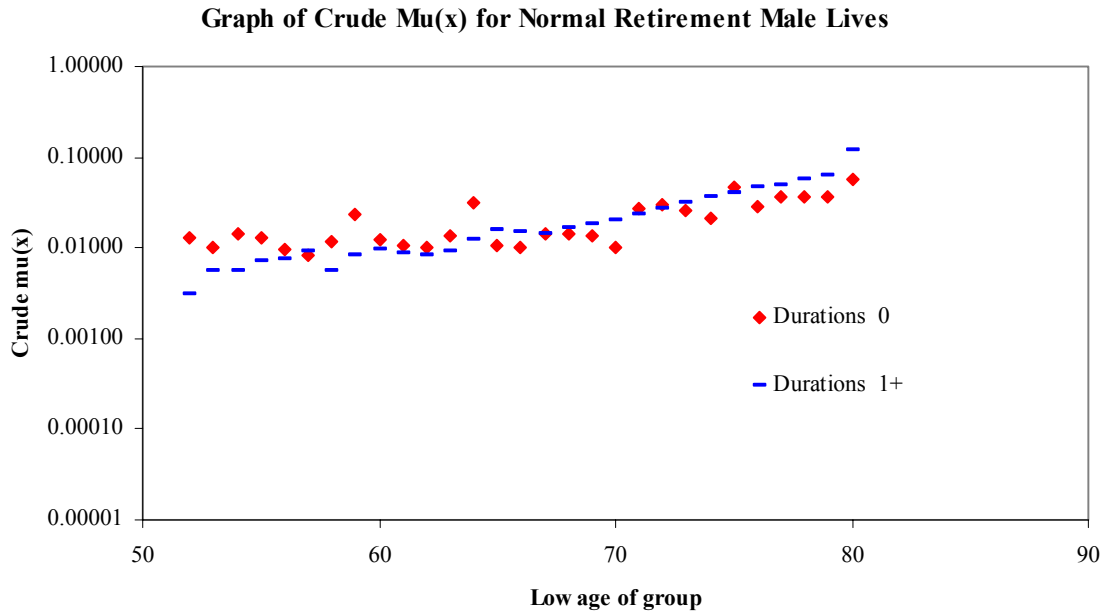
Normal/Late Retirements



Early Retirements



Reverse selection also features (illustrated in the graph below for male lives normal/late retirements) and if not for the generally very light mortality for people retiring at 60/61 for females and 65/66 for males reverse selection would have been even more pronounced.



This is another aspect of the u-shaped mortality curve and arguably indicates that the number of years that someone retires before the state retirement age could be a factor influencing mortality. People retiring well before state pension age appear to have high mortality and those who retire on or just after the exact state pension age have relatively light mortality.

(iii) Annuitant Investigations

Summary of issues for the Annuitant Investigations

The Immediate Annuity investigation has experience for lives and amounts and separate experiences for durations up to 5+. The Retirement Annuities and Personal Pension investigations only have lives experience with no durational split.

- Comparisons have been made within investigations and between investigations. Based on the results of the comparisons there are no grounds for amalgamating any of the experiences. Hence, graduations of all experiences are possible.
- The immediate annuitants investigation (Investigation 12) exhibits little evidence of selection by duration and the Working party suggests that if a standard table is produced for this investigation it should not contain select periods.

Investigation 12 – Immediate Annuitants

Summaries of the data – 1999-2002, all ages combined

Females, Amounts

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Average Amount	
				Central EtR	Actual Deaths
0	7,947,891	434,445	418,717	4,172	5,570
1	10,872,653	786,569	646,843	4,457	5,784
2	12,868,825	950,983	783,841	4,367	4,979
3	13,987,759	1,274,003	845,645	4,151	6,096
4	13,659,721	1,483,476	759,941	3,941	6,181
5+	83,482,545	9,027,251	5,862,853	2,271	2,590
1+	134,871,502	13,522,282	8,899,123	2,754	3,173
0+	142,819,393	13,956,727	9,317,840	2,807	3,216

Females, Lives

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0	1,905.0	78	87	single ages	86
1	2,439.5	136	126	77-87	89-92
2	2,947.0	191	154	77-88	86-88
3	3,369.5	209	186	74-89	87-92
4	3,466.0	240	187	75-90	84-94
5+	36,752.5	3,486	3,735	54-101	75-103
1+	48,974.5	4,262	4,388	54-101	74-103
0+	50,879.5	4,340	4,475	53-101	74-103

Males, Amounts

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Average Amount	
				Central EtR	Actual Deaths
0	4,541,789	225,246	360,436	4,103	4,597
1	7,063,740	327,446	379,673	4,466	5,198
2	8,865,906	578,025	425,461	4,378	6,568
3	10,125,191	537,896	528,152	4,300	4,597
4	10,159,688	724,915	508,690	4,237	5,492
5+	57,974,504	4,662,375	2,853,237	2,276	2,177
1+	94,189,027	6,830,657	4,695,213	2,784	2,687
0+	98,730,816	7,055,903	5,055,649	2,826	2,723

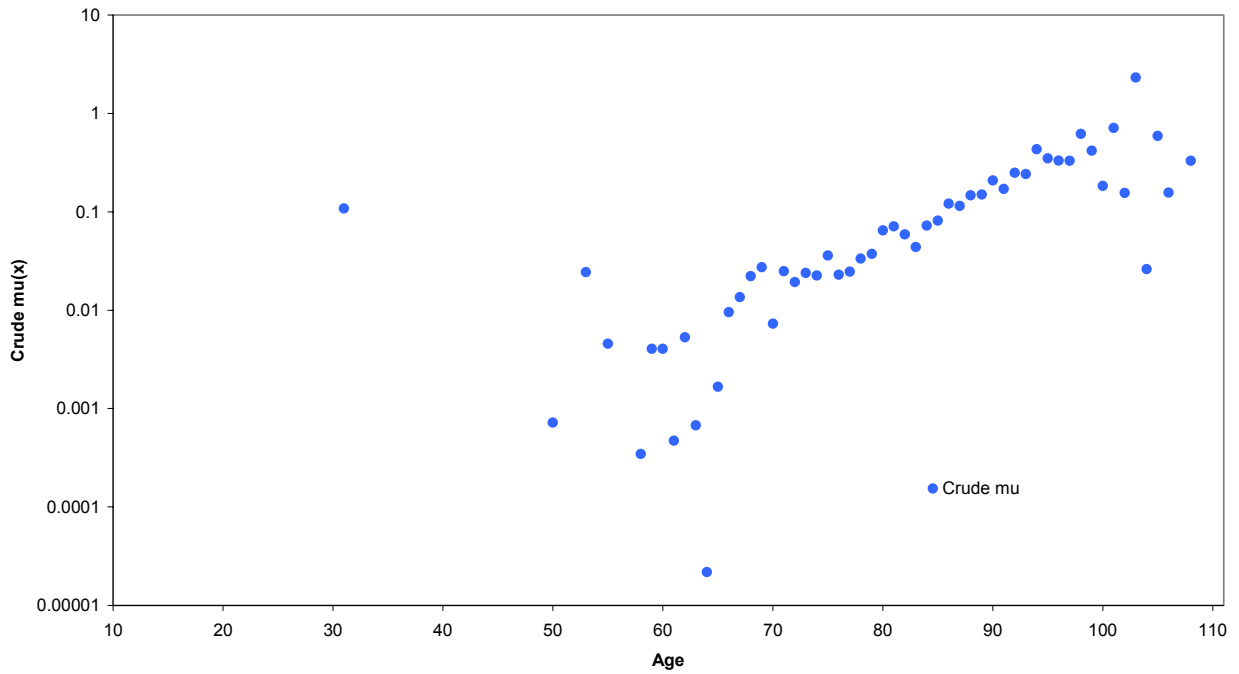
Males, Lives

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR \geq 100	Deaths \geq 10
0	1,107.0	49	70	no ages	no ages
1	1,581.5	63	93	66-67	no ages
2	2,025.0	88	94	67-68	no ages
3	2,354.5	117	120	68-69	no ages
4	2,398.0	132	112	69-70	single ages
5+	25,474.5	2,142	1,774	56-97	71-101
1+	33,833.5	2,542	2,193	54-97	71-101
0+	34,940.5	2,591	2,263	54-97	68-101

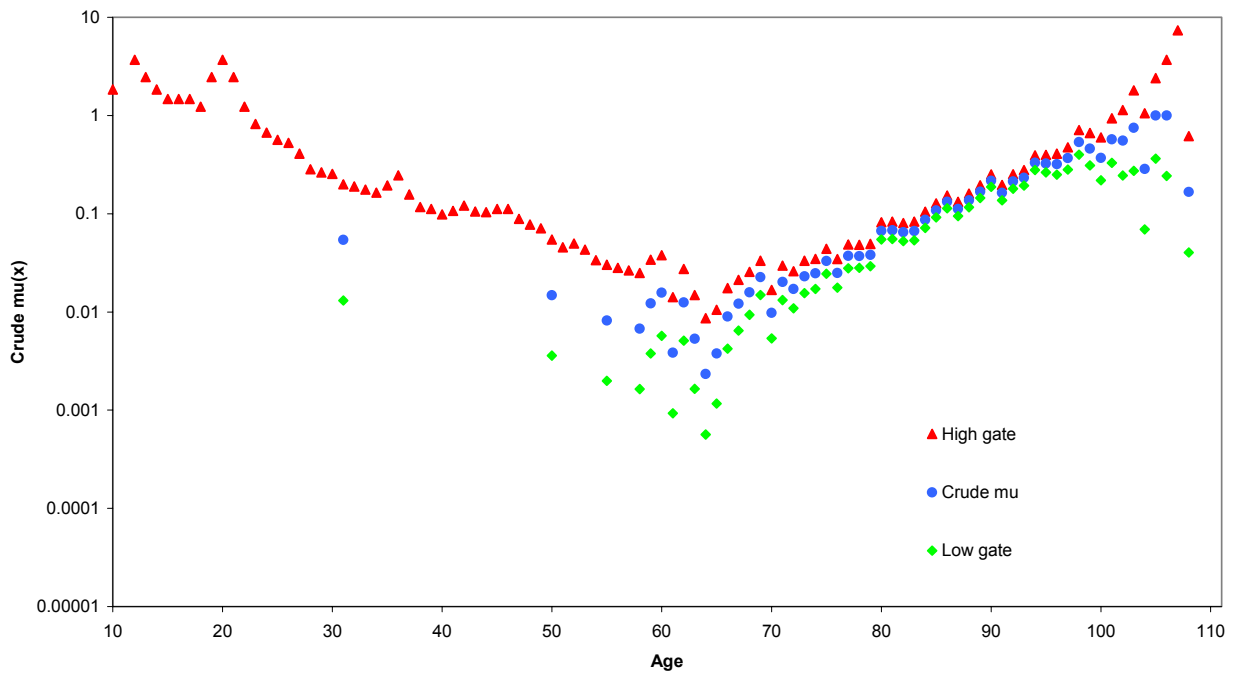
The volume of data is similar to that of the previous quadrennium for females, and slightly reduced for males, except for durations 0-3.

Crude mortality rates

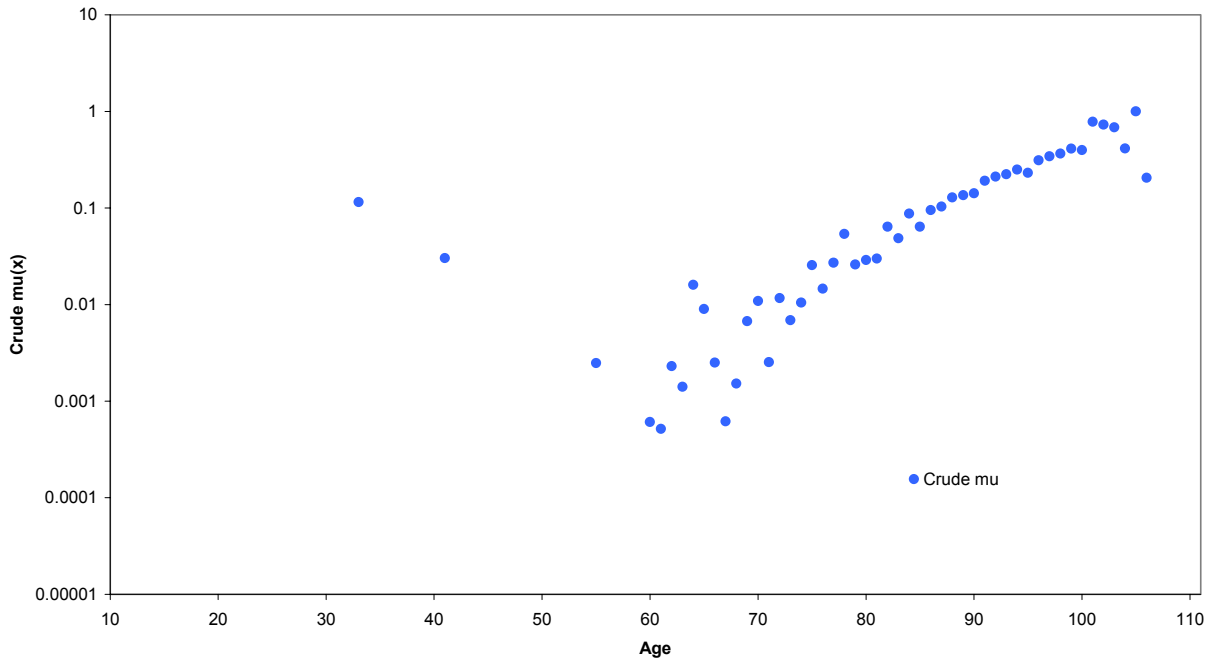
Crude Mu for Immediate Annuitants, Males, Amounts



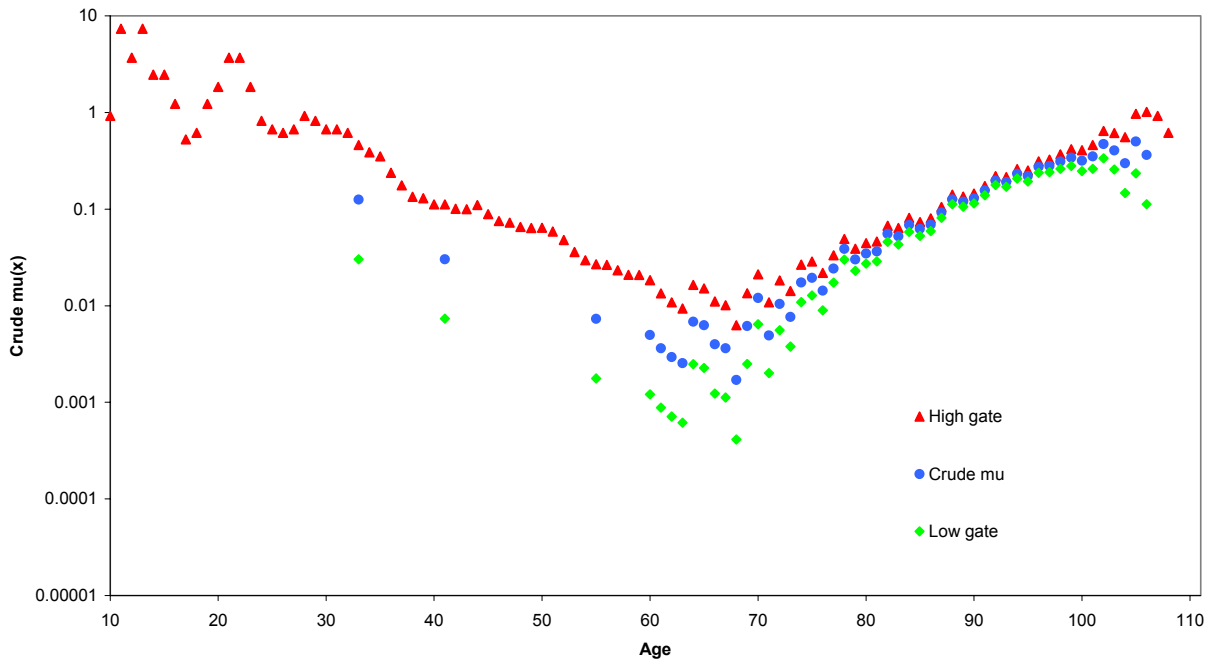
Crude Mu and Low and High Gates for Immediate Annuitants, Males, Lives



Crude Mu for Immediate Annuitants, Females, Amounts



Crude Mu and Low and High Gates for Immediate Annuitants, Females, Lives



Comparison of 1999-2002 experience with “92” Series tables

Investigation 12, Females, Amounts, comparison basis IFA92 (C=yyyy)

Age	100 A/E (C=2020)		100 A/E (C=2000)		100 A/E (C=1992)	
	Dur 0	Dur 1+	Dur 0	Dur 1+	Dur 0	Dur 1+
60	-	81	-	44	-	34
61	-	59	-	33	-	26
62	-	199	-	115	-	89
63	-	102	-	60	-	47
64	6,739	587	4,072	354	3,224	281
65	-	428	-	264	-	211
66	-	101	-	64	-	51
67	-	21	-	14	-	11
68	-	44	-	29	-	24
69	1,865	39	1,252	26	1,034	22
70	-	211	-	144	-	120
71	-	44	-	31	-	26
72	407	123	288	87	243	73
73	621	38	447	27	380	23
74	-	104	-	76	-	65
75	716	152	532	113	459	98
76	535	73	402	55	350	48
77	-	163	-	125	-	109
78	150	260	116	201	102	177
79	168	102	132	80	116	71
80	35	107	28	85	25	76
81	97	89	78	72	70	64
82	342	153	278	124	250	112
83	146	106	120	87	109	79
84	41	172	34	143	31	130
85	180	104	151	87	138	79
86	289	129	245	109	225	101
87	90	132	77	113	71	105
88	72	144	62	125	58	116
89	209	130	183	113	170	106
90	41	123	36	109	34	102
91	22	145	19	129	18	121
92	55	140	49	126	47	119
93	36	133	32	120	30	114
94	13	131	12	119	11	113
95	-	114	-	105	-	100
96	201	129	186	119	178	114
97	161	127	149	118	144	114
98	-	125	-	117	-	113
99	-	125	-	118	-	114
100	340	109	323	104	314	101
All	138	131	117	115	107	107

Investigation 12, Females, Lives, comparison basis IFL92 (C=yyyy)

Age	100 A/E (C=2020)		100 A/E (C=2000)		100 A/E (C=1992)	
	Dur 0	Dur 1+	Dur 0	Dur 1+	Dur 0	Dur 1+
60	-	412	-	224	-	171
61	-	261	-	146	-	112
62	-	158	-	91	-	71
63	-	115	-	68	-	53
64	2,432	170	1,469	103	1,163	81
65	-	197	-	122	-	98
66	-	107	-	68	-	55
67	-	84	-	54	-	44
68	-	33	-	22	-	18
69	961	76	645	51	533	42
70	-	171	-	117	-	97
71	-	62	-	43	-	36
72	670	85	474	60	401	51
73	237	59	170	43	145	36
74	-	134	-	98	-	84
75	251	120	186	89	161	77
76	331	69	249	52	216	45
77	-	123	-	94	-	82
78	115	165	89	127	78	112
79	271	103	212	81	188	72
80	46	113	36	90	32	80
81	108	102	86	82	77	73
82	233	131	189	106	170	96
83	162	110	133	90	121	82
84	62	130	52	108	47	98
85	138	102	116	85	106	78
86	208	97	177	82	162	76
87	145	117	125	100	115	93
88	151	140	131	121	121	112
89	221	118	193	103	180	96
90	36	115	31	101	29	95
91	31	123	27	109	26	103
92	103	137	92	122	87	115
93	129	119	116	107	110	102
94	111	128	101	116	96	111
95	-	112	-	102	-	98
96	272	121	251	112	241	107
97	103	113	96	105	92	102
98	-	113	-	106	-	102
99	-	112	-	106	-	103
100	-	97	-	92	-	90
All	137	118	115	103	105	96

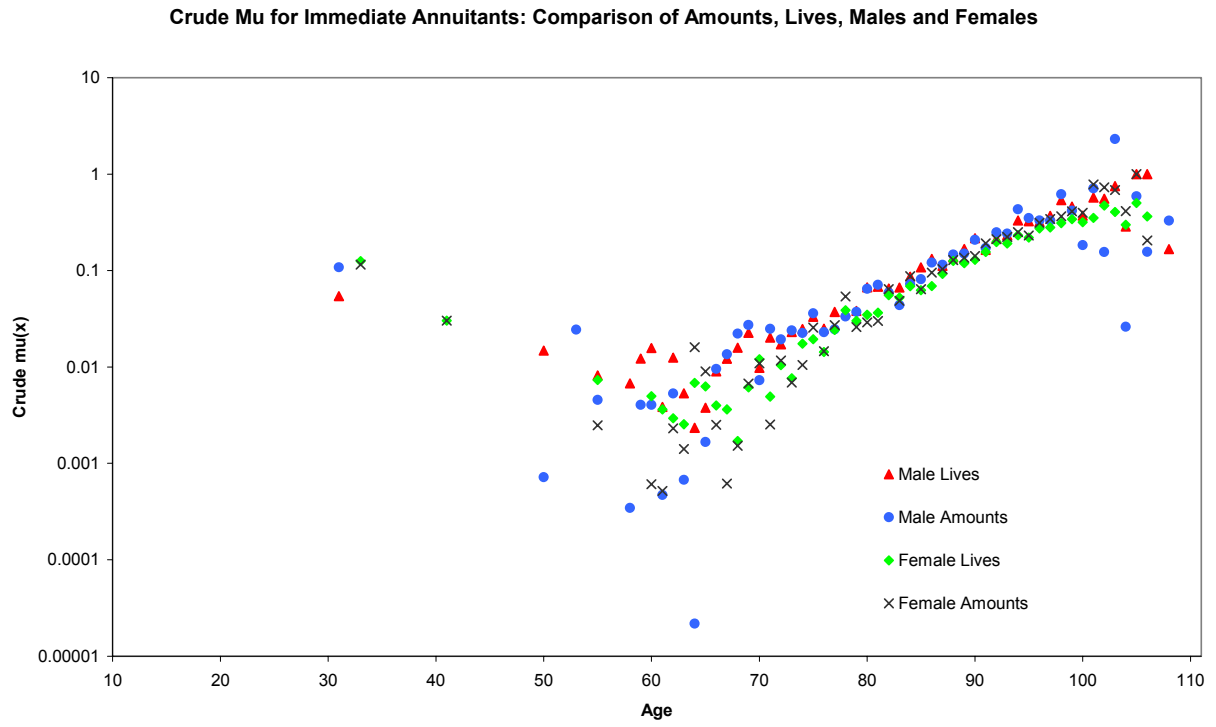
Investigation 12, Males, Amounts, comparison basis IMA92 (C=yyyy)

Age	100 A/E (C=2020)		100 A/E (C=2000)		100 A/E (C=1992)	
	Dur 0	Dur 1+	Dur 0	Dur 1+	Dur 0	Dur 1+
60	-	158	-	86	-	65
61	-	16	-	9	-	7
62	1,015	71	583	41	453	32
63	-	15	-	9	-	7
64	-	0	-	0	-	0
65	90	21	56	13	45	11
66	79	138	50	88	40	71
67	-	163	-	105	-	86
68	-	237	-	156	-	128
69	-	249	-	167	-	138
70	-	59	-	40	-	34
71	128	171	89	119	75	100
72	-	121	-	85	-	72
73	414	119	298	86	253	73
74	-	108	-	79	-	68
75	-	150	-	111	-	96
76	70	84	52	63	45	55
77	119	77	91	59	79	51
78	306	84	236	65	208	57
79	-	96	-	75	-	66
80	55	148	44	117	39	104
81	277	134	223	108	199	96
82	87	104	71	84	63	76
83	48	70	39	58	35	52
84	106	101	88	84	80	76
85	176	98	148	82	135	75
86	459	125	389	106	358	98
87	124	114	106	98	98	90
88	119	130	103	113	95	105
89	168	118	146	103	136	96
90	408	143	359	126	337	118
91	-	114	-	101	-	95
92	-	143	-	128	-	121
93	-	128	-	115	-	109
94	-	197	-	179	-	171
95	251	146	230	134	220	128
96	-	129	-	119	-	115
97	-	118	-	110	-	106
98	-	182	-	170	-	165
99	-	123	-	116	-	112
100	-	55	-	53	-	51
All	137	123	113	104	102	95

Investigation 12, Males, Lives, comparison basis IML92 (C=yyyy)

Age	100 A/E (C=2020)		100 A/E (C=2000)		100 A/E (C=1992)	
	Dur 0	Dur 1+	Dur 0	Dur 1+	Dur 0	Dur 1+
60	-	556	-	303	-	231
61	-	121	-	68	-	52
62	1,548	234	890	135	692	105
63	-	117	-	69	-	54
64	-	43	-	26	-	20
65	271	33	168	20	134	16
66	181	114	115	72	92	58
67	-	139	-	89	-	73
68	-	158	-	104	-	85
69	-	196	-	132	-	109
70	320	68	219	46	182	38
71	226	129	158	90	132	75
72	-	100	-	71	-	60
73	632	107	454	77	387	66
74	-	112	-	82	-	70
75	-	131	-	97	-	84
76	96	86	72	65	63	56
77	161	111	123	85	108	74
78	240	96	186	74	163	65
79	-	93	-	73	-	64
80	107	141	85	112	75	99
81	256	124	206	99	184	89
82	73	109	59	88	53	79
83	132	99	108	81	98	73
84	162	114	134	94	122	86
85	257	125	216	105	197	96
86	279	136	237	115	218	106
87	178	105	152	90	141	83
88	138	116	119	100	110	93
89	167	127	146	111	136	103
90	315	144	278	127	260	119
91	-	104	-	92	-	87
92	-	119	-	107	-	101
93	-	118	-	106	-	101
94	-	150	-	136	-	130
95	207	132	189	121	181	115
96	-	121	-	111	-	107
97	-	125	-	116	-	112
98	-	157	-	147	-	142
99	-	129	-	121	-	117
100	-	100	-	94	-	92
All	155	120	125	101	112	93

Comparisons



Investigation 21, 22, 23 & 24 – Retirement Annuitants and Personal Pensioners

Summaries of the data – 1999-2002, all ages combined

Retirement Annuitants in Deferment, Females

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0+	678,178.1	1,644	1,590	29-75	44-74

Retirement Annuitants in Deferment, Males

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0+	3,873,251.0	13,329	12,721	27-79	34-75

The volume of data is similar to that of the previous quadrennium for females, and slightly reduced for males.

Retirement Annuitants in Payment, Females

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0+	288,287.5	4,716	2,535	48-96	58-98

Retirement Annuitants in Payment, Males

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range EtR ≥ 100	Continuous Age Range Deaths ≥ 10
0+	878,142.2	29,654	19,030	42-97	52-98

The experience has increased considerably in size since the last quadrennium. Standard tables (RFV92 and RMV92) were produced for the first time based on the 1991-1994 quadrennium, and we would expect to graduate this experience, combined with any other experience if appropriate.

Personal Pensioners in Deferment, Females

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0+	4,324,288.9	4,507	2,774	17-75	27-70

Personal Pensioners in Deferment, Males

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0+	8,554,555.8	16,544	10,467	17-75	22-75

This experience has increased considerably in size since the last quadrennium. No standard tables have previously been produced for Personal Pensions, as the class was very new ten years ago. It would be worthwhile to graduate this experience or, if appropriate, to amalgamate it with any experience to which it may be similar.

Personal Pensioners in Payment, Females

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0+	292,631.4	1,835	459	33-85	51-84

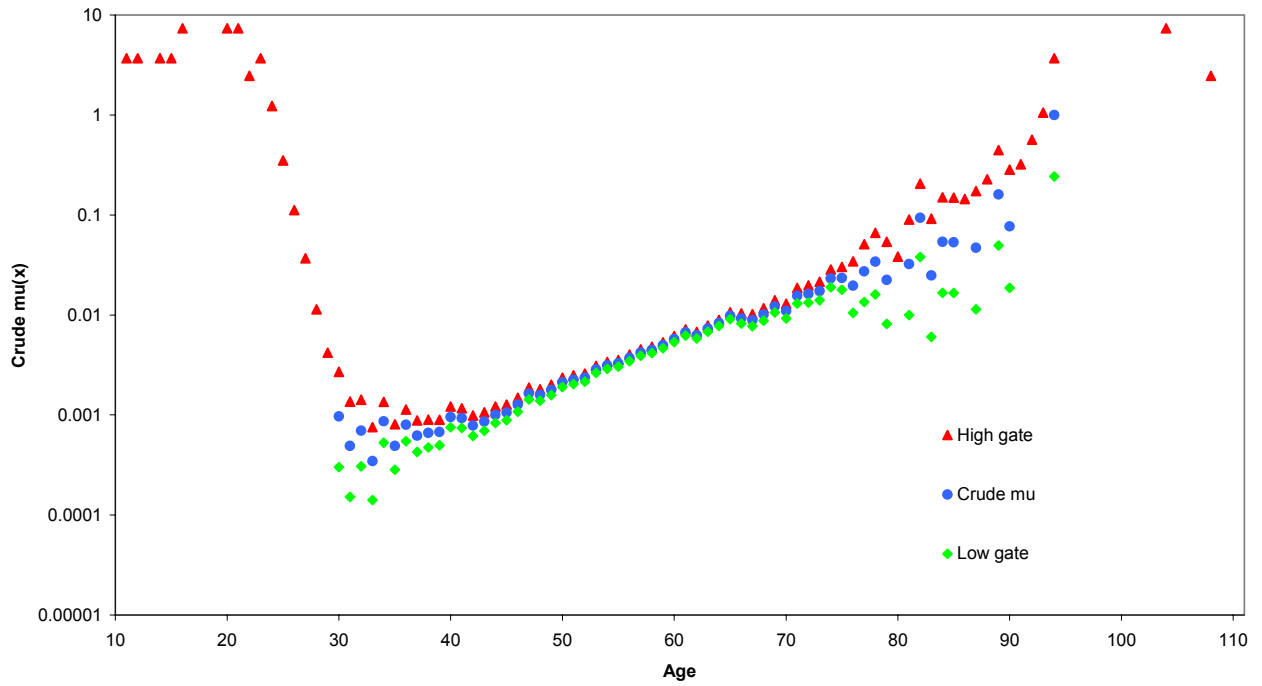
Personal Pensioners in Payment, Males

Duration	Central EtR	Actual Deaths	1995-1998 Deaths	Continuous Age Range	
				EtR ≥ 100	Deaths ≥ 10
0+	687,358.8	9,775	2,420	35-88	49-87

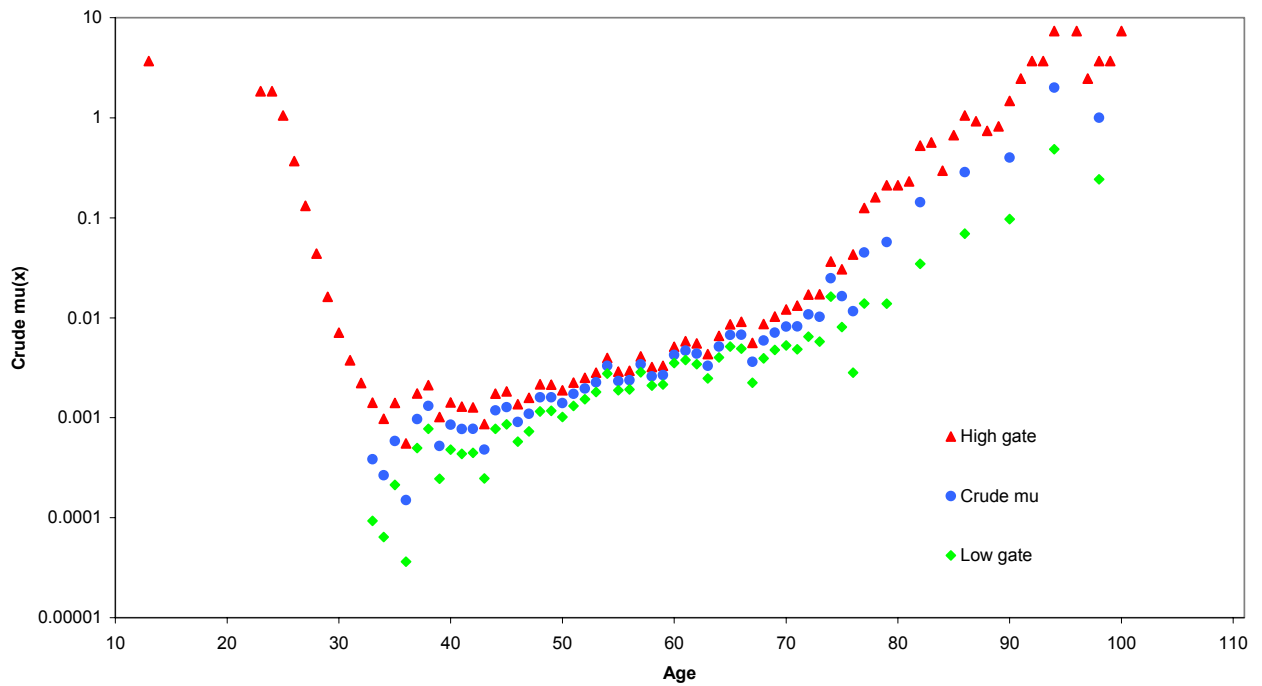
This experience is large enough to justify graduation. The experience appears to be considerably lighter than that of Retirement Annuitants, and therefore worth separate consideration.

Crude mortality rates

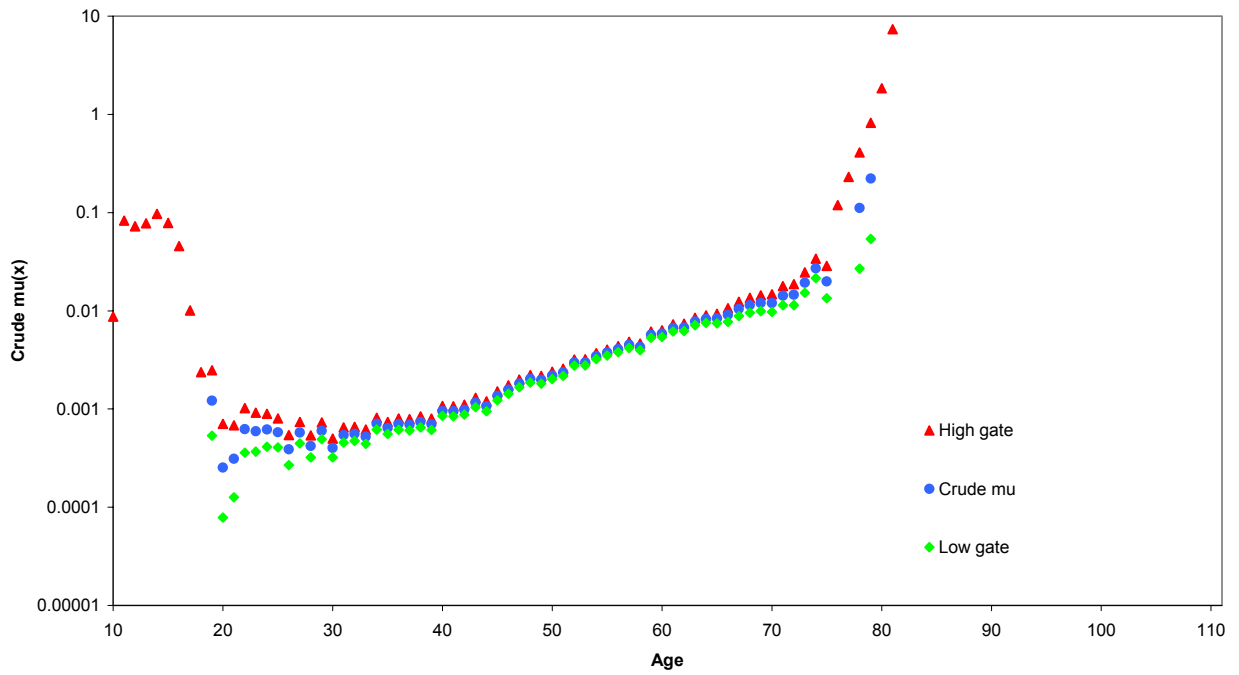
Crude Mu and Low and High Gates for Retirement Annuitants in Deferment, Males



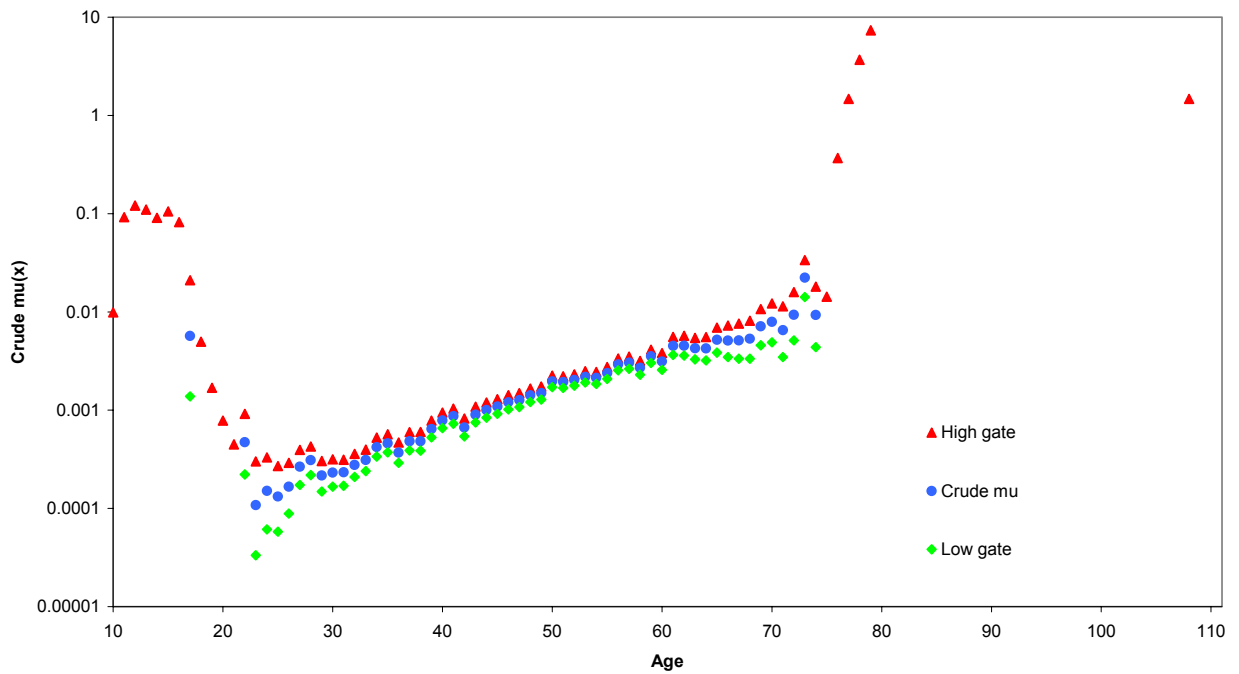
Crude Mu and Low and High Gates for Retirement Annuitants in Deferment, Females



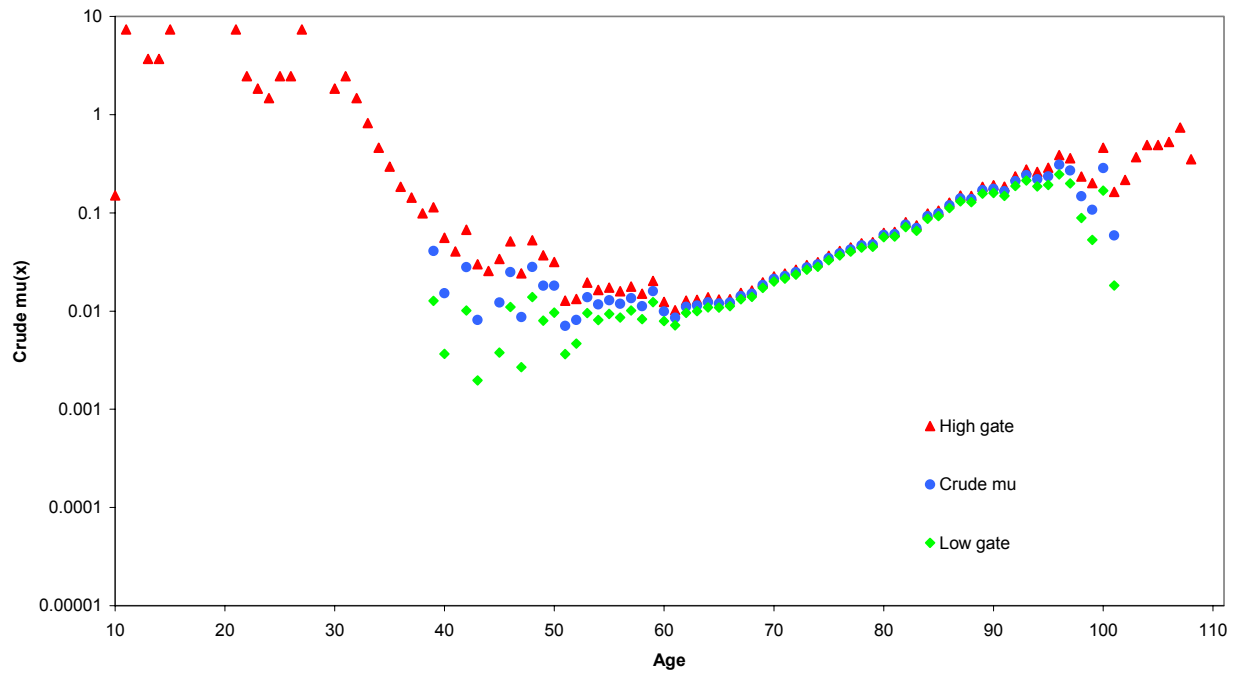
Crude Mu and Low and High Gates for Personal Pensioners in Deferment, Males



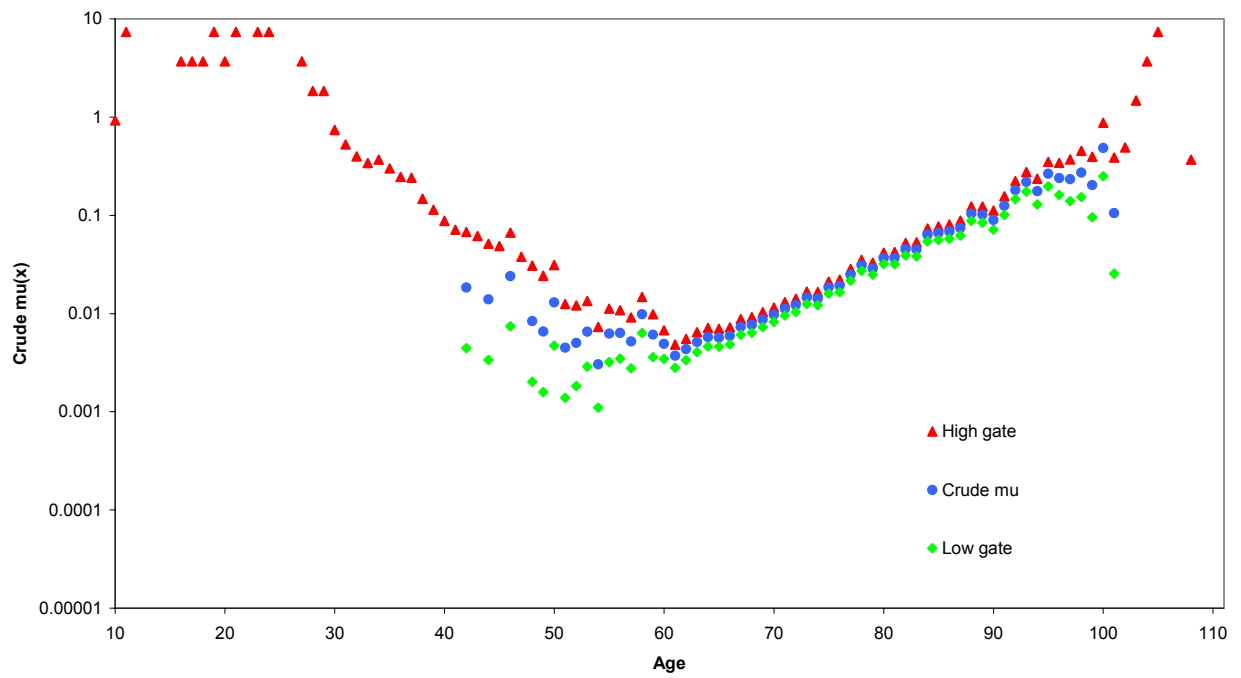
Crude Mu and Low and High Gates for Personal Pensioners in Deferment, Females



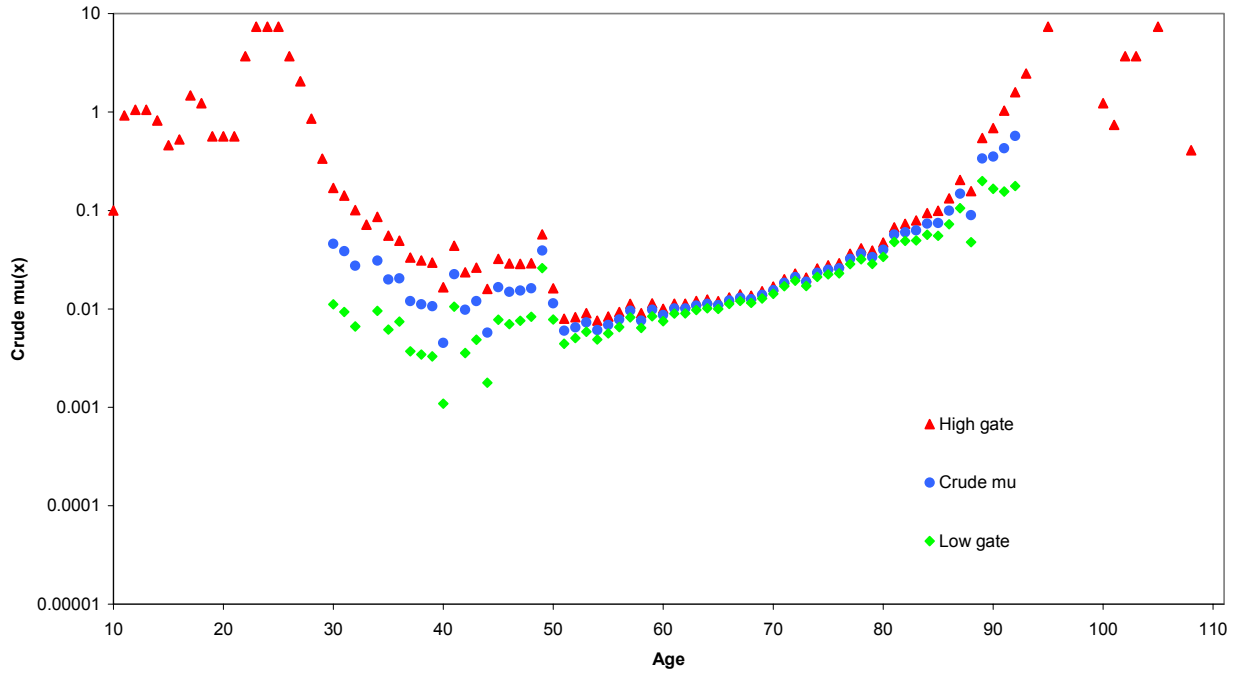
Crude Mu and Low and High Gates for Retirement Annuitants in Payment, Males



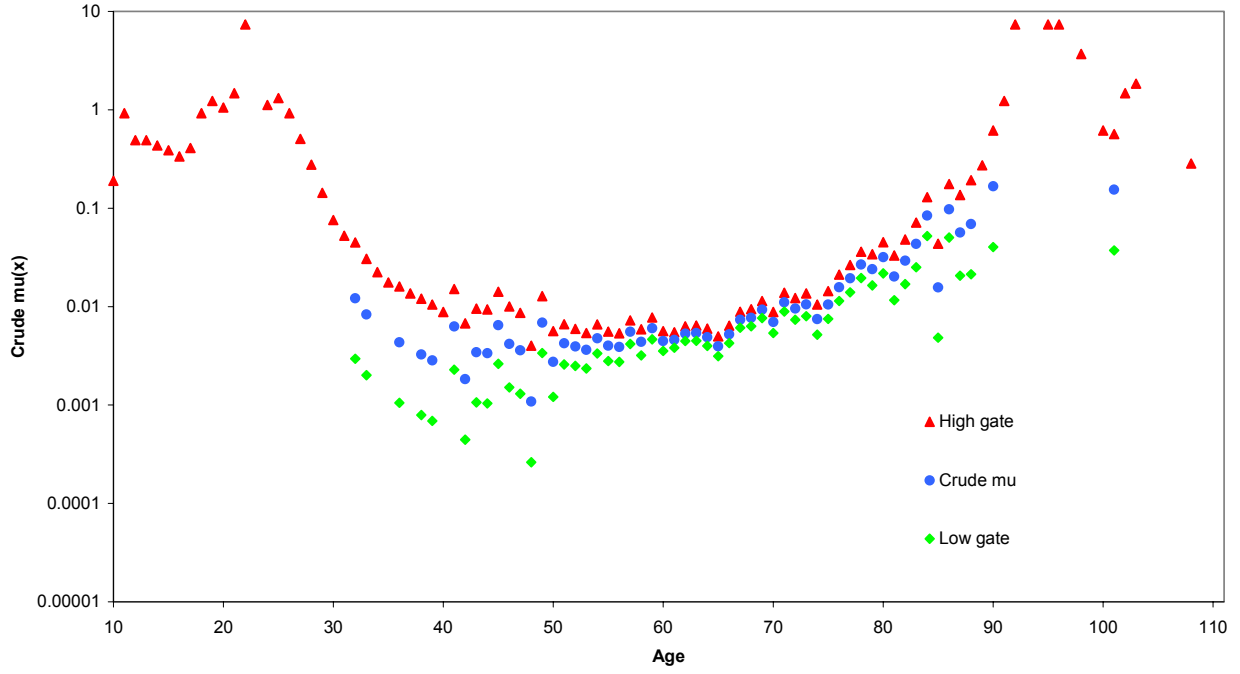
Crude Mu and Low and High Gates for Retirement Annuitants in Payment, Females



Crude Mu and Low and High Gates for Personal Pensioners in Payment, Males



Crude Mu and Low and High Gates for Personal Pensioners in Payment, Females



Comparison of 1999-2002 experience with “92” Series tables

In Deferment sections, comparison basis AM92 ult (males) or AF92 ult (females)

Age	Retirement Annuitants		Personal Pensioners	
	100 A/E AF92 Female	100 A/E AM92 Male	100 A/E AF92 Female	100 A/E AM92 Male
30	-	166	71	69
31	-	82	66	91
32	-	114	73	92
33	95	55	77	83
34	61	133	96	110
35	124	73	97	95
36	29	113	72	100
37	174	84	87	93
38	218	84	80	94
39	80	80	98	83
40	119	106	110	106
41	99	95	111	97
42	91	74	78	93
43	51	74	96	101
44	116	79	98	84
45	114	76	97	98
46	74	82	98	102
47	81	96	94	107
48	108	83	95	107
49	98	84	91	93
50	78	89	109	93
51	88	85	97	89
52	90	79	93	100
53	94	85	91	89
54	125	83	80	92
55	80	78	82	89
56	73	78	90	86
57	96	79	85	84
58	66	74	68	72
59	61	74	81	85
60	88	76	65	77
61	88	78	85	78
62	74	65	77	71
63	51	68	65	72
64	71	69	59	68
65	84	73	65	62
66	77	61	58	60
67	37	52	53	62
68	55	53	49	60
69	59	57	60	56
70	61	46	60	51
71	56	59	45	54
72	66	55	58	50
73	57	53	123	59
74	124	64	47	74
75	74	58	-	49
All	80	74	86	84

In Payment sections, Females, comparison basis RFV92 (C=yyyy)

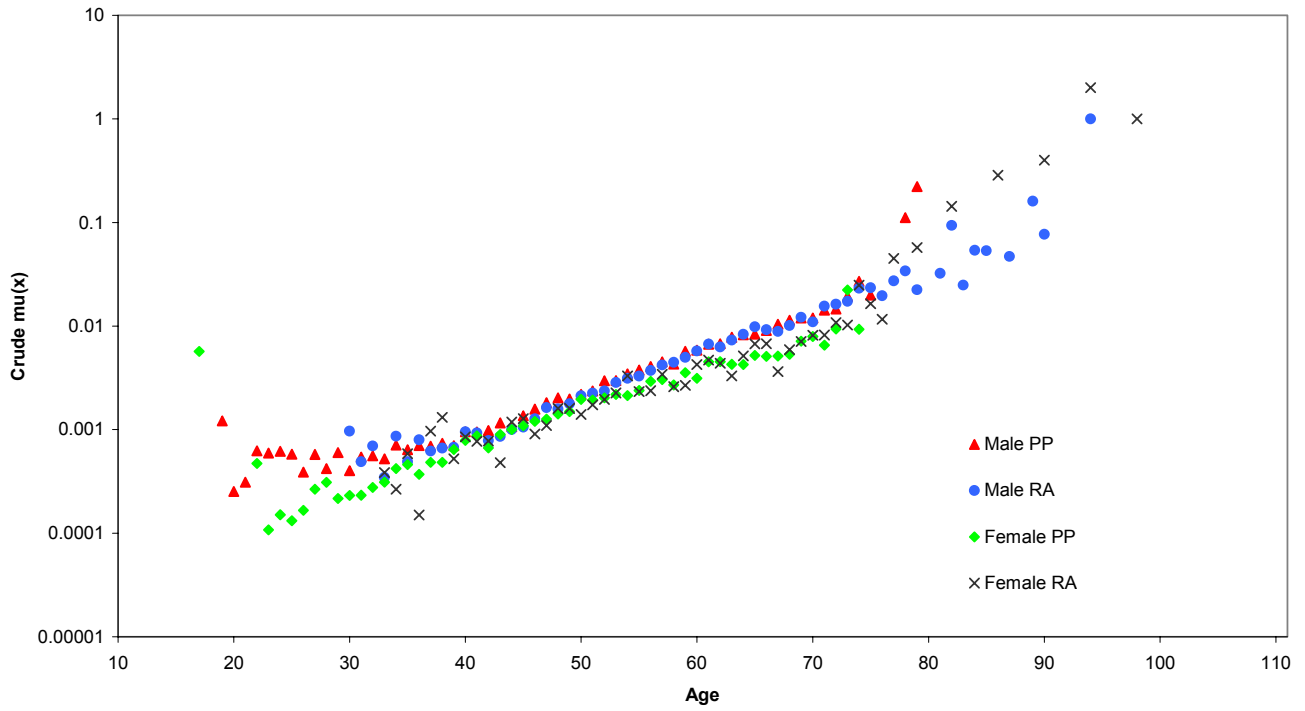
Age	Retirement Annuitants 100 A/E using RFV92			Personal Pensioners 100 A/E using RFV92		
	C=2020	C=2000	C=1992	C=2020	C=2000	C=1992
50	242	132	100	52	28	21
51	89	48	37	84	46	35
52	105	57	43	82	45	34
53	144	78	59	80	43	33
54	70	38	29	110	60	45
55	151	82	62	97	53	40
56	159	87	66	98	53	41
57	136	74	56	145	79	60
58	265	144	110	118	64	49
59	168	91	70	167	91	69
60	137	74	57	125	68	52
61	100	56	43	123	69	53
62	111	64	50	136	78	61
63	124	73	57	130	77	60
64	130	79	62	110	67	53
65	118	73	58	82	51	41
66	113	71	57	99	63	51
67	126	81	66	127	82	66
68	118	78	64	119	78	64
69	120	80	66	129	86	71
70	119	82	68	85	58	48
71	121	84	71	120	83	70
72	116	82	69	91	65	55
73	122	88	75	89	64	54
74	105	77	66	55	41	35
75	120	89	77	69	51	44
76	110	82	72	90	68	59
77	125	95	83	98	75	66
78	138	106	94	119	92	81
79	112	88	78	94	74	65
80	126	100	89	110	87	78
81	112	90	80	62	50	45
82	122	99	89	79	65	58
83	107	88	80	104	85	77
84	132	110	100	174	145	132
85	122	103	94	30	25	23
86	112	95	88	159	134	124
87	108	93	86	83	71	66
88	133	115	107	90	78	72
89	116	101	94	-	-	-
90	92	81	76	165	145	136
All	119	89	77	104	66	53

In Payment sections, Males, comparison basis RMV92 (C=yyyy)

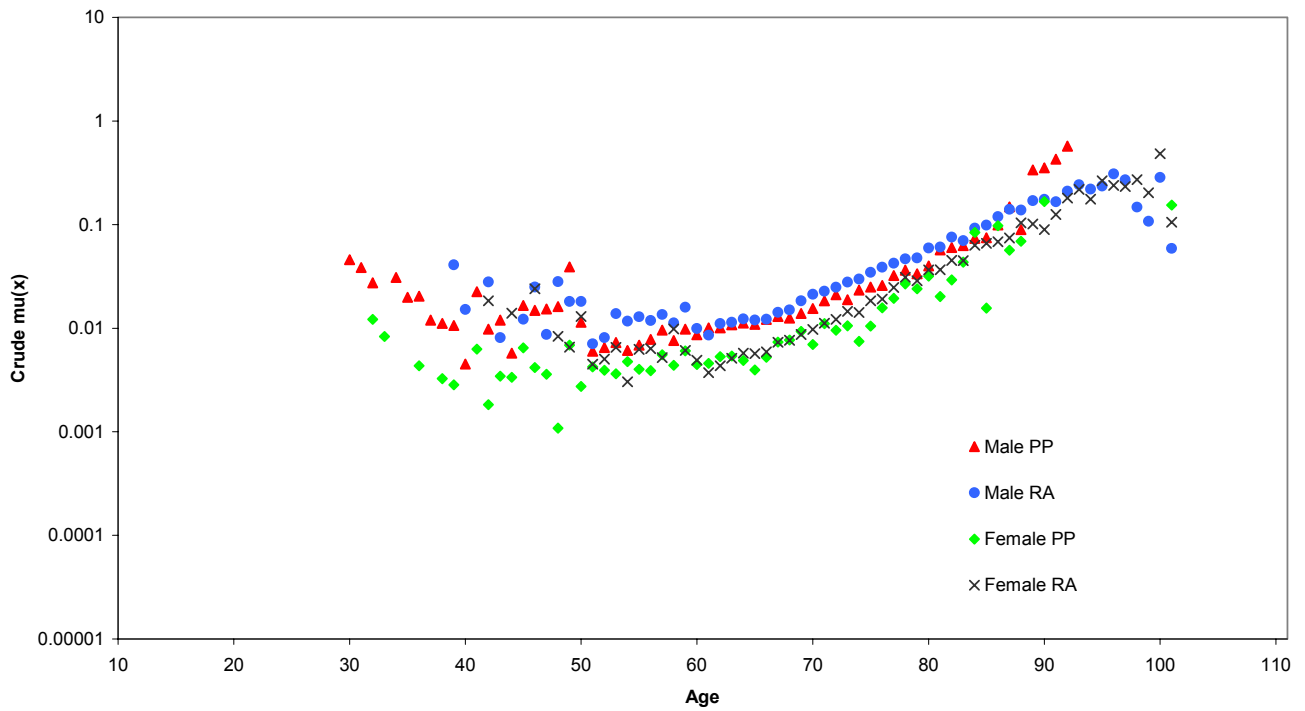
Age	Retirement Annuitants 100 A/E using RMV92			Personal Pensioners 100 A/E using RMV92		
	C=2020	C=2000	C=1992	C=2020	C=2000	C=1992
50	200	109	83	126	69	52
51	81	44	34	69	38	29
52	96	52	40	77	42	32
53	169	92	70	89	49	37
54	148	80	61	77	42	32
55	168	91	69	89	49	37
56	158	86	66	104	57	43
57	185	100	76	131	71	54
58	156	85	65	106	58	44
59	224	122	93	138	75	57
60	141	77	58	123	67	51
61	117	66	51	138	77	59
62	145	83	65	132	76	59
63	142	84	66	135	80	62
64	145	88	69	132	80	63
65	132	82	65	121	75	60
66	126	79	64	125	79	64
67	135	87	71	123	79	65
68	131	86	71	109	72	59
69	145	98	81	110	74	61
70	151	103	86	111	76	63
71	146	102	85	119	83	69
72	143	101	85	121	86	72
73	142	102	87	97	70	59
74	135	99	85	106	78	67
75	140	104	89	101	75	65
76	139	104	91	93	70	61
77	135	103	90	103	79	69
78	132	102	90	103	80	70
79	121	95	84	85	67	59
80	134	107	95	91	72	64
81	123	99	88	115	92	83
82	137	111	100	109	89	80
83	114	94	85	103	84	76
84	135	112	102	108	90	82
85	130	109	100	99	83	76
86	140	119	109	118	100	92
87	148	127	117	156	134	123
88	133	115	107	88	76	71
89	147	128	119	271	236	220
90	137	121	113	256	226	211
All	135	102	88	113	74	61

Comparisons

Crude Mu for in Deferment sections: Comparison of RA and PP, Males and Females



Crude Mu for in Payment sections: Comparison of RA and PP, Males and Females



Males v Females

Female experience is lighter in all investigations and is significantly lighter in all investigations except for Investigation 12 Amounts. Here, the difference between males and females is only significant at the 5% level for durations 5+ (where most of the experience actually is).

Amounts v Lives (Investigation 12)

Amounts experience is generally lighter than lives experience, particularly at durations 5+. At earlier durations, the difference is often not significant.

Deferred v Vested (Investigations 21-24)

Vested mortality is heavier for both pairs of investigations. For female personal pensions, they come fairly close together for ages 65 to 75 but there is still a significant difference at the 5% level.

Deferred v Permanent Assurances (01)

The comparison was made for all durations. Investigation 21 mortality is generally lighter and Investigation 22 mortality generally heavier than Investigation 01 mortality, particularly in the age range 40 to 60.

Deferred v Temporary Assurance (02)

The comparison was made for all durations. Deferred mortality is heavier for both sexes.

Deferred v Pension Term Assurance (29)

Deferred mortality is heavier for males. There were only 205 female deaths in Investigation 29 which reduces the value of any comparison.

Pension Annuities (23, 24) v Life Office Pensioners (31 and 33)

The combined Life Office Pensioner experience was generally heavier. In the case of Retirement Annuitants this was true for all ages above 65 (M) or 60 (F). For males, Personal Pension mortality was heavier up to age 50 and Life Office Pensioner mortality heavier from age 63. Between ages 50 and 63 there is no significant difference between the two experiences. A closer examination of Investigation 24 against Investigations 31 and 33 separately shows that for males only, 24 and 33 are not significantly different according to the plus/minus and runs tests but that the chi-squared test result has probability 0.

Comparisons by duration

Only Investigation 12 has data by duration.

Male Lives

There are very few circumstances in which the differences in mortality due to duration are significant.

Mortality at duration 2 is particularly light when compared with later durations but there are only 88 deaths at duration 2. This is therefore not very significant.

Duration 1 compared with duration 4 and durations 0-1 compared with both 2-3 and 2-4 both show heavier mortality for the early duration(s) up to age 82 and lighter mortality thereafter. Overall, mortality is heavier at later durations.

In general, duration 0 mortality is heavier than mortality at durations 1 or 2, but less than 5% of deaths occur at durations 0 and 1.

Conclude: Graduate with no select period.

Female Lives

There are very few circumstances in which the differences in mortality due to duration are significant, the few circumstances being that mortality at durations 0-2 and 0-4 is heavier than at durations 5+ for ages up to 84.

Mortality at duration 0 is always lighter than at subsequent durations (although there are only 78 deaths at duration 0). At all other durations, the picture is much more mixed.

Conclude: Graduate durations 1+ and then define duration 0 as a percentage of 1+.

Male Amounts

The tests show that there is little significant variation in mortality by duration. The only 'significant' case is 2-3 v 4+ where the number of runs (13) is small for the split of pluses and minuses (16 to 19).

Duration 0 mortality is marginally lighter than all combinations of 2 or more later years, but there are only 49 deaths.

Duration 1 mortality is at least 10% lighter than any combination of 2 or more later years, but there are only 68 deaths.

Conclude: There is little evidence for selection. Graduate for all durations combined without any selection.

Female Amounts

There are only 5 comparisons out of 70 which show significant results.

Mortality at duration 0 is not well correlated with age when compared with later durations. It is heavier at younger ages and lighter at older ages. Furthermore, mortality at durations 1-4 and 3-4 is heavier than at durations 5+, particularly at ages over 80. This all suggests that any selection effect is confusing.

Conclude: Graduate for 1+ and set duration 0 as a percentage based on experience over age 85, say.

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Appendix – Note on Statistical Tests

1. This note describes the algebra for the comparison of two mortality experiences, as used in this Working Paper.

2. We start with data for two experiences, $i = 1, 2$. After adding together investigations and durations as required, and possibly adjusting the exposure to central, we have available at each age, x , for each experience, i , the numbers of Actual Deaths ($A_{i,x}$) and Central Exposed to Risk ($R_{i,x}$).

3. We first group the ages so that in each group there are at least k Actual Deaths. Typically k is taken as 5. The procedure used is as follows. We start with the lowest age. If the number of deaths in each experience is greater than or equal to k , then that age forms the first group. Normally the data are sparse at the ends of the age range, so normally the criterion is not met. We add additional ages to the first age until the number of deaths in each experience for the group is at least k . We then start to form a second group on the same lines. If the experience is reasonably large, single ages in the middle of the age range form single groups. We may, however, reach the last age without the current partial group having at least k deaths in each experience. In this case the last partial group is added to the next previous complete group. If the experience is small, there may be only one group. If it is very small, there may be too few deaths to form even one group. In that case all ages together form one group, but any tests are likely to show no statistical significance.

4. We denote the groups with a subscript y . We now have Actual Deaths and Exposed to Risk for each experience for each group, $A_{i,y}$ and $R_{i,y}$. We add the experiences together, group by group, to get totals of Deaths and Exposed:

$$\begin{aligned}A_y &= A_{1,y} + A_{2,y} \\ R_y &= R_{1,y} + R_{2,y}\end{aligned}$$

5. We then calculate the “crude” mortality rates (μ) for each group, for each experience, and for the combined experiences:

$$\mu_{i,y} = A_{i,y} / R_{i,y}$$

and

$$\mu_y = A_y / R_y$$

Necessarily each μ_y is intermediate between $\mu_{1,y}$ and $\mu_{2,y}$, unless all three are equal.

6. Using the combined mortality rates we calculate the Expected Deaths (E) for each group for each experience:

$$E_{i,y} = \mu_y \times R_{i,y}$$

There is no need to calculate the Expected Deaths for the combined experience, because necessarily:

$$E_y = \mu_y \times R_y = A_y$$

If $\mu_{1,y} > \mu_{2,y}$ then $E_{1,y} > A_{1,y}$ and vice versa.

7. For each group for each experience we then calculate the deviation (D):

$$D_{i,y} = A_{i,y} - E_{i,y}$$

and we then adjust each deviation to get an adjusted value (F):

$$\begin{aligned} \text{if } D > 0.5, & \quad F = D - 0.5 \\ \text{if } 0.5 \geq D \geq -0.5, & \quad F = 0 \\ \text{if } -0.5 > D, & \quad F = D + 0.5 \end{aligned}$$

These “continuity corrections” are included because we are going to assume in the next steps that the standardised deviations (z) are normally distributed. But the Actual Deaths are necessarily integers (unless we have adjusted the data for variance ratios or amounts scaling) and in this case the adjusted deviations give better results.

8. We then calculate the standardised deviations (z):

$$z_{i,y} = F_{i,y} / \sqrt{E_{i,y}}$$

We are slightly mixing assumptions here. Under certain assumptions, which we normally make, the number of deaths (A) is Poisson distributed with expected value E and variance E. If A is large enough (at least 5) then each z is approximately standard normally distributed.

9. We then square the values of z and sum all of them (for both experiences) to get a value of χ^2 :

$$\chi^2 = \sum_{i,y} (z_{i,y})^2$$

If there are n groups there are $2n$ values of z . But we have fitted n “parameters”, in the values of the combined mortality rates (μ). So we have only n degrees of freedom. We then calculate, accurately, $p(\chi^2)$, the probability that the calculated value of χ^2 would be as great or greater if it came from a χ_n^2 distribution. A low value for $p(\chi^2)$, corresponding to a high value of χ^2 , shows significance. A one-tailed test is appropriate. A too low value of χ^2 shows that the two experiences are unusually close, and this seldom happens. Note that the expected value of χ_n^2 is equal to n and the standard deviation is equal to $\sqrt{2n}$. If the number of degrees of freedom, n , is even moderately large, it resembles a normal distribution, but accurate convergence is quite slow, and there are better approximations.

10. In addition we calculate the ratios of total actual to expected for the two experiences:

$$\text{Ratio}_i = 100A/E_i = 100 \sum_y A_{i,y} / \sum_y E_{i,y}$$

The heavier experience overall has the higher ratio.

11. We also carry out tests on the signs of the discrepancies of each group, using the sign (+ or -) of either $\mu_{1,y} - \mu_{2,y}$ or $A_{1,y} - E_{1,y}$ (which are necessarily the same; if both are zero the sign is taken as +).

12. The first test is on the numbers of positive and negative signs. If the two experiences had the same underlying mortality rates then the probability of positive would be the same as that of a negative and would be 0.5. If the number of groups is n , the observed number of positives is np and the observed number of negatives is nm (thus $n = np + nm$), we calculate the exact probabilities (with a binomial assumption):

$$P1 = \text{Prob}(\text{Number of Positives} < np)$$

$$P2 = \text{Prob}(\text{Number of Positives} = np)$$

$$P3 = \text{Prob}(\text{Number of Positives} > np)$$

We then calculate:

If $P1 + P2 < 0.5$, we show $p(+)$ = $P1 + P2$ followed by the marker (+)

If $P3 + P2 < 0.5$, we show $p(+)$ = $P3 + P2$ followed by the marker (-)

Otherwise, we show $p(+)$ = 0.5

This identifies the probabilities of the two tails. If the number of positives is much less than the number of negatives, then $P1 + P2$ is relatively small, and may be significant at e.g. a 2.5% or 0.5% level. If the number of positives is much greater than the number of negatives, then $P3 + P2$ is relatively small, and may be significant at the other tail. In other cases, where np and nm are not very different, $P2$ straddles the 0.5 probability point, and no significance can be ascribed.

A marker, (+) or (-) respectively, is shown in the tables in this Working Paper to indicate which of $\{P1 + P2\}$ or $\{P3 + P2\}$ has been calculated. For 'otherwise' cases assigned a probability value of 0.5, no marker is shown.

13. The second test is on the numbers of runs of groups with the same sign. This is one more than the number of "changes of sign", which is another way of expressing the test. If the two experiences had roughly "parallel" mortality rates, even if not at the same level, then the number of runs would be suitably large. If the rates are not parallel, then the number of runs may be small. If the number of runs is unduly large, the experiences interlock surprisingly much, but this seldom happens. The distribution of the number of runs, nr , depends on the numbers np and nm , and is calculated exactly. We then get probabilities:

$$Q1 = \text{Prob}(\text{Number of Runs} < nr)$$

$$Q2 = \text{Prob}(\text{Number of Runs} = nr)$$

$$Q3 = \text{Prob}(\text{Number of Runs} > nr)$$

As before we calculate:

If $Q1 + Q2 < 0.5$, we show $p(\text{runs}) = Q1 + Q2$ followed by the marker (+)
If $Q3 + Q2 < 0.5$, we show $p(\text{runs}) = Q3 + Q2$ followed by the marker (-)
Otherwise, we show $p(\text{runs}) = 0.5$

A marker, (+) or (-) respectively, is shown in the tables in this Working Paper to indicate which of $\{Q1 + Q2\}$ or $\{Q3 + Q2\}$ has been calculated. For 'otherwise' cases assigned a probability value of 0.5, no marker is shown.

In general a one-tailed test is appropriate, and a negative value of $p(\text{runs})$ hardly ever occurs.

14. One can consider the tests in sequence.

If the value of $p(+)$ is significant in either direction, then the two experiences have different levels of mortality, and should probably not be amalgamated. Usually the two 100A/E ratios are fairly different.

If the value of $p(+)$ is satisfactory, but the value of $p(\text{runs})$ is significantly low then the levels of mortality may be the same, but the shapes are not. One may be consistently higher than the other at some ages, lower at other ages. Probably the experiences should not be amalgamated.

If the values of $p(+)$ and $p(\text{runs})$ are satisfactory, but the value of $p(\chi^2)$ shows significance, then probably this is caused by too many deaths in one or other experience at a few ages. This may be because of duplicates, which may be inadequately adjusted for by variance ratios if these are used, or for some other, often unexplained, cause. Often the experiences can still be amalgamated if there is no other reason to keep them separate.