Differences in mortality experience by
health status and postcode

Challenger Group
Services Pty. Ltd.

2 September 2009

Prepared by:

Insurance & Financial Services
Watson Wyatt Limited
(Actuaries & Consultants)

Watson Wyatt
Worldwide

Table of Contents

This page is intentionally blank

Section 1: Introduction

1.1   We have been commissioned by Challenger Group Services Pty. Ltd. ("Challenger") to provide mortality analyses based on UK population experience that quantify the differences in life expectancy between a "healthy" population and the entire population and between different clusters of postcodes.

1.2   If we assume that pension provision is compulsory then the standard annuity rates per unit pension fund that should be offered by annuity providers will be based on the expected mortality experience of the entire population, and there would be an implicit cross-subsidy between "healthy" and "unhealthy" lives such that "healthy" lives are receiving more generous annuity rates than they should otherwise obtain.

1.3   Our analysis compares these standard annuity rates per unit pension fund with the reduced annuity rates per unit pension fund that would be charged if only "healthy" lives purchased annuity policies. This change in annuity rates per unit pension fund could be regarded as a proxy for the impact of changing from voluntary to compulsory pension provision, if annuity providers were not allowed to offer better than standard annuity rates to "unhealthy" lives and "unhealthy" lives were prepared to purchase annuities at standard annuity rates.

1.4   We present a UK patient medical record database, the General Practice Research Database ("GPRD"), in section 2 that we have used extensively to quantify differences in mortality experience by prior health status. We then provide comparative analyses of life expectancy and annuity rates per unit pension fund for "healthy" lives, "unhealthy" lives and the entire population in section 3, and hence quantify the impact of inclusion or exclusion of "unhealthy" lives.

1.5   In section 4 we describe the development of a postcode mortality tool that uses generalised linear models ("GLM") on a large UK mortality experience dataset to define non-contiguous geographical areas that would be expected to have similar mortality. Section 5 then provides comparative analysis of the degree of variation in mortality experience between clusters of postcodes.

1.6   This Report is provided in hard copy and in electronic form. The Report should be read in its entirety, as parts of it, if read in isolation, may be misleading.

This page is intentionally blank

Section 2: General Practice Research Database

2.1   UK actuaries have historically made use of the following data sources in developing current assumptions over mortality experience:

- Own experience on annuitant or assured portfolio

- Analyses of experience for different product classes from a number of different insurers presented by the Continuous Mortality Investigation Bureau ("CMI") in CMI Reports or Working Papers

- Databases of deaths and central exposures for assured lives as collected by the CMI for calendar years 1947 to 2005

- All-cause and cause-specific mortality experience on the general population from the Office for National Statistics ("ONS")

2.2   However, over the last couple of years there has been considerable interest in other UK data sources that provide data on cause-specific mortality rates and to a lesser extent on the diagnosis of disease and subsequent mortality as extracted from primary care medical records. There are four major databases that hold information on large longitudinal cohorts of patients:

- General Practice Research Database ("GPRD")

- The Health Improvement Network ("THIN")

- QRESEARCH

- Doctors Independent Network Database ("DIN")

2.3   The databases have developed from prior voluntary arrangements between General Practitioner ("GP") practices and providers of medical records software in the UK. The two largest databases are QRESEARCH and GPRD, but QRESEARCH is only available to academic researchers or non-commercial organisations. GPRD has a worldwide reputation for data accuracy and completeness, and is widely used by pharmaceutical companies, medical regulatory authorities, research service providers and government departments.

2.4   The GPRD consists of series of dated episodes for each patient in the contributing GP practices. Data collection software within the VISION IT software extracts the necessary data approximately every 6 weeks, and this is submitted to the GPRD. The GPRD requires that the following items of data, amongst others, should be recorded by GPs:

- Significant morbidity events (but not all events) including referrals and abnormal test results

- Date of original onset of chronic or recurrent conditions

- Deaths, including date and cause of death where known

- Smoking status, alcohol intake and height/weight assessed every 3-5 years

2.5   The GPRD provides a practice-based quality marker for researchers, the Up-To-Standard ("UTS") date. This is the date that a particular practice first met quality standards set out by the GPRD. All analyses in this Report based on GPRD experience in a particular calendar year have been limited to that data which was collected by practices after their UTS date.

2.6   The GPRD provides data to external researchers in a number of different formats. The most comprehensive is an ongoing object-oriented database known as the Full Feature GPRD ("FF-GPRD") that enables users to carry out on-line queries on the entire database.

2.7   The FF-GPRD consists of compulsory core elements, covering diagnoses and treatments, and optional modules covering test results, further information on referrals, immunisation details, patient lifestyle and additional clinical details.

2.8   GPRD has developed a bespoke web-based interrogation tool for use by Watson Wyatt on a version of the FF-GPRD that contains core and optional elements. The web-based interrogation tool enables us to identify a population whose prior history either includes or excludes a specified disease or group of diseases, and then to track whether such individuals develop particular diseases or die within a pre-defined period. However, the interpretation and conclusions based on data extracted from the FF-GPRD are those of Watson Wyatt.

Section 3: Analysis of mortality experience by health status

3.1 We used our interrogation tool on the GPRD to identify individuals with a prior history of any of the following diseases as at 1 January 2000 that might lead to their inclusion in an "unhealthy" group of lives:

- Diabetes

- Stroke, ischaemic heart disease, aneurysms & heart failure

- Cancers of breast, cervix, larynx, prostate, uterus, colon, ovary, rectum, urinary system, brain, lung, oesophagus, pancreas and stomach, plus oral cancers, malignant melanoma, multiple myeloma, lymphomas and leukaemias

- Alzheimer's disease, Parkinson's disease & dementia

- Chronic obstructive pulmonary disease, pneumonia, tuberculosis, Crohn's disease, peptic ulcers, clostridium difficile infection, ulcerative colitis and diseases of liver and urinary system

3.2 We have carried out a series of runs for the "unhealthy" and "healthy" group of lives, each of which tracks deaths for different cohorts as defined on 1 January 2000 to the end of successive calendar years from 31 December 2000 to 31 December 2008. We then compare and disaggregate the different runs in each series to determine population exposures, number of deaths and mortality rates for each cohort for calendar years 2000 to 2008.

3.3 Table 3.1a & 3.1b sets out the number of lives and deaths in 5-year age cohorts in both groups of lives during each calendar year over the period 1 January 2000 to 31 December 2008 for men and women respectively.

Table 3.1a - Patient exposure and number of deaths for male lives over the period 2000 to 2008 for different groups

Age group at start of period	Calendar year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	Avg
Patient exposures for "healthy" lives [1]										
50-54	83243	78995	75305	72642	70785	68096	64652	61411	47618	69194
55-59	63169	59962	57210	55167	53649	51478	48758	46102	35580	52342
60-64	47323	44810	42519	40698	39314	37494	35411	33442	25751	38529
65-69	36507	34427	32562	31051	29874	28406	26769	25119	19179	29321
70-74	27367	25655	24112	22805	21654	20281	18859	17422	13108	21251
TOTAL	257608	243849	231708	222362	215276	205754	194449	183497	141236	210638
Patient exposures for "unhealthy" lives [2]										
50-54	14084	13298	12621	12110	11735	11185	10520	9962	7758	11475
55-59	15907	15000	14189	13558	13063	12440	11716	11041	8507	12825
60-64	18788	17605	16534	15703	14982	14100	13170	12314	9432	14736
65-69	21214	19724	18385	17272	16343	15257	14125	13077	9905	16145
70-74	21411	19555	17920	16498	15267	13904	12522	11233	8255	15174
TOTAL	91404	85181	79649	75141	71390	66887	62052	57628	43857	70354
Patient exposure for "unhealthy" lives as % of all lives [2 / (1 + 2)]										
50-54	14.5%	14.4%	14.4%	14.3%	14.2%	14.1%	14.0%	14.0%	14.0%	14.2%
55-59	20.1%	20.0%	19.9%	19.7%	19.6%	19.5%	19.4%	19.3%	19.3%	19.7%
60-64	28.4%	28.2%	28.0%	27.8%	27.6%	27.3%	27.1%	26.9%	26.8%	27.7%
65-69	36.8%	36.4%	36.1%	35.7%	35.4%	34.9%	34.5%	34.2%	34.1%	35.5%
70-74	43.9%	43.3%	42.6%	42.0%	41.4%	40.7%	39.9%	39.2%	38.6%	41.7%
TOTAL	26.2%	25.9%	25.6%	25.3%	24.9%	24.5%	24.2%	23.9%	23.7%	25.0%
Number of deaths" for healthy" lives [3]										
50-54	227	247	289	300	365	331	335	344	260	300
55-59	292	324	316	341	402	406	437	398	342	362
60-64	335	397	428	438	495	468	449	450	405	429
65-69	455	465	549	522	598	582	551	630	489	538
70-74	554	605	652	684	773	692	692	698	572	658
TOTAL	1863	2038	2234	2285	2633	2479	2464	2520	2068	2287
Number of deaths for "unhealthy" lives [4]										
50-54	185	164	134	140	148	139	143	112	93	140
55-59	276	240	204	244	206	212	224	217	165	221
60-64	439	449	386	378	417	388	361	384	298	389
65-69	763	680	666	658	665	640	577	566	452	630
70-74	1176	1028	1014	994	933	941	851	790	606	926
TOTAL	2839	2561	2404	2414	2369	2320	2156	2069	1614	2305
Number of deaths for "unhealthy" lives as % of all lives [4 / (3 + 4)]										
50-54	44.9%	39.9%	31.7%	31.8%	28.8%	29.6%	29.9%	24.6%	26.3%	31.8%
55-59	48.6%	42.6%	39.2%	41.7%	33.9%	34.3%	33.9%	35.3%	32.5%	37.9%
60-64	56.7%	53.1%	47.4%	46.3%	45.7%	45.3%	44.6%	46.0%	42.4%	47.5%
65-69	62.6%	59.4%	54.8%	55.8%	52.7%	52.4%	51.2%	47.3%	48.0%	53.9%
70-74	68.0%	63.0%	60.9%	59.2%	54.7%	57.6%	55.2%	53.1%	51.4%	58.5%
TOTAL	60.4%	55.7%	51.8%	51.4%	47.4%	48.3%	46.7%	45.1%	43.8%	50.2%

Table 3.1b - Patient exposure and number of deaths for female lives over the period 2000 to 2008 for different groups

Age group at start of period	Calendar year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	Avg
Patient exposures for "healthy" lives [1]										
50-54	84346	80222	76639	74128	72431	69994	66795	63593	49464	70846
55-59	65108	62032	59260	57190	55815	53899	51437	48908	38014	54629
60-64	52372	49850	47656	46017	44863	43234	41203	39135	30374	43856
65-69	44375	42305	40538	39150	38105	36664	34927	33057	25514	37182
70-74	38858	36847	35074	33565	32385	30823	28995	27089	20661	31589
TOTAL	285059	271257	259168	250050	243598	234613	223358	211782	164028	238101
Patient exposures for "unhealthy" lives [2]										
50-54	11316	10690	10179	9787	9502	9122	8660	8229	6397	9320
55-59	12492	11784	11200	10744	10393	9916	9357	8860	6894	10182
60-64	14706	13839	13115	12524	12054	11482	10809	10203	7926	11851
65-69	16836	15781	14877	14133	13516	12808	11969	11191	8571	13298
70-74	19263	17814	16547	15415	14446	13378	12253	11207	8385	14301
TOTAL	74614	69909	65916	62604	59912	56705	53048	49690	38174	58952
Patient exposure for "unhealthy" lives as % of all lives [2 / (1 + 2)]										
50-54	11.8%	11.8%	11.7%	11.7%	11.6%	11.5%	11.5%	11.5%	11.5%	11.6%
55-59	16.1%	16.0%	15.9%	15.8%	15.7%	15.5%	15.4%	15.3%	15.4%	15.7%
60-64	21.9%	21.7%	21.6%	21.4%	21.2%	21.0%	20.8%	20.7%	20.7%	21.3%
65-69	27.5%	27.2%	26.8%	26.5%	26.2%	25.9%	25.5%	25.3%	25.1%	26.3%
70-74	33.1%	32.6%	32.1%	31.5%	30.8%	30.3%	29.7%	29.3%	28.9%	31.2%
TOTAL	20.7%	20.5%	20.3%	20.0%	19.7%	19.5%	19.2%	19.0%	18.9%	19.8%
Number of deaths" for healthy" lives [3]										
50-54	164	166	162	195	221	253	215	229	198	200
55-59	176	224	239	241	273	239	303	278	234	245
60-64	225	310	265	318	352	357	360	376	320	320
65-69	324	350	397	446	485	465	465	533	408	430
70-74	485	515	641	635	677	677	711	728	581	628
TOTAL	1374	1565	1704	1835	2008	1991	2054	2144	1741	1824
Number of deaths for "unhealthy" lives [4]										
50-54	159	129	112	100	91	102	83	79	81	104
55-59	184	183	152	159	135	177	118	141	88	149
60-64	288	253	227	264	238	250	233	237	191	242
65-69	436	370	391	395	373	368	385	346	297	373
70-74	748	678	691	685	663	638	599	603	428	637
TOTAL	1815	1613	1573	1603	1500	1535	1418	1406	1085	1505
Number of deaths for "unhealthy" lives as % of all lives [4 / (3 + 4)]										
50-54	49.2%	43.7%	40.9%	33.9%	29.2%	28.7%	27.9%	25.6%	29.0%	34.2%
55-59	51.1%	45.0%	38.9%	39.8%	33.1%	42.5%	28.0%	33.7%	27.3%	37.7%
60-64	56.1%	44.9%	46.1%	45.4%	40.3%	41.2%	39.3%	38.7%	37.4%	43.1%
65-69	57.4%	51.4%	49.6%	47.0%	43.5%	44.2%	45.3%	39.4%	42.1%	46.5%
70-74	60.7%	56.8%	51.9%	51.9%	49.5%	48.5%	45.7%	45.3%	42.4%	50.4%
TOTAL	56.9%	50.8%	48.0%	46.6%	42.8%	43.5%	40.8%	39.6%	38.4%	45.2%

3.4   Tables 3.1a & 3.1b illustrate the higher proportions of deaths in individuals who have a prior history of the different selected diseases, and that approximately 35% of the male and 25% of the female population aged 65-69 had a prior history of one of the diseases or conditions that we have considered in this Report.

3.5   Tables 3.2 & 3.3 set out the ratio of mortality experience by 10-year age cohorts for the "healthy" and "unhealthy" groups as compared to the entire population for each calendar year over the period 2000 to 2008.

Table 3.2 - Ratio of mortality experience for "healthy" group vs entire population for different calendar years after selection on `1 January 2000

Age group at start of period	Calendar year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	Avg
Men										
45-54	66.5%	74.7%	78.1%	79.3%	82.3%	81.2%	80.7%	87.1%	86.3%	79.6%
50-59	63.9%	70.6%	77.2%	75.2%	82.1%	81.2%	81.1%	82.9%	83.7%	77.5%
55-64	61.5%	67.2%	73.1%	72.7%	76.9%	77.1%	78.2%	75.8%	79.9%	73.6%
60-69	58.8%	63.9%	70.7%	70.4%	73.2%	73.3%	74.5%	76.5%	78.0%	71.0%
65-74	57.4%	64.0%	68.7%	69.0%	74.8%	71.7%	74.1%	78.1%	78.6%	70.7%
Women										
45-54	58.7%	67.0%	69.0%	75.0%	83.1%	80.4%	83.2%	84.6%	82.3%	75.9%
50-59	57.8%	64.4%	69.8%	72.6%	79.3%	73.7%	83.1%	80.4%	82.8%	73.8%
55-64	56.6%	67.7%	70.1%	69.8%	76.7%	71.2%	79.7%	77.2%	81.0%	72.2%
60-69	57.3%	68.1%	68.3%	70.6%	75.7%	74.6%	74.4%	79.1%	77.7%	71.8%
65-74	58.4%	64.6%	69.5%	70.6%	74.1%	74.0%	75.3%	78.5%	79.1%	71.6%

Table 3.3 - Ratio of mortality experience for "unhealthy" group vs entire population for different calendar years after selection on 1 January 2000

Age group at start of period	Calendar year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	Avg
Men										
45-54	325.5%	271.3%	249.1%	241.5%	221.6%	230.6%	235.0%	190.4%	195.1%	240.0%
50-59	275.3%	243.9%	212.3%	223.1%	189.4%	194.8%	195.8%	187.3%	182.8%	211.6%
55-64	221.7%	204.8%	187.0%	188.9%	176.0%	176.3%	173.4%	181.7%	168.2%	186.4%
60-69	185.5%	175.9%	162.4%	163.8%	158.6%	159.5%	157.7%	153.7%	150.6%	163.1%
65-74	162.9%	154.3%	148.2%	148.8%	140.5%	146.6%	143.8%	137.9%	137.6%	146.7%
Women										
45-54	453.9%	384.7%	368.3%	318.2%	248.1%	272.6%	248.8%	237.2%	256.7%	309.8%
50-59	363.6%	324.2%	290.9%	274.5%	233.0%	270.4%	210.8%	228.7%	212.5%	267.6%
55-64	286.0%	240.0%	230.6%	232.9%	204.1%	229.9%	192.8%	204.8%	187.2%	223.2%
60-69	229.8%	198.6%	199.3%	193.1%	178.2%	183.0%	184.8%	170.0%	175.0%	190.2%
65-74	194.8%	182.6%	172.6%	171.7%	164.8%	166.3%	164.5%	157.0%	156.3%	170.1%

3.6 Tables 3.2 & 3.3 illustrate mortality experience for the "healthy" and "unhealthy" lives can be modelled by a multiple, where this multiple converges to 1 with increasing starting age and increasing duration.

Cohort life expectancies

3.7 The analyses from the GPRD only provide comparisons over a 9 year period. We have made the following assumptions to develop consistent sets of lifetime mortality rates from different starting ages:

■ Multiples of mortality experience developed from the GPRD can be applied to an annuitant table to differentiate between "healthy" and "unhealthy" annuitants.

■ Multiples for years 2009 and later are assumed to trend towards 1 by age 100.

■ Starting mortality assumption for all annuitants is 100% PCMA00 with mortality improvements equal to the average of Medium and Long cohort over the period from 2000 to 2009 for men or 100% PCFA00 with mortality improvements equal to 75% of the average of Medium and Long cohort over the period from 2000 to 2009. Medium and Long cohorts are sets of mortality improvements introduced by the UK Continuous Mortality Investigation Bureau ("CMI") in December 2002 in CMI Working Paper 1 and are in widespread usage by UK insurers.

■ Future mortality improvements for all annuitants group equal to the average of Medium and Long cohort for men or 75% of the average of Medium and Long cohorts for women, subject to a minimum floor of 1.5% pa up to age 90 and then tapering linearly to 0% pa by age 120.

3.8 Table 3.4 sets out complete cohort life expectancies for different selected ages for the different groups for men and women.

Table 3.4 - Complete cohort life expectancy for different groups for selected ages

Starting age	Life expectancy			
	All	Healthy	Unhealthy	Healthy - All
Men				
50	37.9	38.7	33.5	0.8
55	32.9	33.8	29.0	1.0
60	27.8	29.1	24.6	1.2
65	23.0	24.4	20.4	1.4
70	18.4	19.9	16.4	1.5
Women				
50	39.9	40.8	34.3	0.9
55	34.8	35.7	30.4	0.9
60	29.6	30.7	26.0	1.0
65	24.6	25.9	21.4	1.3
70	19.8	21.1	17.1	1.3

Annuity rate calculations

3.9 We have subsequently calculated annuity rates for a £50,000 pension fund based on constant interest rates of 4.5% pa, illustrative initial expenses of 2% of premium and £25 pa renewal expenses, inflating at 3% pa, with payments made annually in advance. The choice of interest rate was intended to provide an approximation to the current UK interest yield curve. The amounts of annual lifetime annuity payments expected from a £50,000 pension fund for different groups at selected ages are set out in Table 3.5 for men and women.

Table 3.5 - Lifetime annuity payments for a £50,000 pension fund for different groups for selected ages

| Starting age | Annual annuity payment | | | |
	All £	Healthy £	Unhealthy £	Healthy – All £
Men				
50	2660.9	2626.8	2881.2	-34.1
55	2832.4	2781.9	3069.4	-50.5
60	3077.0	2991.5	3344.5	-85.5
65	3426.4	3287.3	3724.3	-139.0
70	3928.1	3715.2	4274.1	-212.9
Women				
50	2592.0	2559.1	2849.4	-32.9
55	2742.7	2700.7	2988.7	-41.9
60	2961.1	2897.1	3226.9	-63.9
65	3279.6	3170.6	3613.6	-109.1
70	3738.2	3570.5	4154.0	-167.7

3.10 Challenger further asked us to calculate the equivalent annuity rate that would apply if an annuity certain had been purchased rather than a lifetime annuity, where the term of the annuity certain was equal to the complete life expectancy for that starting age. Table 3.6 sets out the amounts of annual annuity payments for an annuity certain of equivalent term for the different groups at selected ages for men and women on the same interest and expense assumptions as for Table 3.5. Table 3.7 sets out differences in the amounts of annual annuity payments between Tables 3.5 & 3.6.

Table 3.6 - Annuity payments from annuity certain of equivalent term for a £50,000 pension fund for different groups for selected ages

Starting age	Annual annuity payment			
	All £	Healthy £	Unhealthy £	Healthy – All £
Men				
50	2561.5	2540.2	2701.2	-21.3
55	2723.0	2687.9	2890.8	-35.1
60	2951.9	2887.6	3158.7	-64.3
65	3282.2	3170.9	3527.8	-111.2
70	3767.2	3587.0	4070.8	-180.2
Women				
50	2511.8	2491.4	2673.2	-20.4
55	2655.2	2626.7	2825.5	-28.5
60	2859.6	2812.3	3060.9	-47.3
65	3157.3	3070.9	3430.2	-86.4
70	3595.1	3455.8	3954.0	-139.3

Table 3.7 - Difference in annuity payments between lifetime annuity and annuity certain from Tables 3.5 & 3.6 for different groups for selected ages

Starting age	Annual annuity payment		
	All £	Healthy £	Unhealthy £
Men			
50	99.4	86.6	180.0
55	109.4	94.0	178.5
60	125.0	103.9	185.9
65	144.2	116.4	196.4
70	160.9	128.2	203.3
Women			
50	80.2	67.7	176.3
55	87.4	74.0	163.2
60	101.5	84.8	166.0
65	122.3	99.6	183.4
70	143.0	114.6	200.0

Commentary on results

3.11   Tables 3.4 & 3.5 indicate that differences in both life expectancy and annuity rates between the "healthy" population and the entire population increase with increasing starting age. The differences in the last column of each table indicate the potential impact of moving from a situation where annuities are purchased by those who are "healthy" to compulsory pension provision for the entire population.

3.12   We understand that the purpose of the comparisons of lifetime annuities and annuities certain with the term equal to the future expected life expectancy is to demonstrate the effect of future mortality on annuity rates. Tables 3.6 & 3.7 clearly illustrate that annuity rates on a lifetime annuity are relatively higher at older starting ages and for those with a prior history of disease.

This page is intentionally blank

Section 4: Development of postcode mortality model

Introduction

4.1   Over the last few years there has been increased interest in the use of generalised linear models ("GLM") and survivor models in analysing mortality experience. In comparison to traditional actuarial mortality analyses that consider age, sex and calendar year, multi-factor models allow the simultaneous consideration of all factors for which data has been captured. In the case of a pension scheme these might include pension amount, final salary, type of retirement, occupational class and policy options such as escalation rates and guaranteed annuity rate options.

4.2   It has been clear from a number of recent multi-factor mortality investigations that we have carried out, together with related work by other UK insurance and pension actuaries that postcode has a strong influence on pensioner and annuitant mortality in the UK.

4.3   It is clearly impractical to seek to analyse the mortality of any postcode in isolation because of insufficient mortality experience. Any study of mortality variation by postcode therefore requires some form of combining postcodes. Although postcode is clearly only a proxy to the actual underlying drivers of mortality, such as perhaps health status and wealth, postcode groups combined according to some common feature often demonstrate a degree of mortality homogeneity amongst the residents of all postcodes in the group.

4.4   One approach to combining postcodes in a way intended to create such mortality homogeneity has been to use "off-the-shelf" demographic "lifestyle" clustering indices, whereby postcodes are grouped together according to perceived commonality of socio-economic, lifestyle or wealth characteristics.

4.5   This approach has been adopted by another actuarial consultancy, Richards Consulting, in developing an internet-based analytical tool, MortalityRating, that recommends appropriate percentages of a standard mortality table based on the distribution of members in a pension scheme by postcode. We understand that MortalityRating is based on analysis of mortality experience from several insurers and pension schemes and socio-economic indices that have been provided by Experian, a credit scoring company with detailed financial data at postcode level. The underlying assumptions and construction of MortalityRating are not available for examination.

4.6   We are in the process of developing an "open source" tool that uses a variety of clustering techniques on a range of different data sources to analyse grouped pension scheme data, and hence to provide postcode mortality rating factors for every postcode in the UK by age and pension amount. This provides a simple and robust tool to estimate the base level mortality of any pension scheme or annuitant portfolio using the postcode distribution of its members together with data on the members' age, sex and pension amount. We provide more description on the construction of the tool in the following paragraphs before presenting comparative analyses in section 5.

Method of cluster grouping

4.7   We have deliberately chosen to use a number of different methods to produce different versions of non-contiguous area clusters, and used the combination of these different non-contiguous area clusters to provide a basis for predicting mortality experience in a particular postcode based on pension scheme mortality experience.

4.8   We have collated mortality experience from a number of large pension schemes, with a combined population exposure of approximately 3 million years and approximately 100,000 deaths. These schemes had collected data on pension amount and current postcode, as well as in some cases type of retirement and occupational class. We have created non-contiguous postcode mortality clusters using a proprietary technique that deduces clusters with similar mortality characteristics after allowing for age, sex and other relevant factors, the clustering being influenced by a credibility measure to reflect the amount of data in any group of postcodes.

4.9   We have obtained population exposures and numbers of death for England, Wales & Scotland from the Office of National Statistics ("ONS") by 5-year age groups for the period 2001 to 2005 by lower layer super output area ("LSOA") in England & Wales and by datazone in Scotland. LSOA and datazones are small geographical areas that were introduced for the 2001 census to provide a basis for aggregating data from different census forms, and have a population of the order of 1,000 persons. We have produced separate non-contiguous area clusters based on population mortality experience for ages 50 to 89, as age 89 is the oldest age for which population estimates are provided for individual ages.

4.10   Finally we have purchased a licence for two external indices produced by CACI, a competitor to Experian. The external indices provide ratings down to the level of individual postcode. The first, ACORN, is similar to indices produced by Experian in that it is based on financial and census data, and each postcode is allocated to descriptive categorical groupings such as "older affluent professionals". The second, HealthACORN, seeks to sort postcodes according to the health status of residents by referencing the results of annually updated self-reported health status questionnaires. We have used the descriptive categorical groupings that underlie these indices as two further separate sets of initial non-contiguous postcode clusters.

4.11   We would note that all the external indices developed by CACI and Experian were not originally developed to aid mortality analysis, and their predictive power is based on the extent to which elements captured in the index are a good proxy for mortality experience. As such, we would expect an external index based in part on health status to have greater predictive power than one based on credit scoring.

4.12   We have grouped each of the different finely divided sets of categories into successively broader categories based on differences in the observed pension scheme mortality experience between categories and the width of confidence intervals calculated by GLM to apply to each category.

Section 5: Variation in mortality experience by postcode group

5.1 The purpose of this section is to segment different geographical areas based on expected mortality experience, using the results of our GLM and data for the individual lives in our collated pension schemes, and hence illustrate differences in mortality experience between different ranked segments.

5.2 We are able to state the particular category within each of the different broad categorical groupings to which each life in our collated pension schemes belongs. The GLM provides us with the relative mortality for each broad categorical grouping, and hence we can construct an expected mortality rate for each life. We have grouped different lives based on age group and sex, and then we have allocated all lives of a particular sex in a particular age group to different LSOA and datazones to produce average expected mortality rates. We have then ranked the different LSOA and datazones to provide comparative mortality analyses for different deciles for each age group and sex.

5.3 Table 5.1 sets out central mortality rates applying to the different deciles for men and women, and Table 5.2 provides comparative mortality analyses between the different deciles and an average mortality rate across lives in the collated pensions dataset by age group and sex.

Table 5.1 - Central mortality rates for different deciles for men and women in age groups 50-59 to 70-79

Decile grouping	Men			Women		
	50-59	60-69	70-79	50-59	60-69	70-79
1	0.00855	0.01936	0.05764	0.00641	0.01271	0.03647
2	0.00747	0.01698	0.05058	0.00571	0.01146	0.03301
3	0.00688	0.01575	0.04663	0.00534	0.01076	0.03113
4	0.00643	0.01473	0.04363	0.00506	0.01020	0.02966
5	0.00603	0.01377	0.04094	0.00484	0.00973	0.02829
6	0.00570	0.01302	0.03868	0.00462	0.00930	0.02708
7	0.00540	0.01231	0.03656	0.00439	0.00884	0.02581
8	0.00507	0.01154	0.03426	0.00414	0.00835	0.02437
9	0.00472	0.01076	0.03185	0.00389	0.00784	0.02285
10	0.00414	0.00944	0.02767	0.00348	0.00702	0.02049

Table 5.2 - Mortality comparisons between different deciles for men and women in age groups 50-59 to 70-79

Decile grouping	Men			Women		
	50-59	60-69	70-79	50-59	60-69	70-79
1	145%	144%	145%	135%	134%	134%
2	127%	127%	127%	120%	121%	121%
3	117%	117%	117%	112%	113%	114%
4	109%	110%	109%	107%	107%	109%
5	102%	103%	103%	102%	102%	104%
6	97%	97%	97%	97%	98%	99%
7	92%	92%	92%	92%	93%	95%
8	86%	86%	86%	87%	88%	89%
9	80%	80%	80%	82%	83%	84%
10	70%	70%	69%	73%	74%	75%

5.4   Table 5.2 illustrates that those in decile 1 have approximately twice the mortality experience of those in decile 10. These patterns are stable by age group and show marginally smaller differences for women than men.

5.5   We have used the same assumptions on aggregate mortality experience, interest rates and expenses as in Table 3.5 to illustrate differences in the amounts of annual lifetime annuity payments expected from a £50,000 pension fund for different deciles. For the purposes of illustration only we have assumed that the multiples in Table 5.2 for different starting age groups apply to all subsequent ages. Table 5.3 sets out comparisons for men and women at selected starting ages.

Table 5.3 - Lifetime annuity payments for a £50,000 pension fund for different deciles for selected ages

Starting age	Annual annuity payment				
	All £	Decile 1 £	Decile 10 £	Dec 1 – All £	Dec 10 – All £
Men					
60	3077.0	3304.1	2902.8	227.1	-174.2
65	3426.4	3738.5	3185.5	312.1	-240.9
Women					
60	2961.1	3107.4	2832.9	146.3	-128.2
65	3279.6	3483.5	3102.3	203.9	-177.3

Section 6: Reliances & limitations

Reliances

6.1   In carrying out our analysis and producing this Report we have relied without independent verification upon the accuracy and completeness of the data and information provided to us, both in written and oral form, by the organisations which produced the sources of information discussed in the Report. Where possible, we have reviewed some of the information provided for reasonableness and consistency with our knowledge of the insurance industry.

6.2   Reliance has been placed upon, but not limited to, the following information:

- Patient counts and exposure measures produced by the interrogation tool "Conditional Probability Report" as developed by the General Practice Research Database, United Kingdom

Limitations

6.3   The Report has been prepared by Watson Wyatt Limited on an agreed basis to meet the specific purposes of Challenger Group Services Pty. Ltd. must not be relied upon for any other purpose. The Report has been prepared for use by persons technically competent in the areas covered. Except with the written consent of Watson Wyatt Limited, the Report and any written or oral information or advice provided by Watson Wyatt Limited must not be reproduced, distributed or communicated in whole or in part to any other person, or be relied upon by any other person. Any reference to Watson Wyatt Limited in any report, accounts or other published documents is not authorised without our prior written consent.

6.4   The Report must be considered in its entirety as individual sections, if considered in isolation, may be misleading. Draft versions of the Report must not be relied upon by any person for any purpose. No reliance should be placed on any advice not given in writing. If reliance is placed contrary to the guidelines set out above, Watson Wyatt Limited disclaim any and all liability which may arise.

6.5   Assumptions are made about future experience, including mortality and morbidity. These assumptions have been made on the basis of reasonable estimates. However, actual future experience is likely to differ from these assumptions, due to random fluctuations, changes in the operating environment, differences in experience between the UK and other countries, and other factors. Such variations in experience could have a significant effect on the results and conclusions of this Report. No warranty is given by Watson Wyatt Limited that the assumptions made in this Report will be reflected in actual future experience.

6.6   This Report was based on data available to Watson Wyatt Limited at, or prior to, 2 September 2009, and takes no account of developments after that date. Watson Wyatt Limited is under no obligation to update or correct inaccuracies which may become apparent in the Report.

6.7   This Report is subject to the terms and limitations, including limitation of liability, set out in our engagement letter of 21 July 2009.

Legal jurisdiction

6.8   This Report will be governed by and construed in accordance with English law and the parties submit to the exclusive jurisdiction of the English courts in connection with all disputes and differences arising out of, under or in connection with this Report. If any part of a provision of this Report is held invalid, illegal or unenforceable then the remainder of such provision shall remain valid and enforceable to the fullest extent permitted by law.

Daniel Ryan
Insurance & Financial Services
2 September 2009

Watson Wyatt Limited
21 Tothill Street
London
SW1H 9LL
United Kingdom

Authorised and regulated by the Financial Services Authority