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Continuous Mortality Investigation

Life Office Mortality Committee

Working Paper 45

Consultation on the Proposed Methodology for the Analysis of CMI 'Per Policy' mortality data

Contents

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Cheapside House, 138 Cheapside, London EC2V 6BW
Tel: 020 7776 3820 Fax: 020 7776 3810
www.cmib.org.uk info@cmib.org.uk

Executive Summary

The CMI Life Office Mortality investigations have historically been carried out on what is termed 'scheduled' data. That is, the data provided by contributing offices has been in a census format containing numbers of policies (in force and deaths) split by age and duration. No policy specific details were requested from contributors which means that the level of analysis that could be carried out on the data has been limited. Analyses of actual and expected deaths have used initial exposure, calculated using a census method, and initial rates of mortality (q_x).

In recent years the CMI has been switching to 'Per Policy' data collection for life office mortality and critical illness data. The aim is to capture much more detailed information that will allow analyses that would previously have been impossible – for example by size of policy and distribution channel – as well as improving the accuracy of the analysis.

This Working Paper sets out the CMI Life Office Mortality Committee's proposed methodology to be used for Per Policy mortality investigations.

The Committee is proposing to move to a methodology which analyses actual incidences of death compared with expected deaths calculated using forces of mortality applied to the central exposure, derived on a day-count basis. This is similar to the approach now used for the CMI SAPS Mortality investigation.

The proposed methodology removes the need for many of the assumptions implicit in the current analyses, which are detailed in this paper.

However the proposed methodology gives rise to a number of issues which are discussed in the paper. In particular, although data on deaths are being collected by year of settlement, the Committee proposes to continue to analyse actual deaths against expected deaths based on incidence. This gives rise to an issue around the allowance to be made for late settled deaths. In previous CMI analyses, this issue has been addressed by delaying the collection of data, thereby seeking near-complete information on deaths. With Per Policy data, the Committee proposes carrying out an initial analysis using only deaths that occur and are settled in an investigation year and then providing a single re-statement including the deaths submitted in the following investigation year.

The full impact of the changes in methodology proposed in this paper can only be assessed using Per Policy data. However the impact of changing the methodology of calculating expected deaths from multiplying rates of mortality (q_x) by initial exposure to one of multiplying forces of mortality (μ_x) by central exposure is illustrated in the paper, using 'scheduled' data for 2003-2006.

The paper includes a number of specific questions on the proposed methodology; responses are invited by 30 June 2010.

The CMI intends to issue a further Working Paper to consult on the content, format and physical means of transmission of these results. It is hoped that the first results using Per Policy data may then be issued by the end of 2010.

Continuous Mortality Investigation

Life Office Mortality Committee

Working Paper 45

Consultation on the Proposed Methodology for the Analysis of CMI 'Per Policy' mortality data

1 Introduction

1.1 Background

The Life Office Mortality investigations of the CMI have historically been carried out on what is termed 'scheduled' data. That is, the data provided by contributing offices has been in a census format containing numbers of policies (in force and deaths) split by age and duration. No policy specific details were requested from contributors which means that the level of analysis that could be carried out on the data has been limited.

In recent years the CMI has been switching to 'Per Policy' data collection for life office mortality and critical illness data. The aim of this is to capture much more detailed information that will allow analyses that would previously have been impossible – for example by size of policy and distribution channel – as well as improving the accuracy of the analysis.

Under the Per Policy submission requirements, offices are asked to submit a separate record for each benefit for each life insured on each policy for each period that this benefit is in force with unchanged details within a calendar year. This means that more than one record per year is required for many policies. For example, an additional record is required if a policy is taken out of force during the year and brought back into force as is the case with an alteration. Each record should occupy one "row" in the medium of submission (e.g. one row in a spreadsheet, one database record or one text line) and should contain the information shown in the Appendix. Further details on the Per Policy data requirements can be found at: http://www.actuaries.org.uk/knowledge/cmi/cmi_data

A significant number of offices have started supplying Per Policy data and considerable progress has been made in verifying and processing this data. However, the additional time and effort required by offices and the CMI to validate Per Policy data, especially the first time it is submitted by the office, means that it will be some time before sufficient offices' validated data is available for the CMI to issue All Office results to members. In the interim, validated Per Policy data is being converted to the scheduled format to be combined with submitted Scheduled data for the All Office results.

1.2 The scope of this Working Paper

This Working Paper sets out the CMI Life Office Mortality Committee's proposed methodology to be used for Per Policy mortality investigations, including the allowance for claim settlement delays, the estimation of missing dates of death, the exposure calculations and comparisons of actual and expected deaths.

Although the paper considers only mortality data, these considerations are also relevant to Per Policy data for the critical illness investigation. As far as possible, the CMI will seek consistency between these investigations, which has benefits both to the CMI, in terms of systems and processes, but more importantly to practitioners seeking to understand CMI results. However particular features of the two datasets may lead the Life Office Mortality and the Critical Illness Committees to take different approaches in some areas; if these prove necessary, the CMI will seek to make such differences apparent to practitioners.

Given that the critical illness investigation is already based on individual data records (rather than 'scheduled' data), the move to Per Policy data is a less substantive change. In particular, the Critical Illness Committee has already made progress in some of the areas discussed in this paper, based on pre-Per Policy data. Where appropriate, we have therefore made reference within this paper to the approach that has been adopted to date for critical illness; we hope this will aid understanding for those familiar with the work of the Critical Illness Committee.

1.3 Next Steps

Comments on the proposed approach are welcome and should be sent to the CMI by 30 June 2010. Contact details are given in section 7 of the paper.

The Life Office Mortality Committee does not expect this consultation to lead to substantive changes from the proposed approach but will indicate any changes when it issues the first results produced from Per Policy data.

The CMI intends to issue a further Working Paper later in 2010 to consult on the content, format and physical means of transmission of these results. It is hoped that results can be produced in a very similar format for both mortality and critical illness.

2 Current methodology

Scheduled data is currently analysed using initial exposure and rates of mortality (q_x).

The exposure is calculated using a census method. The age definition used is nearest age at 1 January for in force and nearest age at death for deaths. Duration is defined as curtate.

Thus, for a particular calendar year Y:

$$E_{x,r} = (StartIf_{x,r} + EndIf_{x,r} + Deaths_{x,r}) / 2$$

where:
$E_{x,r}$ = Initial exposure at age x and duration r
$StartIf_{x,r}$ = In force at 1/1/Y at age x and duration r
$EndIf_{x,r}$ = In force at 1/1/Y+1 at age x and duration r
$Deaths_{x,r}$ = Deaths during Y at age x and duration r

Note that $StartIf_{x,r}$ and $EndIf_{x,r}$ comprise entirely different sets of lives.

Expected deaths are then calculated by multiplying the initial exposure by an appropriate mortality rate. Even though values of q_x are used in the analyses, in recent graduated tables such as the "00" Series these were derived from graduated values of μ_x.

The rate year for age x is a life year, with age nearest implying a range from x–½ to x+½, on average x at death. So, given graduated rates that apply to age exact, where an ultimate duration mortality comparison basis is used:

$$\text{Expected deaths at age } x = E_x \times q_{x-½}$$

The required mortality rates ($q_{x-½}$) are derived by using the relevant graduation formulae to produce values of $\mu_{x-½}$, then using the same approximation as used to produce the published values of q_x from the graduated μ_x (see section 1.2.6 of CMI Report No. 23).

The rate year for duration r is a policy year, with curtate duration implying a range from r to r+1, on average r+½ so where a select duration mortality comparison basis is used:

$$\text{Expected deaths at age } x, \text{ duration } r = E_{x,r} \times q_{[x-½-r]+r}$$

Actual deaths are then compared with Expected deaths.

This methodology is dependent on a number of implicit assumptions that are set out in section 5.

3 The Proposed Methodology for Analysing Per Policy Data

The Committee is proposing to move to a methodology which analyses actual incidences of death compared with expected deaths calculated using forces of mortality applied to the central exposure, derived on a day-count basis. At this level, this is consistent with the approach used recently by the CMI SAPS Mortality Committee as described in CMI Working Paper 34.

Note that for simplicity we refer simply to deaths (and the date of death) in the remainder of this paper; however for assurances, claim incidences include diagnoses of terminal illness (in which case the date of claim incidence will be the date of diagnosis of terminal illness).

The following sections set out the proposed methodology to be used in calculating the central exposure by age and duration for each Per Policy data record. This is described at a high level for the lives analysis, in section 3.1, followed by amounts analysis, in section 3.2. Section 3.3 then contains further detail on a number of areas, for example relating to the dates at which the age and duration change.

The proposed methodology gives rise to a number of issues which are discussed in Section 4.

Note that the description of the proposed methodology assumes that analyses will only be carried out for investigation periods that correspond to calendar years; in particular information on actual deaths is only captured on a calendar year basis.

3.1 Lives analysis

Calculation of exposure

For each Per Policy data record, the contribution to the exposure cell for age x and duration r in a given investigation year equals the number of days the life insured is at risk in the observation period and is age x and duration r (according to the age and duration definitions) divided by the number of days in the year (i.e. 365 days or 366 days in a leap year).

For a life exposed to risk throughout a year, this would result in total exposure of 1 year (split between age and duration cells). This means that the expected number of claim incidences may be slightly underestimated in leap years as the actual length of exposure in leap years is higher by a day (in theory, we would see slightly higher actual claim incidences in leap years).

Calculation of expected deaths

Expected deaths will be calculated by multiplying the central exposure (E^c_x) by an appropriate force of mortality. For example, under the age nearest birthday definition the rate year for age x is a life year, with age nearest implying a range from x–½ to x+½, on average x. Note that within the analyses μ_x is assumed to apply to age exact and to be constant over the life year and applies to the range x–½ to x+½. So, where an ultimate duration mortality comparison basis is used:

$$\text{Expected deaths at age } x = E^c_x \times \mu_x$$

The rate year for duration r is a policy year, with curtate duration implying a range from r to r+1, on average r+½ so where a select duration mortality comparison basis is used:

$$\text{Expected deaths at age } x, \text{ duration } r = E^c_{x,r} \times \mu_{[x-½-r]+r+½}$$

Allocating actual deaths by age and duration
Deaths are allocated according to the age and duration on the date of death, based on the age and duration definitions used to calculate exposure.

Actual deaths are then compared with Expected deaths.

3.2 Amounts analysis

In many cases benefit amounts change during an investigation period.

Where benefit amounts change regularly as a policy condition (without new underwriting), the Per Policy data requirements request the benefit amounts applicable at the start and end of the year as well as the date the benefit amount is reviewed during the investigation year. Using this information, it is proposed to estimate the benefit amount applicable to each day during the investigation year by assuming that the amount only changes once, on the relevant date. Note that if benefit amounts change more frequently (for example, on some mortgage decreasing policies the benefit amount reduces monthly) then the review date will be taken as 1 July which, on average, gives an appropriate total amount of exposure, although the allocation by age and duration will not be entirely accurate.

Where benefit amounts alter on an irregular basis (whether or not this is contractual), the data requirements depend on whether new underwriting was carried out:

- For increases without new underwriting (and for reductions in benefit), offices are asked to submit two records, one before and one after, each with the relevant benefit amount.
- For increases with new underwriting, offices are again asked to submit two records, the original record being unchanged and the increase in benefit submitted as a separate record with the benefit commencement date set to the date of the increase.

Calculation of exposure
For each Per Policy data record the exposure to a particular age and duration cell is calculated in a similar way to the exposure for the lives analysis but weighted by amounts. Therefore the amounts exposure to risk on a given date will be their lives exposure for that date multiplied by the amount applying to that date. If the amount were £1 throughout the investigation period, the lives and amounts exposure will be identical.

Calculation of expected deaths
For amounts analyses, expected deaths will be calculated in an identical manner to the lives analyses.

Allocating actual deaths by age and duration
The amount of benefit applicable on the date of death is allocated to the relevant age and duration in a similar way to the lives analysis.

Note that where the benefit amount changes more frequently than annually, this amount may not equal the assumed amount of exposure on that date.

Actual deaths are then compared with Expected deaths.

3.3 Areas of detail

Age definition

The Per Policy system currently allows exposure to be calculated as both age last and age nearest. Other age definitions could also be allowed if required.

The age last birthday definition is clear – a life attaining age x on 1st July is regarded as age x-1 up to and including 30th June and age x from 1st July.

However, on the age nearest birthday definition, the date at which age is assumed to increase (i.e. the age anniversary) for a life is not clear and different approaches could be taken, as discussed in section 4.1.

Duration definition

We propose to use curtate duration. This definition is currently used by the CMI and we are not aware of alternatives being used in practice by offices. Note that while it is likely that in the majority of analyses duration would be measured in years, the CMI's systems have been designed to allow for more frequent durational splits – for example possible anti-selective effects might be more apparent with quarterly durations, if data volumes permit.

First day of exposure

For each Per Policy data record, the first day of exposure to a given age x and duration r cell will be the last of the following dates during the investigation period:

a) The first day of the investigation period;
b) The date the record was brought into force;
c) The benefit commencement date; and
d) The date on which the life reaches both age x and curtate duration r according to the definitions applicable.

Last day of exposure

For each Per Policy data record, the last day of exposure to a given age x and duration r cell will be the first of the following dates during the investigation period:

a) The last day of the investigation period;
b) The date of claim incidence. (The proposed approach where this date is not available is discussed in section 4.4.);
c) The day before the record is taken out of force during the investigation period for a reason other than claim, e.g. due to surrender, benefit alteration or maturity (see section 4.2 for further discussion); and
d) The day before the life reaches age x+1 according to the age definition applicable **or** the day before the benefit reaches curtate duration r+1, whichever happens first.

Leap years

Birthdays or policy anniversaries falling on 29th February will be assumed to occur on 1st March in non-leap years. This ensures that any exposure on both 28th February and 1st March in non-leap years is allocated to the correct age and duration cell.

Age anniversary falling in short months for age nearest birthday definition

For a birthday in a long month (e.g. 31 days), the age anniversary will be the last calendar day in the month that is 6 calendar months before the birthday. For example, a birthday on 31st October would result in an age (nearest birthday) anniversary on 30th April.

Consistent with this approach, birthdays on 29th to 31st August will be treated as having an age anniversary falling on 28th February in a non-leap year and 29th February in a leap year.

4 Issues arising from the proposed methodology

4.1 Calculating exposure with an "Age nearest birthday" definition

As noted earlier, the calculation of exposure using an "age last" definition is intuitive, but different approaches can be considered using "age nearest".

The Committee intends to take a "layman's" approach to calculating age nearest birthday which effectively says that the age anniversary is six calendar months before the birthday (e.g. a life born on 1st January is assumed to be age *x* nearest from 1st July to 30th June). For birthdates on the 29th to the 31st of a month, the date of the age anniversary will be limited to the last date in the month of the anniversary.

Note that this approach means that the periods before and after a birthday may be unequal. An alternative approach that reduces the impact of this issue (for individual records) is to set the date of the age anniversary as, say, 183 days before the birthday.

We propose to use the first approach as it is known to be used by some offices and is perhaps more intuitive – we are not aware of offices using any variants of the second approach.

4.2 Definition of the Maturity date

The Committee believes that different approaches are adopted to the cessation of exposure with regard to the maturity date – some offices treat the maturity date as corresponding to the last day of cover under the policy, whilst others treat it as corresponding to the first day on which the cover no longer applies. The treatment of maturity dates may also vary within an office, for example depending on the administration system.

We propose to assume that the maturity date provided by offices is the first day on which cover no longer applies.

4.3 Defining a "claim"

a) Assurances. Offices are asked to submit data on valid claims under the policy terms in the year they are admitted OR in the year they are settled.

   Even if an office has been notified of a claim within the calendar year of death, unless the claim is admitted or settled there is a possibility that it may be declined. As the investigation is only concerned with valid claims under the policy conditions, we would wish to exclude any deaths where the claim is declined.

   Therefore claims only become valid either when they are admitted or when they are settled and offices need to decide which of these two events they wish to use to define "valid claims" for the purpose of submitting data.

   Whichever event is used, all the claims settled (or admitted) in the year should be submitted even if the policy had previously been treated as lapsed. This means that all settled claims should eventually be collected.

   Where offices use admission as the key event, the CMI expects that all admitted claims are eventually settled. (In the rest of this paper, unless otherwise stated, references to

settled claims include admitted claims where these are used by offices to define valid claims.)

b) Annuities. Offices are asked to submit data on annuities where the benefit payments have ceased after the office has been notified of the death of a policyholder (in a form acceptable to the office).

Further details and guidance on the definitions and treatment of claim events are given in the Per Policy Coding Guide. The latest version of this can be found at: http://www.actuaries.org.uk/knowledge/cmi/cmi_data.

Note that under the scheduled data submissions, offices are asked to supply data on deaths occurring within a year, but to delay submitting data until at least 6 months after the end of the investigation year to allow for late reported deaths. In particular, offices are asked **not** to provide further submissions on deaths reported after data has been submitted. The analyses therefore understate the true underlying experience. From the data received to date, the CMI is not able to investigate the extent of the understatement but has anecdotal evidence that this could be in the range of 3% to 10% depending on the investigation.

4.4 Missing dates of death

As well as identifying the last day of exposure, the date of death is used to calculate the age and duration at claim and to assign each claim to a particular investigation year.

For assurances, offices are asked to provide at least one of four dates relating to each claim event (dates of death (or confirmed diagnosis of a terminal illness), notification, admission and settlement) with the date of death being preferred and offices being encouraged to provide all four dates of claim.

For annuities, dates of admission and settlement have little meaning so these dates are not required – offices are requested to provide at least one of the dates of death and notification for such business. Again, the date of death is preferred.

However the date of death may not be clear, particularly for terminal illness claims and suspended annuities and hence the precise date of death may not be known by offices. Alternatively it may be known but not recorded in a suitable form for inclusion in the data submitted to the CMI.

For these policies, the Committee will need to estimate the date of death from whichever of the dates of notification, admission and/or settlement are provided by the office. In these cases, we propose to use a single point-estimate of the date of death to allocate claims to particular investigation years and to determine the age and duration at death. Note that this issue has already been encountered in the CMI critical illness investigation; this is discussed, and the estimates used are set out, in CMI Working Paper 14.

Initially, data volumes are unlikely to warrant detailed analysis and a simple methodology for estimating missing dates of death is likely to be adopted. Once data volumes permit, the intervals between the dates of death, notification, admission and settlement may be analysed separately by factors such as office, product type and joint life status; a more sophisticated method can then be used to estimate missing dates of death. Therefore, at least for the first few years, the results for previous years may be re-stated as the estimation process and

calibration of settlement delays is developed to reflect data received. Re-statements may also be needed in future if delay patterns change over time.

4.5 Analysis of claims incidence or claims settlement?

Given the data being captured, there are three main alternatives for analysing claims for the purpose of reporting experience:

a) *Analyse actual claim settlements against expected claims incidences*
This is a natural approach given the form in which data is submitted, in particular the key driver for submitting data on deaths to the CMI is the year of settlement.

For a stable population, the number of deaths occurring in the investigation year but not settled within the investigation year will be approximately balanced by the number of deaths occurring in previous years but settled in the investigation year. In this case, an analysis of claim settlements against expected claim incidences during the investigation year could be a reasonable approximation to an analysis of claim incidences. However, for a number of reasons such as offices starting and stopping data submissions, the introduction of new products and changes in the sales volumes of products, we cannot assume a stable population.

[Note that results produced on this basis for the CMI critical illness investigation are now referred to as "unadjusted results".]

b) *Analyse actual claim settlements against expected claims settlements.*
This approach involves using the exposure in prior years to calculate expected incurred deaths then using a model of the time interval between the occurrence of a death and its settlement to generate expected settled deaths. Consequently it is not straightforward to apply, for example:
- Exposure in prior years will need to be estimated where (consistent) data was not submitted for those years; and
- It requires a model of the claims process which may vary by office, policy type, etc. This may necessitate a considerable volume of data (and analysis) to produce an initial model and, as more data becomes available, re-statements of the results may be necessary.

Such results have been produced for the CMI critical illness investigation (and are referred to as "adjusted results") however they may be difficult to interpret. As noted in CMI Working Paper 33 "adjusted results ... properly match claims to exposure, but do so in terms of settled claims, not diagnosed claims. Adjusted results therefore need careful interpretation, particularly in terms of results by duration."

c) *Analyse actual claim incidences (i.e. deaths resulting in a valid claim event) against expected claim incidences*
This is the traditional approach used by the CMI for its mortality investigations. However, delays in claims being settled means that a decision is required on how to allow for late settled claims as discussed in Section 4.6.

The Life Office Mortality Committee is pleased to note that the proportion of claims data that includes dates of death in Per Policy data received to date is considerably higher than for the critical illness investigation (perhaps reflecting the greater uncertainty associated with a "date

of diagnosis" than a "date of death"). Given the high proportion of data with dates of death and taking account of the various issues with all three approaches, the Committee's preferred approach is the third type of analysis described above.

4.6 Allowance for late settled claims

Where claims data includes the date of death, it will be relatively easy to remove settled claims with a date of death in a previous year. This can also be done for the other claims using the estimated date of death.

However, it is less straightforward to allow for Incurred But Not Settled (IBNS) claims (which are deaths occurring during the investigation year that will only be settled by the office in future investigation years). One particular complication for the CMI is that any approach taken to deal with IBNS claims is vulnerable to offices stopping data submissions or altering the types of business for which data is submitted. As well as affecting analyses for that office, this could make the analyses for the "All Office" experience more complex and less reliable.

Effectively there are three options for dealing with IBNS claims in the experience analyses:

1) Analysis of the data could be delayed until the office has submitted data for the following investigation year in order to capture (most) IBNS claims. Indeed the analysis could be delayed further so that all of the IBNS claims can be assumed to have been captured.
2) Carry out an initial analysis excluding IBNS claims and then provide re-statements as offices submit further data on these claims in later investigation years.
3) Carry out an initial analysis including estimated IBNS claims and then provide re-statements as offices submit data on actual claims in later investigation years. A process such as a chain ladder method could be used to estimate IBNS claims.

Option 1 involves a delay before any analysis is reported to offices. This makes the analysis less useful and the Committee considers this unacceptable.

The Committee is concerned that IBNS estimates are unlikely be to sufficiently accurate where data volumes are small, for example when analysing by product type and other factors. Therefore the Committee intends to use Option 2 initially. This will mean that reported experience will understate the true experience to the extent of the (unknown) IBNS claims and the Committee will seek to provide an indication of the overall degree of under-statement.

As the methodology for estimating claim delays evolves, the Committee may consider assessing the accuracy of estimates of IBNS claims (Option 3).

4.7 Updating of results as more data are received

As more or revised data on claim settlements are received it may be appropriate to re-state results in subsequent years. The Committee proposes to only re-issue the full results for year N once, after data for year N+1 has been submitted and processed. Abbreviated analyses of the impact of subsequent re-statements may also be produced.

The use of actual claims data will also alter the calculation of exposure; for example, an office may treat an assurance as a lapse once premium payments stop, before it is aware it is a

death claim. The date at which the office considers the policy to have lapsed is exceedingly unlikely to correspond to the date of death, hence the exposure is inaccurate as well as the number of actual claims.

The Committee considers that any inaccuracies in the exposure calculation arising from incomplete claims data are likely to have a significantly lower impact on the experience analysis compared to the impact of allocating claims between investigation years and by age and duration. Where the date of death has to be estimated, inaccuracies will remain in the exposure calculations even when offices submit additional data on IBNS claims. Therefore, the Committee intends that re-statements of results should not extend to the re-calculation of exposure but will consider the impact (based on real data) before reaching a final decision.

4.8 Graduations

As far as graduations are concerned, the aim is again to analyse claims incidence. The Committee expects that graduations will only be undertaken after 1 or 2 years' additional data has been processed, to allow for full information on settled claims. In the meantime, trial graduations could be produced.

As well as creating a more accurate set of data on actual claims, the Committee proposes to also use this data to re-calculate exposure for graduations.

This approach again assumes that dates of death are (eventually) received for a large proportion of the claims. If this is not the case, then alternative approaches will be considered (one alternative is that followed by the Critical Illness Committee; see CMI Working Paper 43).

5 The Rationale for Changing the Methodology

There are three main issues with the current methodology described in section 2. These are described below, followed by a description (in *italics*) of how these are addressed by the proposed methodology.

5.1 Data issues

As data is not collected on date of birth or date of commencement, a number of assumptions are necessary regarding how birthdays and policy anniversaries are distributed over the calendar year. Under the current methodology, they are assumed to be evenly distributed over the calendar year so that the group of lives of age x and duration r at the start of a year contribute equal amounts of exposure to the exposure cells $[x, r]$ and $[x+1, r+1]$ (but none to either $[x+1, r]$ or $[x, r+1]$). Effectively this assumes that birthdays and policy anniversaries fall half way through calendar years on average. The exposure calculations at duration 0 may be especially sensitive to these assumptions.

The move to Per Policy data provides much more detailed information on a policy by policy basis (including date of birth and date of commencement) which enables more accurate calculations of the exposure and does not necessitate the assumptions outlined above.

5.2 The use of initial exposures

Initial exposures are based on the number of lives that reached age x either in the investigation year or the prior year. This implicitly assumes that there is no difference in the mortality experience between these two groups of lives. This assumption may not be valid when the mix of offices contributing to the investigation changes.

The number of lives reaching age x during the investigation year will be known. However, for lives reaching age x in the year prior to the investigation year only those that survived to the start of the investigation year will be known. In other words, information is not available on the deaths that would have occurred in the previous investigation year at age x where offices entered investigations.

The contribution to initial exposures from these deaths is estimated by extending the exposure for lives that reach age x during the current investigation year and die before the end of the investigation year to cover a full year (i.e. extending the exposure for these lives beyond the end of the investigation year to the earlier of their next birthday or policy anniversary). This implicitly assumes that similar numbers of lives reach age x in the previous calendar year and the current calendar year. Hence, the exposure calculations by duration may be especially sensitive to these assumptions due to fluctuations in new business volumes from year to year.

Moving to a methodology based on central exposures which are based on the number of lives at age x at any time during the investigation year makes the above assumptions unnecessary. It also reduces the impact of a changing mix of offices.

Note that the issues with the use of initial exposure and the differences between central and initial exposure are discussed in the context of CMI SAPS data in a Technical Note (entitled "Comparison of approaches for calculating initial exposure"). This is available from the website (alongside Working Paper 34).

5.3 Implications of the graduation approach

Recent base mortality tables have been produced by graduating the force of mortality whilst analyses are based on initial rates of mortality. The initial rates of mortality have to be estimated from the graduated forces of mortality and some assumptions are involved. For the graduations, the force of mortality is assumed to be constant over the life year. However the rate of mortality is assumed to be constant over the life year in the current analyses.

Moving to an analysis methodology that uses central exposures and forces of mortality (μ_x) is consistent with the graduation methodology and removes the need for the above assumptions and approximations.

6 Effect of Changing the Methodology

The full impact of the changes in methodology proposed in this paper can only be assessed using Per Policy data. For example, 'scheduled' data does not contain sufficiently detailed information to allow a day-count method to be used in calculating exposure; hence the impact of moving from a census method cannot be assessed.

However the impact of changing the methodology of calculating expected deaths from multiplying rates of mortality (q_x) by initial exposure to one of multiplying forces of mortality (μ_x) by central exposure (described in Section 2.3) can be illustrated using 'scheduled' data. The impact on 100A/E values is illustrated in the tables below, using the permanent assurances investigation from the 2003-2006 quadrennium as the underlying experience.

In the following tables the exposure has been calculated using a census method. In each case, the first comparison shown is based on initial exposure and q (i.e. the current methodology) and the second comparison is based on central exposure and μ (i.e. the proposed new methodology).

In the following tables, differences in the integral 100A/E values are highlighted in **bold**. In the majority of cases where there is a material number of expected deaths the difference in 100A/E, if any, is 1. Where the difference is bigger, then this tends to be where the expected deaths are small, so the 100A/E values are more sensitive to changes in E, or at older ages, where the mortality rates are increasing more quickly and so the approximation between q and μ is less accurate.

Table 1. Permanent assurances, males, combined, 2003-2006: comparison of actual and expected deaths using the AMC00 select table.

		Initial Exposure and q		Central Exposure and μ	
Age	Actual Deaths	Expected Deaths	100 A/E	Expected Deaths	100 A/E
Duration 0					
All ages	19	11.2	**169**	11.3	**168**
Duration 1					
All ages	13	15.9	**82**	15.5	**84**
Durations 2+					
16-30	36	34.7	104	34.7	104
31-35	80	91.4	88	91.3	88
36-40	186	232.2	80	232.1	80
41-45	381	446.9	85	446.7	85
46-50	731	809.2	90	808.8	90
51-55	1,532	1,705.2	90	1,704.4	90
56-60	3,191	3,607.7	88	3,606.4	88
61-65	3,324	3,854.0	86	3,853.8	86
66-70	2,268	2,628.3	86	2,629.5	86
71-75	2,947	3,369.8	87	3,373.9	87
76-80	3,583	3,889.4	92	3,895.4	92
81-85	3,867	4,117.4	94	4,127.9	94
86-90	2,643	2,908.4	**91**	2,928.6	**90**
91-95	1,399	1,953.8	**72**	2,020.8	**69**
96-100	368	1,076.4	**34**	1,208.0	**30**
16-100	26,536	30,724.8	86	30,962.5	86

Table 2. Permanent assurances, females, combined, 2003-2006: comparison of actual and expected deaths using the AFC00 select table.

		Initial Exposure and q		Central Exposure and μ	
Age	Actual Deaths	Expected Deaths	100 A/E	Expected Deaths	100 A/E
Duration 0					
All ages	6	4..7	**128**	4.8	**124**
Duration 1					
All ages	14	12.5	**112**	12.1	**116**
Durations 2+					
16-35	38	59.3	64	59.3	64
36-40	98	116.1	**84**	116.0	**85**
41-45	226	222.2	102	222.0	102
46-50	391	359.9	109	359.7	109
51-55	621	619.3	100	619.1	100
56-60	949	1,009.7	94	1,009.3	94
61-65	783	904.2	87	904.0	87
66-70	859	954.1	90	954.1	90
71-75	1,125	1,178.4	95	1,178.2	95
76-80	1,317	1,349.0	98	1,348.9	98
81-85	1,475	1,469.3	100	1,469.1	100
86-90	1,037	1,052.2	**99**	1,053.5	**98**
91-95	717	721.9	99	723.6	99
96-100	191	267.3	**71**	279.9	**68**
16-100	9,827	10,282.8	**96**	10,296.6	**95**

In the above tables it can be seen that changing the methodology to calculate expected deaths using central exposure and forces of mortality has very little, if any, effect on the resulting 100A/E values. This is also true for other investigations, though the results are not shown in this Working Paper.

Note that a comparison of the change from initial exposure to central exposure using SAPS Mortality data is contained in Working Paper 44.

7 Areas for Consultation

This section sets out the specific areas on which the Life Office Mortality Committee wishes to seek views.

Q1. Do you have any comments on the proposed new analysis methodology? Comments are specifically invited on the following aspects (though are not restricted to them):
- Using central exposure and forces of mortality.
- The age and duration definitions.
- The exposure calculations.

Q2. Do you have any comments on the CMI's definition of valid claims?

Q3. Is the CMI's preferred approach to analyse claims incidence, rather than claim settlements, appropriate?

Q4. Is the CMI's preference of Option 2 for dealing with IBNS claims appropriate? (That is, to carry out an initial analysis excluding IBNS claims and then provide re-statements as offices submit further data on these claims in their submissions for later investigation years.)

Q5. Do you have any comments on the CMI's suggested approach to updating results, in particular the timing, frequency and intention not to recalculate exposure to reflect IBNS claims.

Responses on the points noted above – and indeed any other comments arising from this Working Paper – should be sent via e-mail to mortality@cmib.org.uk or in writing to: CMI, Cheapside House, 138 Cheapside, London, EC2V 6BW. Responses are requested by 30 June 2010.

References

CMI Report No. 23 : Graduations of the 1999-2002 Life Office Mortality Experiences (February 2009)

CMI Working Paper 14 : Methodology underlying the 1999-2002 CMI Critical Illness experience investigation (May 2005)

CMI Working Paper 33 : A new methodology for analysing CMI critical illness experience (July 2008)

CMI Working Paper 34 : Methodology and assumptions used for CMI Self-Administered Pension Schemes Mortality experience analyses (October 2008)

CMI Working Paper 43 : CMI critical illness diagnosis rates for accelerated business, 1999-2004 (February 2010)

CMI Working Paper 44 : Report on the preliminary results of an analysis into the mortality experience of pensioners of self-administered pension schemes for the period 2001 to 2008 based on data collected by 30 June 2009 (April 2010)

Per Policy Coding Guide; version 1.6 (January 2010)

Technical Note : Comparison of approaches for calculating initial exposure (October 2008).

All of the above can be found at: www.actuaries.org.uk/knowledge/cmi. (The Technical Note can be found alongside Working Paper 34.)

Appendix: Per Policy data requirements

(extract from version 1.6 of the "Per Policy Coding Guide")

Field	Field Position (for fixed length submissions)	Format of Values	Mandatory?
Record type	1	I = In force at the end of the record year O = Policy taken out of force in the record year	Y*
Office Number	2 – 4	NNN	Y*
Record Year	5 – 8	YYYY	Y*
Territory	9	1 = UK 2 = Republic of Ireland	Y*
Product code	10 -19	Any alphanumeric (up to 10 characters[§])	Y*
Client identifier	20-29	Any alphanumeric (up to 10 characters[§])	N
Policy identifier	30-39	Any alphanumeric (up to 10 characters[§])	Y
Benefit identifier	40-49	Any alphanumeric (up to 10 characters[§])	Y (if >1 benefit)
Sex	50	M, F	Y
Medical type code	51	M = Life medically examined on entry N = Life not medically examined on entry but satisfactory evidence of health received P = Lives accepted after paramedical examination S = Lives accepted on minimum evidence of health via a shortened proposal form. U = Unknown/Undifferentiated W = Sold without underwriting	Y
Smoker status	52	N = Non-smoker S = Smoker U = Unknown/Undifferentiated	Y
Date of Birth	53-60	DDMMYYYY	Y
Original Type of Entry	61	C = Compensation case G = Effected by exercising a GIO N = New Business O = Other U = Unknown	Y
Date of policy commencement	62-69	DDMMYYYY	Y
Date of benefit commencement	70-77	DDMMYYYY	Y*

Field	Field Position (for fixed length submissions)	Format of Values	Mandatory?
Entry into Current Status	78	A = Alteration (on) C = Compensation case G = Effected by exercising a GIO H = Annuity benefits suspended as death suspected I = In force at previous submission N = New business O = Other Q = Claim being investigated R = Reinstatement from lapse or suspension T = Bulk transfer-in U = Unknown W = Commencement of a dependant's pension annuity	Y
Movement on date	79-86	DDMMYYYY	Y
Benefit maturity/expiry date	87-94	DDMMYYYY	Y
Business Type	95	H = Hybrid N = Non profit U = Unit linked W = With-profits	Y*
Premium frequency	96	P = Recurrent Single premium R = Regular premium S = Single premium	N
Premiums in payment or paid up	97	N = Paid up Y = Premium paying	N
Single or joint life	98	D = Dual J = Joint life first event benefit or joint life annuity S = Single life benefit	N
Rated or non-rated	99	N = Non-rated Y = Rated	Y
	100-101	Leave blank for fixed length submissions	N

Field	Field Position (for fixed length submissions)	Format of Values	Mandatory?
Benefit type	102-103	DB = Stand Alone Death benefit SC = Stand Alone Critical Illness benefit AC = Accelerated Critical Illness benefit DC = Stand Alone Death component of a multiple benefit Death and Critical Illness policy CA = Accelerated Critical Illness component of a multiple benefit Death and Critical Illness policy CC = Stand Alone Critical Illness component of a multiple benefit Death and Critical Illness policy LA = Life annuity in payment benefit DA = Pension benefits in deferment NA = Pension annuity in payment to members retiring in normal health IA = Pension annuity in payment to pensioners retiring in ill-health PA = Pension annuity in payment where the health status of the pensioner at retirement is unknown XA =Pension annuity where it is not known whether the beneficiary is the member or a dependant WA = Pension annuity in payment to dependants including widow(er)s	Y*
ABI new business code	104-106	NNN	Y
Distribution channel code	107	A = Basic advice (i.e. Stakeholder products) B = Bancassurance I = IFA/Whole of market M = Multi-tie/Limited range N = Non-intermediated S = Single tie U = Unknown	Y*
Location	108-114	Any alphanumeric area postcode	N
Initial benefit amount	115-126	NNNNNNNNN.NN	N
Benefit amount at 'Movement on date'	127-138	NNNNNNNNN.NN	Y
Benefit amount at end of year or 'Date of exit'	139-150	NNNNNNNNN.NN	Y
Date of amount review	151-154	DDMM	Y (if relevant)

Field	Field Position (for fixed length submissions)	Format of Values	Mandatory?
Type of increment / decrement	155	C = RPI subject to a cap D = Decreasing (non-Mortgage) F = Fixed rate increase I = Family Income Benefit L = LPI M = Decreasing (Mortgage) N = No increment (i.e. level) O = Other R = RPI W = With-profits U = Unknown	Y*
Rate of increment / decrement	156-160	NN.NN Rate of increase or decrease in benefit	Y*
Previous Investigation Number	161-162	NN	N
Pension Grouping	254	B = Other bulk purchase annuities (i,e. where the office is unable to identify whether this is "buy-in" or "buy-out" business) C = Buy-out bulk purchase annuities D = Buy-in bulk purchase annuities I = Individual annuities U = Unknown	Y*
Pension Source Type	255	O = Occupational pension P = Private Pension (unknown source) Q = Private pension (personal pension) R = Private pension (income drawdown) S = Private pension (S226) U = Unknown	Y*
Dependant's proportion	256-260	NN.NN	N¥
Date of exit	163-170	DDMMYYYY	Y
Type of exit	171	A = Alteration (off) B = Cover ceases due to a claim on another benefit C = Critical Illness claim paid D = Death claim paid E = Ex-gratia claim paid H = Annuity benefits suspended as death suspected L = Lapse M = Maturity Q = Claim being investigated S = Surrender T = Terminal Illness claim paid U = Unknown X = Other exit	Y
Date of claim	172-179	DDMMYYYY	N*

Field	Field Position (for fixed length submissions)	Format of Values	Mandatory?
Date of notification of claim	180-187	DDMMYYYY	N*
Date of claim admission	188-195	DDMMYYYY	N*
Date of claim settlement	196-203	DDMMYYYY	N*
Cause of CI Claim	204-253	Any Alphanumeric	N

[§] The maximum of 10 characters is only relevant to fixed length data submissions

Fields indicated as Y* for "Mandatory?" are not mandatory if the value is the same for the entire data submission and is clearly specified in accompanying documentation (e.g. the file only contains UK business for office 999 relating to 2006).

In such cases and for non-mandatory fields that are not being supplied, the relevant fields should be filled with blanks where data is submitted in a fixed length format.

The dependant's proportion is shown as N[¥] for "Mandatory?". This need only be recorded for joint life annuities.

The Dates of Claim are shown as N* for "Mandatory?"; however at least one of these four dates **must** be supplied for assurances and at least one of date of death or date of notification **must** be supplied for annuities. The date of the claim event (death or diagnosis) is the preferred field for both assurances and annuities.

The file should also include:

- Header record – a one line record with each field's title.
- End of File record – a one line, one field record simply with the text "EOF".