

APPENDIX B

FORMULAE FOR THE NEW STANDARD TABLES

In this Appendix the formulae used for the calculation of the adjusted values of μ_x are described in detail. The formulae do not apply below age 17; the method of obtaining values of q_x at ages below 17 is described in Section 2.4

A number of basic (graduated) formulae have been used. They are referred to by formula number. Thus F11 means μ_x calculated using formula F11. Most of the formulae are the original graduation formulae, described in the report in *C.M.I.R.*, 9. Three of them are formulae including 'quadratic adjustment' (explained in § 2.2.1.). Values of the parameters for the formulae are shown in Table B1. It should be noted that the parameter values for the basic formulae are shown to six decimal places, and these exact values have been used. They are the same as are shown in the Report in *C.M.I.R.*, 9 for the corresponding experience. For the formulae with quadratic adjustment, the adjusted parameters (b_0 , b_1 and b_2) are shown to six decimal places, though a higher number of decimal places has been retained in the calculations.

It should be noted that the formulae described in this Appendix are used to calculate the values of μ_x for the various experiences into which the data are classified. These values of μ_x are then used to calculate the values of $q_{[x]}$, $q_{[x]+1}$, q_x , etc shown in Appendix A. The values of $q_{[x]}$, $q_{[x]+1}$, q_x , etc are then used to calculate values of $\mu_{[x]}$, $\mu_{[x]+1}$, μ_x , etc as described in Section 2.6. The recalculated values of μ_x for ultimate or aggregate tables agree closely with the original graduated and adjusted values of μ_x , but the values of $\mu_{[x]}$, etc, for select tables do *not* correspond closely with the values of μ_x for 'Duration 0', etc.

Table B1. *Graduated formulae and their parameter values*

Formula No	-	Parameters					
		GM(<i>r,s</i>)	100a ₀	100a ₁	b ₀	b ₁	b ₂
<i>Permanent assurances, males</i>							
F11	Duration 0	GM(2,2)	-0.465192	-0.452546	-3.985723	3.185063	-
F12	Duration 1	GM(2,2)	-0.713368	-0.676049	-3.689744	3.027036	-
F13	Duration 2+	GM(2,2)	-0.338415	-0.386512	-3.352236	4.656042	-
F14	Durations 2-4	GM(2,2)	-0.487122	-0.496613	-3.634119	3.647534	-
F15	Duration 2+*	GM(2,3)	-0.338415	-0.386512	-3.887248	5.052347	-0.495382
(*F13 with quadratic adjustment, see B1.3)							
<i>Permanent assurances, females</i>							
F21	Duration 0	GM(2,2)	-0.169572	-0.158677	-4.755196	3.243579	-
F22	Duration 1	GM(2,2)	-0.076446	-0.089013	-4.253324	4.608019	-
F23	Duration 2+	GM(2,2)	-0.015700	-0.025164	-4.064944	5.044225	-
<i>Temporary assurances, males</i>							
F31	Duration 0	GM(2,2)	-8.935660	-3.775563	-2.318362	0.628717	-
F32	Durations 1-4	GM(2,2)	-0.616370	-0.576586	-3.773543	3.048161	-
F33	Duration 5+	GM(2,2)	-0.620970	-0.676328	-3.340552	4.051857	-
<i>Male Pensioners</i>							
F41	Lives	GM(1,3)	0.557291	-	-4.993529	5.882482	-1.668855
F42	Amounts	GM(1,3)	0.200555	-	-4.716394	5.832085	-1.277676
F43	Amounts*	GM(1,3)	0.200555	-	-3.342787	4.056202	-0.312522
(*F42 with quadratic adjustment, see B4.2)							
<i>Female Pensioners</i>							
F51	Lives	GM(1,3)	0.662810	-	-6.473887	8.069982	-2.174915
F52	Amounts	GM(1,3)	0.679085	-	-7.914792	9.365123	-3.358784
F53	Amounts*	GM(1,3)	0.679085	-	-2.138566	1.663488	0.492034
(*F52 with quadratic adjustment, see B5.2)							
<i>Male Annuitants</i>							
F61	Duration 0	GM(0,2)	-	-	-3.514486	3.332467	-
F62	Duration 1+	GM(0,2)	-	-	-3.375783	4.327411	-
<i>Female Annuitants</i>							
F71	Duration 0	GM(0,2)	-	-	-4.226617	5.419216	-
F72	Duration 1+	GM(0,2)	-	-	-3.979448	5.346654	-
<i>Widows</i>							
F81	Lives	GM(0,2)	-	-	-3.553013	4.316579	-
F82	Amounts	GM(0,2)	-	-	-3.719382	4.962087	-

B1 Permanent assurances, males – AM80 and AM80(5)

B1.1 Duration 0	all ages ($x > 17$)	F11
B1.2 Duration 1	$x < 28$	$(1-k_{11})F_{11} + k_{11}.F_{13}$ where $k_{11} = (F_{12}-F_{11})/(F_{13}-F_{11})$ at $x = 28$ $= 0.60083712$
	$x \geq 28$	F12
B1.3 Duration 2+	$x \leq 80$	F13
	$x > 80$	F15

F15 is derived from F13 by quadratic adjustment above age 80 such that $F_{13} = F_{15}$ at $x = 80$ and $r = 0.7$ at $x = 110$

B1.4 Durations 2-4	all ages ($x > 17$)	F14
B1.5 Duration 5+	as Duration 2+	throughout

B2 Permanent assurances, females – AF80

B2.1 Duration 0	$x \leq 75$	F21
	$x > 75$	$k_{21}.F_{22}$ where $k_{21} = F_{21}/F_{22}$ at $x = 75$ $= 0.46345460$
B2.2 Duration 1	all ages ($x > 17$)	F22
B2.3 Duration 2+	$x < 28$	$k_{22}.F_{22}$ where $k_{22} = F_{23}/F_{22}$ at $x = 28$ $= 1.08156196$
	$x \geq 28$	F23

B3 Temporary assurances, males – TM80

B3.1 Duration 0	$x < 31$	$k_{31}.F_{32}$ where $k_{31} = F_{31}/F_{32}$ at $x = 31$ $= 0.80124215$
	$31 \leq x \leq 65$	F31
	$x > 65$	$k_{32}.F_{32}$ where $k_{32} = F_{31}/F_{32}$ at $x = 65$ $= 0.60410293$
B3.2 Durations 1-4	$x \leq 34$	F32
	$34 < x \leq 44$	$k_{33}.F_{33}$ where $k_{33} = F_{32}/F_{33}$ at $x = 34$ $= 0.95021746$
	$44 < x < 45$	$\min(F_{32}, k_{33}.F_{33})$
	$x \geq 45$	F32
B3.3 Duration 5+	$x < 32$	$k_{34}.F_{13}$ where $k_{34} = F_{33}/F_{13}$ at $x = 32$ $= 0.98018301$
	$x \geq 32$	F33

B4 Male pensioners – PML80Base and PMA80Base

B4.1 Lives	$x < 55$	$k41.k42.F13$
		where $k41 = F41/F42$ at $x = 65$ $= 1.27871549$
		$k42 = F42/F13$ at $x = 55$ $= 1.00074607$
	$55 \leq x < 65$	$k41.F42$
	$65 \leq x \leq 91$	F41
B4.2 Amounts	$91 < x \leq 93$	$k43.F42$
		where $k43 = F41/F42$ at $x = 91$ $= 1.01216060$
	$x > 93$	$k43.F43$
	$x < 55$	$k42.F13$
	$55 \leq x \leq 93$	F42
	$x > 93$	F43

F43 is derived from F42 by quadratic adjustment above age 93 such that $F43 = F42$ at $x = 93$ and $r = 1.25$ at $x = 110$

B5 Female pensioners – PFL80Base and PFA80Base

B5.1 Lives	$x < 28$	$k52.k51.k22.F22$
		where $k51 = F52/F23$ at $x = 67$ $= 1.00769467$
		and $k52 = F51/F52$ at $x = 67$ $= 1.17657278$
	$28 \leq x < 67$	$k52.k51.F23$
	$67 \leq x \leq 95$	F51
B5.2 Amounts	$x > 95$	$k53.F53$
		where $k53 = F51/F52$ at $x = 95$ $= 1.21543261$
	$x < 28$	$k51.k22.F22$
	$28 \leq x < 67$	$k51.F23$
	$67 \leq x \leq 95$	F52
	$x > 95$	F53

F53 is derived from F52 by quadratic adjustment above age 95 such that $F53 = F52$ at $x = 95$ and $r = 2.0$ at $x = 110$

B6 Male annuitants – IM80Base

B6.1 Duration 0	$x < 65$	$k61.k62.F13$
		where $k61 = F61/F62$ at $x = 65$ $= 0.96155011$
		$k62 = F62/F13$ at $x = 65$ $= 1.16879491$
	$65 \leq x \leq 80$	F61
	$x > 80$	$k63.F62$
B6.2 Duration 1+		where $k63 = F61/F62$ at $x = 80$ $= 0.71341513$
	$x < 65$	$k62.F13$
	$x \geq 65$	F62

B7 Female annuitants – IF80Base

B7.1 Duration 0	$x < 28$	$k72.k71.k22.F22$ where $k71 = F72/F23$ at $x = 52$ $= 1.00069170$ and $k72 = F71/F72$ at $x = 52$ $= 0.76087110$
	$28 \leq x < 52$	$k72.k71.F23$
	$52 \leq x \leq 89$	F71
	$89 < x \leq 90$	$k73. \min(F72, \frac{1}{2}(F72 + F52))$ where $k73 = F71/F72$ at $x = 89$ $= 0.80284353$
	$90 < x \leq 95$	$k73. \frac{1}{2}(F72 + F52)$
B7.2 Duration 1+	$x > 95$	$k73. \frac{1}{2}(F72 + F53)$
	$x < 28$	$k71.k22.F22$
	$28 \leq x < 52$	$k71.F23$
	$52 \leq x \leq 89$	F72
	$89 < x \leq 90$	$\min(F72, \frac{1}{2}(F72 + F52))$
	$90 < x \leq 95$	$\frac{1}{2}(F72 + F52)$
	$x > 95$	$\frac{1}{2}(F72 + F53)$

B8 Widows – WL80Base and WA80Base

B8.1 Lives	$x < 28$	$k82.k81.k22.F22$ where $k81 = F82/F23$ at $x = 45$ $= 1.50608926$ $k82 = F81/F82$ at $x = 55$ $= 1.43336009$
	$28 \leq x < 45$	$k82.k81.F23$
	$45 \leq x < 55$	$k82.F82$
	$55 \leq x \leq 81$	F81
	$81 < x \leq 95$	$k83.F51$ where $k83 = F81/F51$ at $x = 81$ $= 1.03414340$
B8.2 Amounts	$x > 95$	$k83.k53.F53$
	$x < 28$	$k81.k22.F22$
	$28 \leq x < 45$	$k81.F23$
	$45 \leq x \leq 90$	F82
	$90 < x \leq 95$	$k84.F52$ where $k84 = F82/F52$ at $x = 90$ $= 1.11235210$
	$x > 95$	$k84.F53$