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CONTINUOUS MORTALITY INVESTIGATION SELF-ADMINISTERED PENSION SCHEMES MORTALITY TABLES

Discussion Meetings

[Held by the Institute of Actuaries, 28 January 2008, and by the Faculty of Actuaries, 5 February 2008]

Introduction

The new graduated tables of self-administered pension schemes' mortality are now out for consultation.

Members of the Continuous Mortality Investigation (CMI) Self-Administered Pension Schemes (SAPS) Committee will present the graduated tables consultation document — Working Paper 32 (WP32) — at these Sessional Meetings, and will lead the discussions on the production and the use of these mortality tables. The discussions will concentrate on: how the tables will be used; which ones to use, and how to scale them for particular schemes; the different categories of pensioners for whom the tables have been produced; the treatment of younger and older ages; and the table names to be used.

It is stressed that the mortality tables contained in WP32 are issued as part of a consultation process, and that they might be changed before final publication.

ABSTRACT OF THE DISCUSSION HELD BY THE INSTITUTE OF ACTUARIES

Mr B. K. Wilson, F.I.A. (introducing the Continuous Mortality Investigation Working Paper 32)**:** I shall start with a few opening comments, then Mr Gaches will remind you of some of the pertinent points in the graduation consultation document, Working Paper 32 (WP32), and of questions on which the CMI Self-Administered Pension Schemes (SAPS) Mortality Committee is asking for responses. Following this, Mr Bodie will give a brief outline of further work which the CMI SAPS Mortality Committee will be carrying out later in 2008.

There are a couple of areas which we will not be covering. First, we have already seen some criticism in the press that WP32 does not consider what rates of mortality improvement may be appropriate for use with the new tables under consideration. It has never been the intention that the graduation work would look at future rates of improvement. It is the view of the Committee, at this point, that our dataset, although large, does not have a sufficiently long history to be a suitable basis from which to obtain future projections. Part of the work about which Mr Bodie will be talking will be an examination of trends within the dataset, but not extrapolations from it.

The Committee is also aware of the heterogeneity of the data, with the vast majority of

schemes only present for one three-year period in the six years covered by the dataset. We can, and we will, be looking at the mortality of different subsets of the dataset, but we did not think that producing 12 times the number of graduations which we have would make for a greater usefulness of the graduations. Reducing from an initial 40 to the current 20 has been hard enough work!

I see the advantages of having these tables, once they are finished, as threefold. First, they are more up to date than any other set of tables, and so are more credible. Secondly, they will be of significant advantage where scheme data are large enough to give a credible experience, and the actuary or the trustees are looking for 'best fit' tables. Note that the shape of the SAPS tables is rather different from the '00' series tables, in that they tend to be relatively heavier at the older ages in retirement compared to the younger ages in retirement. (This is ignoring the proposed changes above age 95.) Some schemes are splitting members into high and low paid for valuation purposes, and the SAPS tables give the flexibility to choose appropriate tables for different sections of the pensioner population and also of the pre-retirement population.

Thirdly, for schemes which are not large enough for a credible experience, they give flexibility to choose normal, light or heavy mortality, according to the type of employment. It may be argued that the '00' tables more accurately reflect the experience of small schemes, as only large schemes form the dataset that we have analysed. However, in producing 'Light' tables, we have provided actuaries advising schemes with a small white-collar-only workforce, with alternative tables which may more closely reflect that type of scheme.

Mr A. T. Gaches, F.I.A. (presenting the CMI SAPS graduation consultation paper (WP32))**:** Data have been collected by the CMI SAPS Mortality Committee since January 2003, and the CMI Working Papers 4, 9, 17 and 29 contain summaries and/or analyses of the underlying data up to various dates. Working Paper 31, which was published at the same time as these proposed graduations, which are covered in WP32, contains a summary of the data underlying these graduations.

The size of the dataset underlying the proposed graduations, which is shown in Figure D.1, is now large, with around 200,000 deaths for males and 150,000 deaths for females. This is around three times the size of the dataset underlying the '00' series pensioners' tables.

It is worth being clear how the SAPS dataset is subdivided. Some schemes are able to differentiate between pensioners who have retired in normal health and in ill-health, and this provides the normal and ill-health categories of data. On the other hand, some schemes cannot

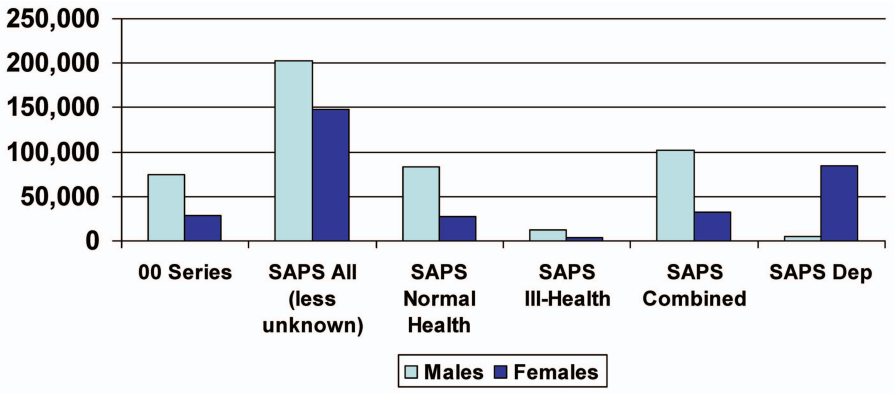

Figure D.1. Data (1) — deaths by type

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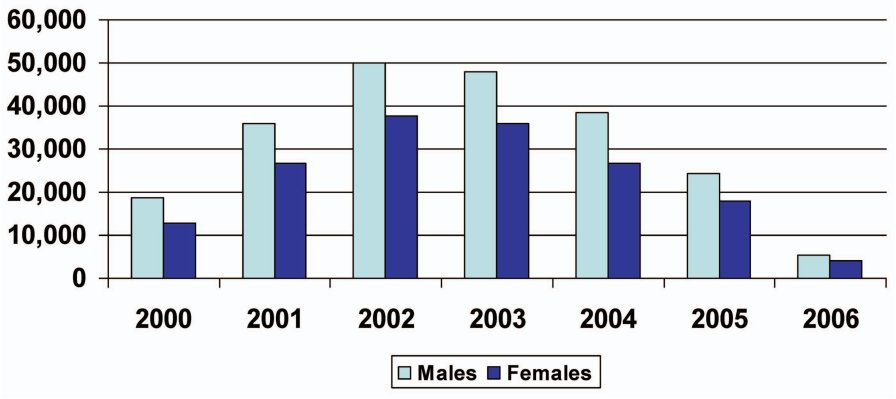

Figure D.2. Data (2) — deaths by year

differentiate between normal and ill-health retirements once they have occurred, and data from such schemes are classified as 'combined'. Data for dependants form the fourth category which we have used. We have not used data for unknown members, that is, those who cannot be divided accurately between pensioners and dependants.

Figure D.2 illustrates the numbers of deaths subdivided by year of death, and highlights a key difference between the collection methods for the life office '00' series and the SAPS data. The former collects data for each calendar year after the end of that year, hence the '00' series was based on four calendar years with, essentially, full data. In contrast, the SAPS study collects data from Scheme Actuaries when available, which typically means that data arrive in three-year chunks, as part of a triennial valuation process. As a result, we do not receive full data for any given calendar year until at least three years after the end of that year. This results in the pattern of data which you see, with most data for 2002 and 2003, and progressively less data for subsequent years.

A large number of possible tables was considered, as shown in Table D.1, including lives and amounts variants, tables for males and females and four types of data. The first was pensioners,

Table D.1. Proposed tables (and names)

		Lives		Amounts	
Data type	Light/Heavy	Female	Male	Female	Male
Pensioners (excluding dependants)	— Light Heavy	SPFL03	SPML03	SPFA03 SPFA03Light SPFA03Heavy	SPMA03 SPMA03Light SPMA03Heavy
Normal health pensioners	— Light Heavy			SNFA03 SNFA03Light SNFA03Heavy	SNMA03 SNMA03Light SNMA03Heavy
Ill-health pensioners	—			SIFA03	SIMA03
Dependants	— Light Heavy	SWL03		SWA03 SWA03Light SWA03Heavy	

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including normal health, ill-health and combined, the second was normal health pensioners, the third was ill-health pensioners and the fourth was dependants.

In addition, as shown in the second column of Table D.1, we have three variants based on pension size: the first contains all pension sizes; the second contains broadly those lives with the top 25% of pensions by size, which we have termed 'Light', because of the lighter resulting mortality; and the third, which contains the bottom 75% of pensions by size, which we have termed 'Heavy'.

These were reduced to the 20 tables highlighted in blue in Table D.1, following preliminary inquiries and consideration of the results. There may still be too many combinations. The tables which are highlighted in red denote those where we have specifically questioned the need for them in the working paper.

WP32 sets out four questions relating to the range of tables. First, we asked for feedback on abbreviations for 'Light' and 'Heavy'. It would be possible to graduate the 'Light' tables based on the top 12.5% of data, rather than on the top 25%, as has currently been done, and feedback has been requested as to whether this should be done. As a result, a further round of consultation has been embarked on. We also welcome feedback, more generally, on whether any specific tables should be dropped to reduce the number of tables, and, finally, on the proposed names illustrated for the tables.

The data for each proposed table were first graduated across the central range of ages, where it was felt that there were sufficient data so to do, and this range varies with the different types of tables.

The graduation fitted a Gompertz-Makeham formula $\mu = \mathrm{GM}(r, s)$, with polynomial of order r and s to the data. This was the approach which was adopted for the '00' series tables. Further details of this approach can be found in Forfar *et al.* (1988).

The tables were then extended at high and low ages. There were some anomalies between tables. For example, the μ_x for normal retirements were, at some ages, higher than those for all pensioners, which is not what we would expect in general. The method for removing such anomalies is set out in WP32. Finally, the μ_x were then converted to q_x, using the same approach as for the '00' series.

Figure D.3 illustrates the method of extending the graduation for high ages. In each case the graduated values have been used up to age 95. μ_x at age 121 has been set to 999 — that is a sufficiently high force of mortality — so that q_x, at age 120, would equal one. μ_x between ages 105 and 120 were then set so that the resulting q_x would equal 0.45 for males and 0.4 for females.

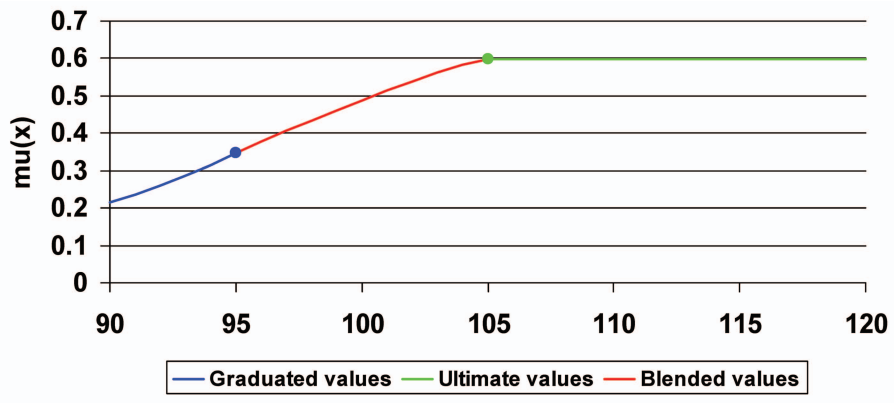

Figure D.3. methodology (2) — extension to high ages

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Table D.2. Methodology (3) — extension to low ages

Data type	Graduation range	Graduation range used	Extended range	Extension method
Pensioners (excluding dependants)	55-95	50-95	—	
Normal health pensioners	55-95	60-95	20-59	Blend of AxC00, AxN00 and AxS00 to match μ_{60}
Ill-health pensioners	35-95	41-95 (m) 44-95 (f)	20-40 (m) 20-41 (f)	Value of μ_{41} (m) Value of μ_{42} (f)
Dependants	45-95	45-95	20-44	GM(0,3) to match graduated μ_{45} and μ'_{45} and AFN00/AFS00 μ_{20}

This is an approach which we have based on recent work published by the Office for National Statistics (ONS) on population data in England and Wales at high ages. There is a reference in WP32 to that work. Between ages 95 and 105, blended values which match the μ_x at ages 95 and 105 are used, and, again, the blending approach is set out in WP32.

This overall approach is somewhat similar to that used for the '00' series. However, a key difference is that, in the '00' series, the values were blended to a μ_x of one at age 120, whereas we have blended to age 105, as described. The expectations of life and annuities at 5% interest, using the approach which we have adopted, are within 0.05% of those under the '00' series approach at all ages up to age 80. We have, however, asked for comments on the proposed method for extending the tables at high ages.

The extensions to low ages are, perhaps, more complex, and are summarised in Table D.2. Considering each data type in turn, the pensioner data were graduated over the age range 55 to 95. The graduation is then extended down to age 50 only. If it were extended to cover pensioners at ages younger than 50, these would be ill-health cases, and the resulting mortality curve would be U-shaped; so we have not taken this approach. In view of the small extension, the graduation formula obtained has been used at all ages from 50 upwards.

Moving on to normal health pensioners, which were also graduated over the range of ages 55 to 95, we noted that the data provided included some normal health retirements at below age 50, suggesting some element of mis-classification. Any mis-classification is unlikely to be restricted only to that youngest age group. For that reason, we have had some doubts over the data up to age 60, and we have used graduated values only between the ages of 60 and 95. These normal tables have then been extended down to age 20 by adopting a blend of various '00' series assured lives tables, such that the value of the extension matches the μ_x at age 60 from the graduation.

The ill health pensioners were graduated over the range of ages 35 to 95. The graduation formula was slightly U-shaped, in that there was a minimum value for μ_x at age 41 for males and at age 42 for females, and they were extended down to age 20, simply by continuing that minimum value of μ_x to the younger ages.

Dependants were graduated over ages 45 to 95 and extended to age 20, where they were set, perhaps somewhat arbitrarily, to match the assured lives smoker, non-smoker and the average of those two, for the widows' 'Heavy', 'Light' and 'All' tables, respectively. The extension also sought to match the graduated value at age 45 and the slope of the curve at age 45, and it was fitted using a Gompertz-Makeham formula of order (0,3).

We recognise that alternative approaches are possible. For example, it would be possible to graduate the all-pensioners data down to age 20 if it was accepted that a U-shaped curve was appropriate, and would be useful for practitioners. Such a table may then be usable for an all-pensioner valuation where ill-health was not differentiated. Similarly, the normal health tables

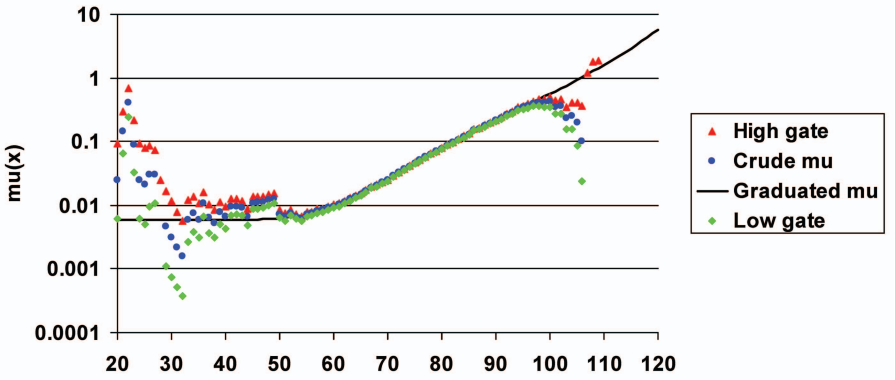

Figure D.4. Example graduation — SPML03

could be curtailed at age 50, and then used in conjunction with the ill-health tables to form a pair of tables to be used where ill-health was differentiated.

Given the range of alternatives possible for these extensions to low ages, there are several questions in WP32 where we have sought feedback. In particular, we have asked which tables practitioners would desire to be extended down to age 20, and, indeed, whether age 20 is the right age to which to extend the tables down. Should it be, perhaps, ages 16 or 17? We have asked whether the all-pensioner tables should stop at age 50 or be extended. We have asked, more generally, for feedback on whether the rates or the methods chosen for extending to younger ages are the most suitable.

The Committee was, in general, satisfied with the fit of graduations over the range where we have graduated the data. Figures 1 to 20 in WP32 demonstrate the results of this.

Figure D.4, which is Figure 1 of WP32, shows a good fit of the graduated curve in black over the range of ages 55 to 95, and that is shown compared to the crude rates of μ_x in blue and what are termed 'High' and 'Low' gates in red and green, showing 2.5 and 97.5 percentiles at each age.

Figures 21 to 29 of WP32 demonstrate the rationale for retaining or not retaining certain tables. I now briefly outline a few of these. Figure D.5, which is Figure 21 of WP32, compares, for males, all-pensioners and normal health pensioners, on an amounts and on a lives basis. The Committee concluded that, probably, only one life table would be necessary, and it retained, for the purpose of the consultation, the all-pensioners table. On an amounts basis, it has retained both the all-pensioners table and the normal pensioners table.

Figure D.6, which is Figure 23 of WP32, compares, for the male all-pensioner amounts tables, the 'Heavy', 'All' and 'Light' graduations. The Committee concluded that all should be retained, because of their distinct differences. However, it has queried whether it is necessary to retain all three if the male normal health pensioner tables are also split between 'Heavy', 'All' and 'Light'.

Figure D.7, which is Figure 26 of WP32, compares females in normal health, showing the 'Heavy', 'All' and 'Light' graduations. It will be noted that the differences are less than for males. However, again, for the purpose of the consultation all have been retained. Finally, Figure D.8, which is Figure 27 of WP32, shows that, for widows, there is a bigger distinction between the 'Heavy', 'Light' and 'All' graduations than for the other female graduations, and all three have been retained.

The 'High' and 'Low' age adjustments are demonstrated in Figures 30 to 41 of WP32, and I now review briefly the effect of the low age adjustment described for two of the tables.

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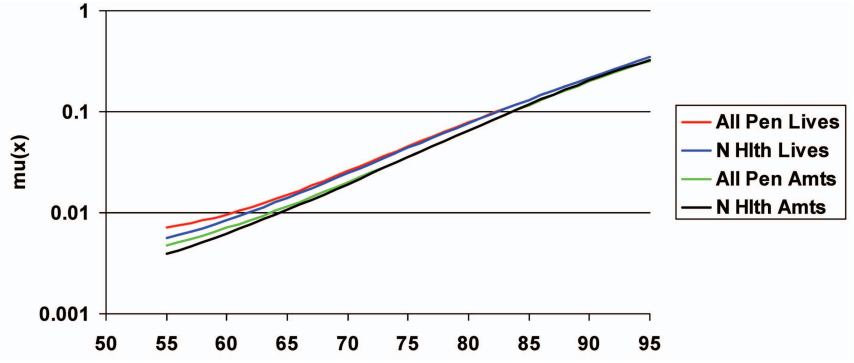

Figure D.5. Comparison of graduations — males

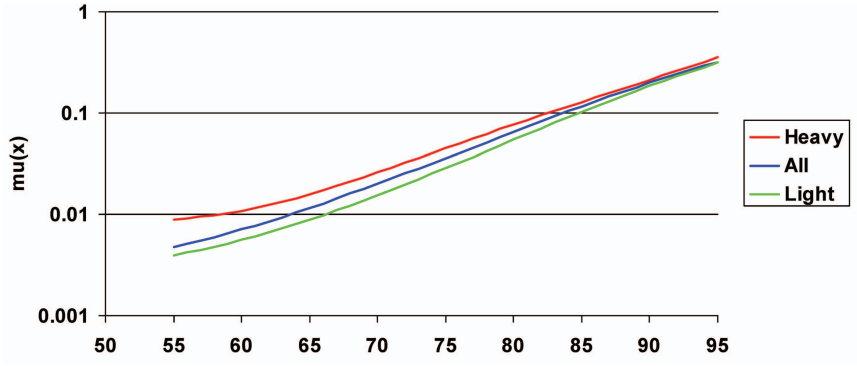

Figure D.6. Male all pensioners amounts

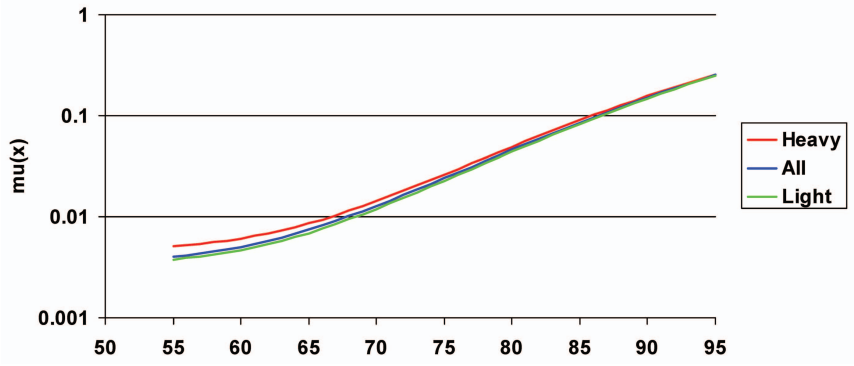

Figure D.7. Female normal health amounts

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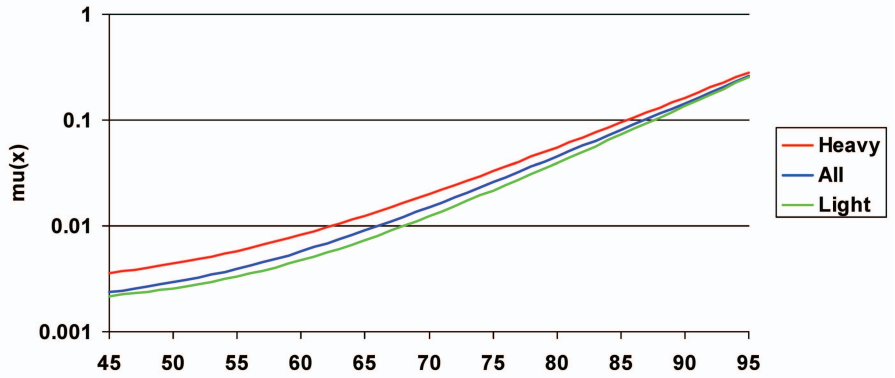

Figure D.8. Widow amounts

Figure D.9, which is Figure 31 of WP32, demonstrates the difficulty of extending the male all-pensioner table so that it is applicable for all pensioners at any age. Below age 50, such a table would need to reflect ill-health retirements only, which have significantly higher rates of mortality. Therefore, it would be necessary either to have a discontinuity at some age between 50 and 60, or to blend the tables, say, from ages 50 to 65, resulting in a U-shaped curve. The appropriate approach, and the appropriate blend, would, presumably, vary, possibly significantly, from scheme to scheme. Therefore, the Committee is minded to graduate the pensioners table from age 50 only. The same issue occurs for females, as shown in Figure 36 of WP32.

Figure D.10, which is Figure 37 of WP32, demonstrates the extension to young ages of the male ill-health amounts tables. The minimum value of the graduated μ_x, in this case at age 41, has been continued to lower ages, and the same approach has been taken for females.

A key feature throughout the SAPS studies has been that heavier mortality experience has been observed than in the corresponding life office pensioner studies.

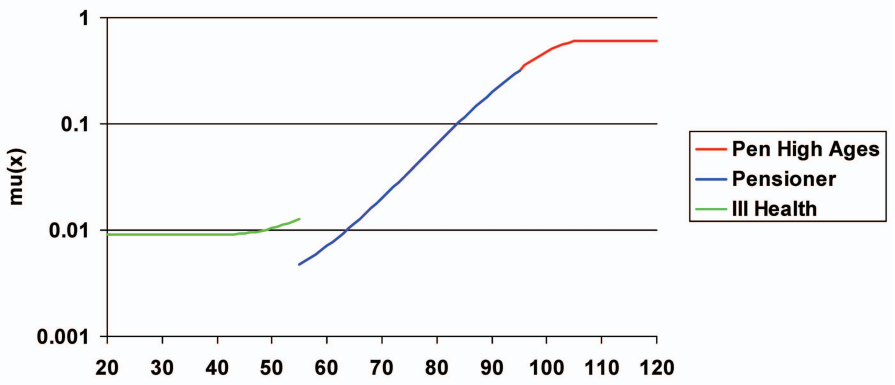

Figure D.9. Male pensioner amounts — low age issue

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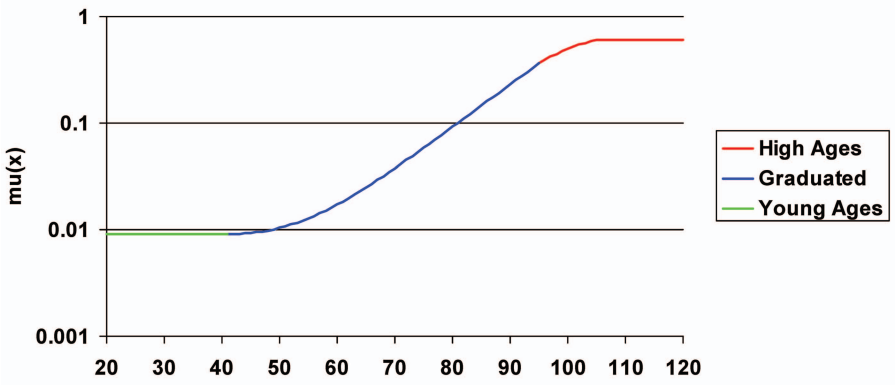

Figure D.10. Male ill-health amounts — extensions

Figures D.11, D.12 and D.13 show a comparison of the SAPS life tables, in red in each case, and the comparative '00' series tables in green . The '00' series table has been projected to 2003, so it is comparable in terms of the calendar year, using medium cohort projections. The choice for this comparison of using a medium cohort projection is entirely arbitrary, and it does not imply that it is a suitable projection for any particular purpose.

The graduation resulting from data related to broadly the top 12.5% of pensions by size is shown in Figure D.11 as the 'Top Band', and that is shown in blue. What the graph shows is that the proposed 'Light' pensioner table for males, in red, is heavier than the comparative '00' series table, in green, from age 70 upwards, so this is for most of the range.

The alternative top band graduation, in blue, is lighter than the comparative '00' series tables up to age 80, but is heavier thereafter. We have a similar analysis, shown in Figure D.12, for female pensioners. As expected, the 'Top Band' graduation, in blue, is slightly lighter than the proposed 'Light' graduation, in red. However, in this case, both the 'Light' and the alternative

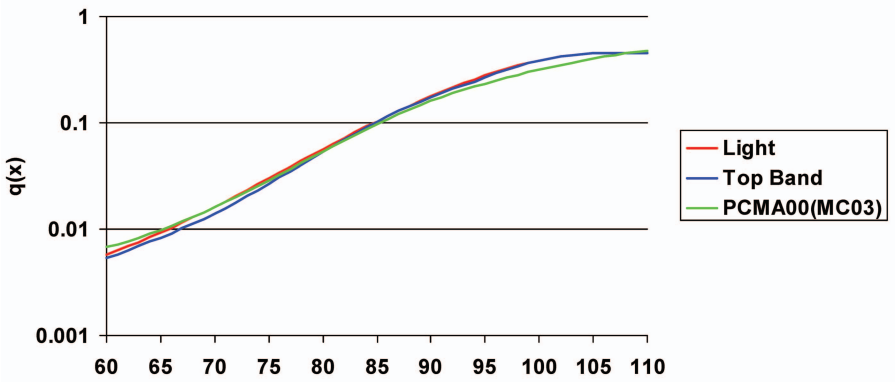

Figure D.11. Male pensioners — 'light' vs. PCMA00 — and 'Top Band' (top 12.5% of pension amounts)

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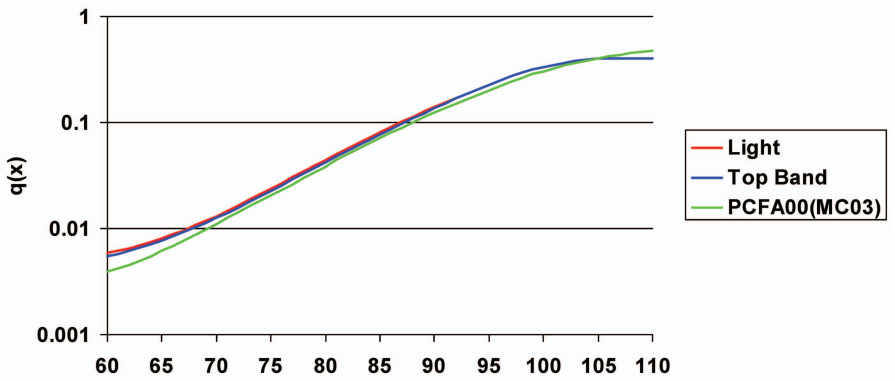

Figure D.12. Female pensioners — 'light' vs. PCFA00 — and 'Top Band' (top 12.5% of pension amounts)

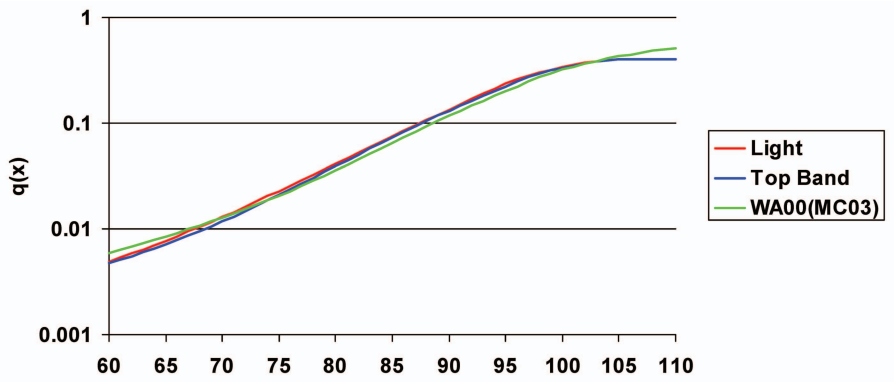

Figure D.13. Widows — 'light' vs. WA00 — and 'Top Band' (top 12.5% of pension amounts)

'Top Band' graduations are heavier across almost the whole range than the comparative '00' series table, which is shown in green at the bottom of Figure D.12.

Finally, we have a similar comparison of the position for widows (Figure D.13), which is, perhaps, similar to that for male pensioners, in that the proposed 'Light' table for widows, in red, is heavier than the comparative '00' series table, in green, from age 70 upwards. The alternative 'Top Band' graduation is in blue and it is lighter than the comparative '00' series table up to age 75, but it is heavier thereafter.

These figures illustrate that, for the proposed SAPS graduations, even the 'Light' tables are, in general, heavier than the comparative '00' series tables projected to 2003. Adopting 'Top Band' rather than 'Light' tables would shift the position somewhat. However, in many cases the comparative '00' series tables would remain lighter.

Figures D.14, D.15 and D.16 illustrate expectations of life at age 65, and further comparisons on annuities are available in Appendix B of WP32. The comparisons for males shown in Figure

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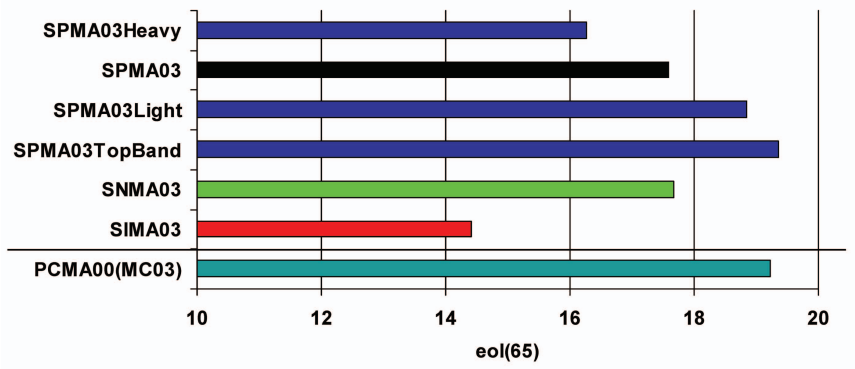

Figure D.14. Period expectations of life — males

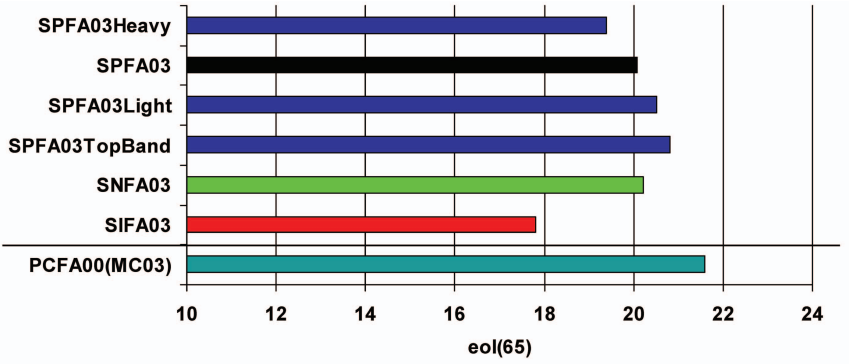

Figure D.15. Period expectations of life — females

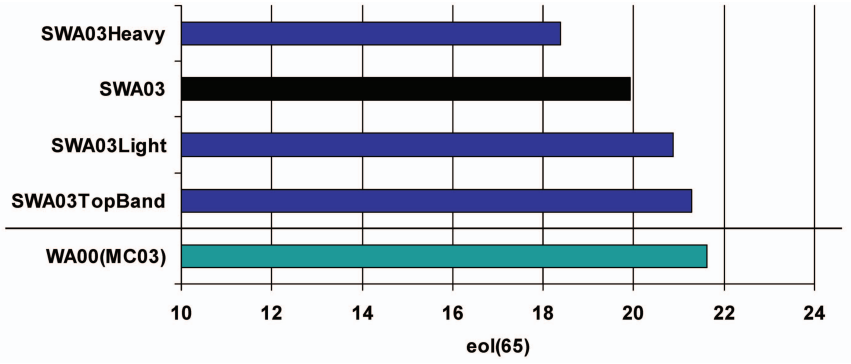

Figure D.16. Period expectations of life — widows

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D.14 demonstrate a difference of around 2.5 years between 'Heavy' and 'Light' pensioners, with the alternative 'Top Band' pensioners being around 0.5 year longer than the 'Light' pensioners. Expectations of life for the comparative '00' series table are between those for the proposed 'Light' and alternative 'Top Band' pensioners. However, that pattern would vary by age. The expectation of life for normal health pensioners is around 0.1 year higher than that for all pensioners. Finally, the ill-health expectation of life is noticeably shorter, at around 3.0 years less than that for normal health.

A similar comparison for females is shown in Figure D.15. Perhaps the key difference is that there are smaller differences by pension size. There is a difference of just over one year in the expectation of life between the 'Heavy' and the 'Light' pensioners, with the alternative 'Top Band' pensioners being 0.25 year longer. The expectations of life for the comparative '00' series table exceed those for both the 'Light' and the alternative 'Top Band' pensioners. The expectation of life for normal health pensioners, in green, is around 0.1 year higher than that for all pensioners, in black, and, again, the ill-health expectation of life is noticeably shorter, at around 2.5 years less than that for normal health.

Finally, Figure D.16 shows a similar comparison for widows, which demonstrates significant differences by pension sizes as for males, with a difference of around 2.5 years between the 'Heavy' and the 'Light' pensioners, with the alternative 'Top Band' pensioners being almost 0.5 year longer.

The expectation of life for the comparative '00' series table exceeds that for both the proposed and the alternative 'Top Band' pensioners.

Reference

Forfar, D.O., McCutcheon, J.J. & Wilkie, A. D. (1988). On graduation by mathematical formula. *Journal of the Institute of Actuaries*, **115**, 1-149, and *Transactions of the Faculty of Actuaries*, **41**, 97-269.

Mr N. D. V. Bodie, F.I.A. (presenting the future work to be carried out by the CMI SAPS Mortality Committee)**:** One of the areas at which we plan to look is the evidence regarding patterns of improvement, based on our data. We have a relatively short span of data to be doing anything about projections. However, we can, at least, see what patterns of improvement are emerging in the data so far. A second area of investigation will be into the experience within industrial classifications.

Currently, our main problem is the clustering of the data in the central years of the investigation. Also we have relatively few schemes which have submitted two sets of valuation data to us. Therefore, we have a real problem in the exposed to risk, in that particular years may be heavily weighted towards particular schemes which happen to have submitted their data for that period, but not on a consistent basis.

With regard to improvements, the data on the CMI website are measured against the '92' series short cohort. We chose the short cohort as the set of improvements at the beginning of the investigation, partly because, in 2003, that was the target at which many pensions actuaries were aiming, rather than at more adventurous tables.

For back analysis, that table of improvements is not too bad, because, at least for the first half of the decade, the differences between the short, medium and long cohorts are small. Clearly, however, the short cohort is now running out of steam, and the Committee is still finding issues to investigate. For the future, we think that this is probably the last time when we will be using the short cohort, although, as has been pointed out by Mr Gaches, this should not be regarded as any form of recommendation.

With regards to the clustering of the data, there is a substantial grouping of the data around 2002 and 2003, but we have very little in 2005 and 2006, as is shown in Figure D.17. With further submissions of data, we are hoping that the bars shown in Figure D.17 will be much more even in height, giving us some consistency in respect of the amount of pension cancelled by death and the ratio of actual to expected deaths. A feature of using the '92' tables, which are a poor fit for

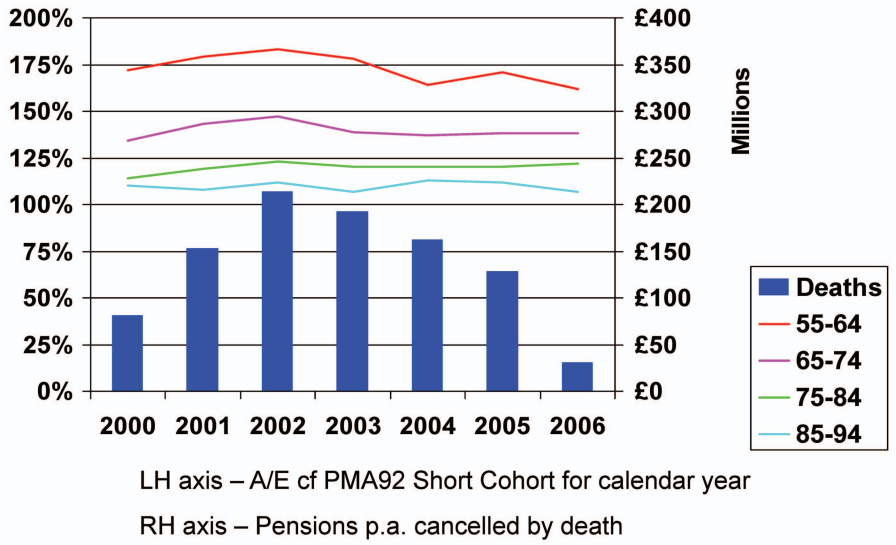

Figure D.17. SAPS males amounts — all retirements

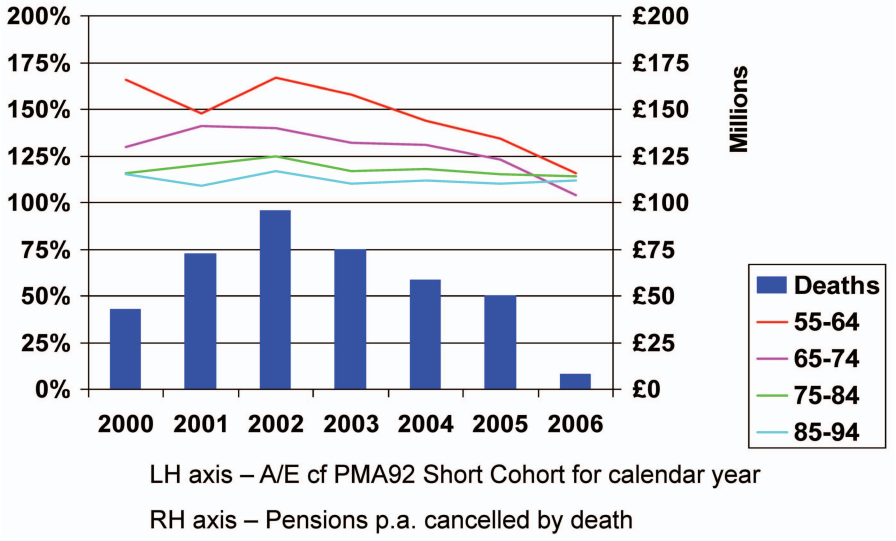

Figure D.18. SAPS males amounts — normal retirements

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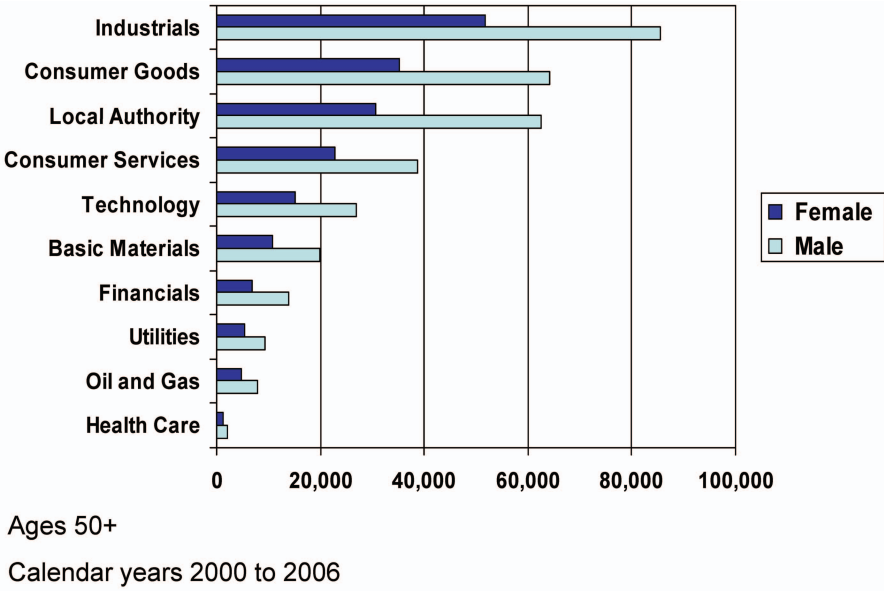

Figure D.19. Industrial analysis — number of deaths

the data, is that the lines are well separated, as shown in Figure D.17. At the youngest pensioner ages of 55 to 64, we have an actual to expected (A/E) of roughly 175%, which drops to 150%, and ultimately to 120%, for the older ages. We are measuring the experience in particular calendar years against the '92' series projected to those calendar years. So, if the short cohort was right for the rate of improvement, even though the absolute levels of the A/E are out of step, we would expect those lines to be fairly horizontal, and they are.

So, for the short and, by analogy, the medium and long cohorts, which are very little different up to, say, 2005, it looks as though the data are supportive of something like the cohort effect, but they do not appear to be a great deal stronger than that, at least when you look at the all retirements category.

We now consider the normal retirements category, and Figure D.18 illustrates that, whilst the oldest age groups are still pretty much on the horizontal line, we find that, in more recent years, the younger pensioners do appear to have their mortality improving much faster than the cohort, because the A/E is declining in these years, although, in 2006, we have almost no data for this normal retirement category.

Finally, we subdivide industrial analysis according to the FTSE classifications. Figure D.19 shows that, for some of the groups, we have very large amounts of data. We will certainly do comparisons of the experience by industrial classifications, and, where we have enough information, we are going to be able to do an analysis of the variation of the experience between schemes within particular industrial classifications. So, we will be able to look within classifications and across classifications as well. We hope that this will also be useful to Scheme Actuaries in forming their valuation bases.

Dr L. M. Pryor, F.I.A. (opening the discussion)**:** Although much of the recent discussion about mortality rates has concentrated on assumptions about future improvements, assumptions about the current rates of mortality (or at least the rates at a specified date in the recent past) are an

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equally important component in the overall estimation of future rates. The starting point affects where you end up, just as much as the direction in which you set off. In this context, the availability of up-to-date mortality rates for pensioners will be a valuable resource for actuaries, and hence for the users of actuarial information.

It is important that, as well as being up to date, the mortality rates are seen to be up to date. WP32 proposes a naming convention for the graduated tables, and requests feedback on it. The proposed convention would use the year 2003 to identify the tables, as that is the central year of the experience on which they are based. This immediately makes it look as if the rates are already five years old. In conversations which I have had with many non-actuaries about mortality tables, they have expressed some surprise that it takes the CMI so long to publish graduated tables, citing delays of up to five or six years, compared with, for example, 'LifeMetrics', which publishes revised index values within a few weeks or months of the underlying data being published.

The '00' series tables were published in 2006 — apparently a wait of six years. The SAPS 2003 tables will be published in 2008, which looks as if it is a wait of five years. The tables will be based on the experience from the years 2000 to 2006, using data collected to 30 June 2007. The proposed graduations are thus being exposed for consultation within seven months of the data becoming available, which is pretty good going. Using the year 2003 in the name, while accurately pinpointing the notional date to which the rates apply, presents a misleading impression as to how up to date the rates are. In my view, this reflects badly on the CMI and on the Actuarial Profession.

The only non-negotiable requirement for the names of tables is that they are unique. Although it is nice if the names reflect the date, it is really an optional extra. Those who use the tables will, if they are competent, know to which dates the rates apply; it does not need to be in the name. Instead, the table names should refer to the year of publication. The trustees and board members who are, in many cases, responsible for the final decisions on the assumptions, can then be confident that they are using the most recent information which is available. Appearances can affect reality, and the Profession will want the CMI to be seen to be operating on the same timescale as the rest of the world.

Professor A. D. Wilkie, C.B.E., F.F.A., F.I.A.: Some actuaries obviously think of a mortality table as a series of values of q_x at integral ages. The more modern way of looking at it is that a mortality table is a function of μ_x for all values of x . This is essential for multiple state work, which is becoming more frequent in many fields.

Traditional actuarial work can be perfectly well done with tables of q_x. The Working Party has produced tables of μ_x, but the CMI has not done that all the way through. The projections for the '80' series and the '92' series were done by projecting q_x, and the medium and other cohorts are factors applied to q_x, so there are no values of μ_x available all the way through, which is a fault. We should revise that in the future.

If one needs a formula for μ_x, it is important to have that formula. I know that there is a formula underlying both the '00' series tables and these SAPS proposals, but they are obscure, because you shift from one formula to another as ages change. There are different parameters coming in. There are little bits where one uses the higher or lower of certain rates. It is actually quite difficult, even for those of us who are used to it, to work out exactly which formula to use to replicate any table all the way through.

A small aspect of the '92' series tables was that it was possible to adjust the parameters, so that one formula fitted the data satisfactorily where there were data, but for old ages and young ages the one formula applied all the way through. Generally, that has not been done here. So, different bits have been spliced in. It appears to be possible to fit a single formula all the way through, but I have not found it yet.

As for old age mortality rates, I suspect that they are a bit too low. Although it makes hardly any difference to the annuities at younger ages, it must make some difference to the annuity values at high ages, and there will be some pension schemes which do have people of ages 95 or 100 in them.

For the younger ages, it is very important, for practical purposes, to have a table for all pensioners down to age 20, not just for the normal health pensioners. Coming down to age 20 for normal health, effectively, something like the assured lives table has been used for the mortality of those who retired in normal health at younger ages, if there were any such people.

On the other hand, there really are ill-health pensioners at young ages and also there are some pension schemes where it is quite difficult to distinguish between ill-health and normal pensioners, and one has to value them using some single table. Even if it means that the all-pensioners table does not quite fit the data at any particular point between ages 50 and 65 quite so well, I would rather see it being brought down to age 20 or possibly to age 17, or with a U-shape, but more or less horizontal from ages 20 to 50, and then rising smoothly thereafter. In some of the pensioners tables, the male lives and the female lives actually do look like that pretty well. However, in the important 'males amounts' table, where a GM(0,4) formula has been used rather than, say, a GM(1,3) one, probably using a slightly different formula would get it to go in the right place.

The Committee has used weights appropriate to smoker, non-smoker and combined from the '00' series tables. The 'combined' data include data both for the smokers and for the non-smokers, as well as for the undifferentiated ones. So, the combined rates, by themselves, would have been more appropriate to use.

We have seen graphs of the rates for 'Heavy', for 'Light' and for 'All' cases. For 'All' cases, on an amounts basis, the 'Light', who have the large pensions, get more weight. So, it is not too surprising that the 'Light' and the 'All' are close together, and the 'Heavy' are a little above them. It might be interesting to see the same thing done on a lives basis, even if they did not become published tables.

In some of the comparisons which were put forward earlier, the 'Light', the top bracket and the '00' series showed very similar results. I wonder what would happen if you applied the '00' series tables to those data. Are they significantly different? It is quite difficult to pick this up, because, on a graph, the rates of mortality look extremely close together, and they may be quite significantly different when it comes to numerical values or monetary values. However, they may also be quite well within the confidence intervals of the parameters, the confidence intervals of the graduation.

The standard errors of the parameter estimates do exist, but they have not been put into the paper. So the general reader cannot readily look at those. It might be worth while putting these into the finally published version. It is quite difficult, even if you have the standard errors of the parameters, to see the effect of this on the mortality rates themselves, unless one performs a technique which has been described in the past, of doing simulations and looking at the mortality rates.

Mr M. Clarke, F.I.A.: I work for the Pension Protection Fund (PPF) as Executive Director of Financial Risk. For too long, the data and the tables available to the majority of schemes have been those derived from national statistics or insurance company evidence, and this has been, in my opinion, a serious deficiency. Of course, judgement is always necessary in forming valuation assumptions, and the context in which those assumptions are made and the sensitivity of the outcome are highly relevant to the significance of the choice of any one particular parameter. However, the developments currently under way have the potential to improve risk management and to address potential imbalances in knowledge and data within the United Kingdom pensions industry.

First, the distribution of private sector defined benefit schemes in the U.K. is highly skewed, with the vast majority of schemes unlikely to have sufficient experience, without some reference to standard tables, on which to base their valuations. The data published by the Pensions Regulator and my own organisation, the PPF, under our 'Purple' brand, shows that only around 250 schemes out of a total population of 7,800 have memberships in excess of 10,000, and that over a third of schemes have fewer than 100 members. So, the greater accessibility of relevant tables to use for measurement, or for benchmarking, is invaluable to both advisers and trustees.

Another imbalance in knowledge is that between schemes and the markets for buy out or for

mortality hedges. The transfer of risk (which we are assured is a growing phenomenon) between parties will be a more even transaction if both parties are able to evaluate the cost of that risk, with more relevant data on which to base decisions, rather than the deep suspicion which, maybe, prevails today that they are measuring the same risk with different rulers.

I am disappointed that postcode data are not yet sufficiently widely available to permit such analysis, and, importantly, to permit investigations into the relative effectiveness of postcode and pension amount as proxies for lifestyle, when it comes to mortality experience. It may be that future mortality projections will be based on postcode data, with adjustments to reflect the working or pension status of a particular individual.

Having said that, I was slightly surprised at the degree of sensitivity of the experience, shown in the results which we have seen, to the size of pension, and whether this disguises some heterogeneity in the underlying data rather than a genuine discriminatory factor of some significance. The suspicion which I have is that there may be differences, for example between the public and the private sector components of the data set, which would explain some of the differences which the differential reveals. So, actuaries making adjustments to the standard tables which we have seen presented ought to be able to compare the composition of the data on which they are working, the industrial classification and the occupations, with the population from which the graduation was derived.

I would be cautious, therefore, about the proposal to graduate an ultralight version to reflect the experience of the lives with very high pension amounts. Producing graduations on ill-health retireds is a great leap forward, and, where the experience supports it, I would favour separate graduations, and possibly even the use of select tables, so far as the data will permit. On the other hand, definitions of ill-health vary, and, again, this is a scheme-specific aspect, and we must be proportionate in the way in which we apply those factors.

Regarding the point about 'Heavy' and 'Light' graduations of the all-pensioner category, which is one of the questions which the working group has raised, I can see uses for this. In my own organisation we do not differentiate between ill-health and normal retirements, so that would be particularly useful. Generally, scheme data do not always permit that classification in any event. Professor Wilkie spoke about extending the table to below age 50 for the all-pensioner category. That is a challenge which we all have, and, if it were not there, we would have to produce our own extensions, so, why not produce it as part of the graduation?

Overall, therefore, there is much invaluable work here, but, as has been acknowledged already, there is a lack of evidence for assumptions about future improvements in mortality. I can only encourage the work which is being promised to measure this, and to track it as we go forward.

Mr R. A. Humble, F.I.A.: I shall concentrate on one aspect of the results which have been produced. This is in relation to the widely held view that socio-economic differences in mortality tend to zero at high ages, which I will refer to as convergence. The age 95 is often taken as the age at which socio-economic differences disappear. A recent example of this assumption was contained in the paper by Hosty *et al*. (2008).

It seems apparent that those who are wealthy have, and will have, even if they are extremely elderly and mentally impaired, wealthier and more highly educated relatives caring for them, and this is likely to be reflected in them receiving a better level of care and better medical treatment than, for example, those who are entirely reliant on the resources of the state. It is difficult to believe that this has absolutely no effect whatsoever on their mortality. However, some graphs of actual over expected mortality seem to support this, by showing a strong convergence, but this is really because they are graphs, a point to which Professor Wilkie referred. The effect is apparent rather than real. What is really happening is that the denominator related to q_x increases very rapidly compared to the numerator (the difference in q_x is by socio-economic class). So, it looks as if they converge.

If you take the information in these two papers and look at the differences in simple death rates, that is q_x for high pension amounts compared to q_x for low pension amounts, there is no sign of this difference converging as age increases. If anything, it diverges. This is true of the crude death rates, and the graduated rates for 'Heavy' and 'Light' in WP32. This is, in some

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circumstances, a very important assumption, and I urge the Profession to think carefully about exactly what it is assuming in this regard.

Reference

Hosty, G.M., Groves, S.J., Murray, C.A. & Shah, M. (2008). Pricing and risk capital in the equity release market. *British Actuarial Journal*, **14**, 41-109.

Mr P. D. G. Tompkins, F.I.A.: It has been interesting to hear a number of people commenting on the issue of the extent to which future improvements will be seen in the data which we are studying and in the population at large. I do not share the criticism of this work not addressing that. It is clear from the data that, thus far, we do not have enough data over a consistent time period to enable us to look at the improvements.

The area of improvements is one which we have to approach with a degree of humility, as a Profession. We have been faced with a good deal of criticism in the past for slowness at recognising the changes which have been happening in the secular trend of improvements in health and longevity generally. However, it is also extremely difficult to determine future improvements from the extrapolation of recent data, even if the data supply and the data which you are able to analyse are five or six years of quality data.

We have a difficulty at the moment, especially if we are advising pension schemes, that this major issue is not being driven by the Profession. It is being driven, for example, by the financial services regulators encouraging insurers to make sure that the reserves which they are putting up allow sufficient improvement to give them some comfort, and, by extension, working its way backwards into the pricing and the quotations which pension schemes might be faced with if they were looking to buy out part of their benefits.

The PPF is reserving for some improvements akin to reserving as an insurer would be, and, perhaps, that has some messages which may be coming through, in the way in which schemes may be facing the calculations which they make for that purpose. As a Profession, we should look to come up with some convergence and a way of forming opinions regarding the improvements which we might expect to see in the population as a whole.

When we look at self-administered pension scheme mortality, we should not forget that it is the population, itself, which is changing. It is changing with business closures and alterations in the population as a whole, which could affect conclusions about extrapolations.

Mr A. G. Sharp, F.F.A.: We should not forget my predecessors on the Pensions Board who initiated this study in the first place. It is very difficult to realise just how hard it was to get this survey together, to pool data from so many different sources, and, not least, to pay for the data being analysed. In a disparate profession, that was very difficult.

If we call the tables the '08' tables, we would know that we had to project forward from 2003, but other actuaries have not had the benefit of this discussion.

I was also interested in the old age question, and looked at the ONS data which are referred to in the paper. By scanning diagonally across the columns of these tables, you see figures of about 0.4 or 0.5, which could well be derived from that. Until we have more data and more experience, it is difficult to do something different.

Going forward, there needs to be more discussion and more co-operation with other demographers. The ONS is the appropriate place to start, with the extra data sets which it has. That too is just as important, as Mr Tompkins said, when we are talking about projections of mortality.

We have come quite a long way in the past year, with all the help which I had from a separate working party, to put the subject of projections more firmly into the mainstream actuarial agenda.

Mr D. M. Pike, F.F.A.: The authors made a two-way split into 'Light' and 'Heavy' mortality. It is possible that some actuaries will want a different categorisation, either in terms of splitting the

population which they have into more than two categories, or in terms of using something intermediate. Given that the 'Light' and 'Heavy' are not parallel, it would be useful to have an indication of how to interpolate between 'Light' and 'Heavy' for the five bands which the authors originally analysed. It would have been interesting to see a top band and a bottom band, together with a table of how to interpolate for the intermediate bands.

Mr T. W. Keogh, F.F.A.: There is a need to consider both the current experience mortality and the improvement rate. They are different. The first is something which, in principle, you could measure if you had perfect data. By contrast, the future improvement rate is always going to be a matter of opinion.

Therefore, when it comes to releasing a paper like this, we have to at least nod towards the improvement area at the same time as we talk about the specifics of the current experience. It is okay to say that we have a programme of work which will deal with these things on parallel tracks, and, whilst this particular document emphasises the current experience, maybe Working Paper 33 will talk about improvements. However, we have to say that we are dealing with both of them, or at least giving that impression, even if it is not quite the case, and we have the hint of how connections can be made. So, just some work on how we could wire these new tables into some of the projections which we might use will be much better.

Dr Pryor was right that we need to have something which communicates the names of the tables a bit better. Maybe we need to build a brand name for these tables, and in 2011 we need to come up with a new brand for the next version, and so on. Then you lose the emphasis on the year. That can be in the technical documents which will be less visible to our clients.

When we talk to our clients about 'Light' and 'Heavy', the 'Light' are actually going to be the rich people, and the 'Heavy' are going to be the less rich, more or less. Perhaps we need to call these economy or business, or blue and gold, or blue and platinum, or something like that. Once again, we need to come up with a naming convention which will make it easier to explain: "This is a table which goes with your employees or scheme members, and this is a table which seems more likely to fit with you and your associates."

I do not have a strong view as to whether the top 12.5% or the top 25% is a better place to have a cut off, but we should have a limited number of tables which cover as wide a range as possible. All the experience which I see of individual schemes is that the experience is genuinely wide, and the closer together the 'Light' and the 'Heavy' tables are, the more it will corral people's thinking in between them, whereas, if you have a wider range, you can always interpolate in some way. People find it very difficult to go outside the range which is defined by the tables made available.

Professor Wilkie: When Mr Clarke was talking about postcodes, was he meaning looking at things broadly by region, which you would get from the first two letters of a postcode, or was he was thinking of going down to the micro level, in what used to be called 'Mosaic' coding or some other proprietary name, which goes right down to trying to classify small districts or separate postcodes as being affluent, deprived or somewhere in between?

There are two different approaches there. One is a regional one and one is trying to get a social class one. To do the latter, you need to make sure that you have accurate postcodes on the data, which is not always very easy.

Mr Clarke: What intrigues me is the potential to use a greater data set in order to rate and to value mortality experience. Certainly, I was referring to the quite granular detail which is available in certain quarters, linking postcode data with the kind of lifestyle information which is available from nationally available sources.

Many of the companies which specialise in this area can build that bridge from the basic postcode through to more detail on various aspects of people's lives. I know that, in the past, some analyses have compared basic postcode data with pension amounts as a discriminator and not been conclusive, but a more granular approach is potentially a better basis for getting the discrimination. In particular, with fragmented working lives, it is increasingly difficult to see that

an accumulation of pension within one particular scheme is going to be, necessarily, a big discriminator of the lifestyle experienced by that individual.

The rejoinder is, of course: "Fine, but we do not have the information." That is another aspect in terms of the journey which pension schemes within the U.K. are on. This is information which we ought to be encouraging, either as a Profession or through our relationships with the other parties involved in pension scheme administration and trusteeship, to make sure that information of this nature is actually readily available.

We do much transfer and transition work at the organisation in which I work, and one of the handicaps there is getting accurate and complete data on which to make sure that we pay the right people the right amount at the right time. Postcode information is one element of that. If we can be on a journey where we are getting the right data, and can administer schemes to a high degree of accuracy and trusteeship, then we will benefit also by being able to get a more relevant, accurate and informative view, in terms of the analysis of the data.

Mr P. M. Jayson, F.I.A. (closing the discussion)**:** Mortality is clearly becoming an ever more important area of the work of the pensions actuary. Mortality mattered much less in those days when interest rates and inflation rates were higher. However, as they have come down, the individual elements of valuation bases have been peeled back, and they are now much more visible. Coupled with that are the accusations that actuaries have been understating mortality in their funding assessments for years. As the assumptions for longevity have been strengthened, there have been big jumps in contribution rates and requirements from scheme sponsors.

We have heard concerns about the public perception of the naming convention of the tables. I feel exposed, as an actuary, to what the public think of me. I am not going to consider whether or not we have been caught on the hop, as a Profession, in not forecasting the unprecedented increases in longevity over the last few years, or even not recognising the trends earlier.

As a Scheme Actuary and as a consultant, I am not too interested in the graduation methods which are adopted and the other technical aspects. I just want the tools to present compelling arguments and reasoning to clients about the assumptions for them to use in their valuations and the other financial assessments, in the light of the increasing focus being given by trustees and sponsors on the risks which are being run in their schemes.

There is plenty of theory on which I can fall back in coming up with financial assumptions, but, until recently, there was very little to back up the mortality side, which is critical in a financial assessment of a scheme, and imposes huge risks on scheme sponsors.

We heard from Mr Clarke, from the PPF, on how important this issue is from a risk management point of view. That is why I am especially grateful for the work which has been carried out by the CMI on this. I hope that we can all support the Committee by providing the data which they are seeking, so that they can extend their studies.

Advice which I and other pensions actuaries have given to clients recently on mortality assumptions is much more robust than it ever was. On the other hand, we have realised that the data available do not match the population and lives which we are considering in our schemes, which is why the arrival of tables specific to self-administered schemes, sliced and diced for different circumstances, is, indeed, an important development. This work is evolving, for example, in analysing the effect of industry sector and mortality improvements.

I am being told by the Regulator and the Profession that I need to consider carefully the mortality assumptions on which I advise. Clients want me to 'use the latest tables'. The Regulator tells me that I need to pay particular attention to the assumptions about future mortality, and that it might be appropriate to adjust standard tables to reflect scheme, employer and geographic factors, where evidence exists to support this.

I understand that the Board for Actuarial Standards is to issue a discussion paper on the type of guidance which should be given regarding mortality advice across all disciplines.

We are very grateful for the work which has been presented to us here. It gives us a better understanding of the subject, and the issues which we need to take into account in our advice, and, also, it gives us the tools with which to advise our clients on this complex issue. One issue which may arise is how the Pensions Regulator will view the use of SAPS tables in forthcoming

valuations, where they serve to bring down the value of a scheme's liabilities, perhaps with some offsetting of the releasing of reserves against allowances for future improvement.

Mr Wilson (replying)**:** Dealing with some of the individual issues, Mr Humble's point about looking at the convergence at high ages is something we probably ought to have another look at before we finalise what we do.

I agree with everything which Mr Tompkins said on mortality projections, even though that is not the subject of the paper. I agree that we need to come to some collective mind on it, as a Profession, in order to maintain the Profession's responsibilities in this area. I know that further work is in hand on it.

Professor Wilkie's comments on trying to get a single graduation formula across all ages is something to which we should try to aspire. Whether we will get there, I do not know. All that I can say is that I know that the '00' tables' producers did not manage it. So, we will be doing quite well if we can do so.

Post coding is something which we are going to start looking at once we have sufficient data. It will be some while yet before we have enough data to look at that. My main concern about it is the high number of deaths which we are likely to get in postcodes of hospitals — the exposed to risk living for ever, and all the deaths at the hospital sites. We need some way to solve that equation. I know that life offices claim to have managed it.

The President (Mr N. J. Dumbreck, F.I.A.): It just remains for me to express my thanks, and the thanks of all of us, to the presenters, to the closer and to all of those who have participated in this discussion. As Mr Sharp said, there have been many other people involved in getting us to this important milestone of having graduated tables for self-administered pension scheme members. We ought to thank those at the CMI, those who have been involved in providing data, and those on the Pensions Board who started the whole thing.