



“16” Series pension annuity in payment mortality tables

July 2020

Summary

This Briefing note is issued alongside the “16” Series pension annuity in payment mortality tables. These are the latest tables produced by the Continuous Mortality Investigation (CMI) and are based on **mortality rates** of individuals receiving regular payments from pension annuities issued by UK life insurance companies.

Actuaries need assumptions about mortality rates in order to manage the finances of insurance companies that commit to pay policyholders a regular income throughout their retirement. In general, mortality rates for such policyholders are lower than those of the general population so many UK life insurance companies use the CMI’s tables as the basis for their assumptions.

Actuaries often consider these assumptions in two stages:

- Assessing a base level of mortality rates for that portfolio, perhaps reflecting their own recent experience, and
- Considering how these rates may change over time.

The “16” Series tables relate only to base mortality rates. They update previous CMI tables and, in particular, the “08” tables to reflect a larger and more recent dataset.

This note provides an overview of the “16” Series tables and outlines the key changes in the composition of the dataset, and the changes in methodology, from the “08” tables. Anyone using the 16 Series tables should consider both the choice of table and how this is adjusted, to ensure the mortality assumptions are appropriate to their portfolio.

Notes

This Briefing note provides an overview of the final “16” Series mortality tables, the latest mortality tables produced by the CMI Annuities Committee. This note is intended for use by those who are presented with results where “16” Series tables have been used as part of the mortality assumptions – such as Non-Executive Directors of insurance companies with annuity portfolios. We strongly encourage actuaries using the “16” tables to refer in addition to Working Papers 130 and 134 and their associated outputs.

While we frequently refer to just “16 Series” in the interests of brevity, in this note this should be understood as “final “16” Series pension annuity in payment mortality tables” and we similarly refer to just “08 Series”.

Some background about the CMI and the 16 Series tables as well as a definitions section are included at the end of this note; defined terms are indicated in **bold italics**.

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Tables

The 16 Series consists of 20 tables; each relates to a subset of the total dataset. The tables are defined by:

- Gender
- Product type. We have produced tables for three specific types of annuities:
 - Individual internal, where the annuity follows a pension saving contract with the same insurer,
 - Individual external, where the annuity was purchased separately, and
 - Pension buy-out; i.e. pensioners insured following a buy-out from a self-administered pension scheme.
- In addition, there are two groups of tables using multiple products:



- Individual combined, including internal and external and also “other individual”, where the product type is known to be individual, but the purchase mechanism is unknown (although we assume all such business must be internal or external), and
- All, which uses all of the above data plus data where the product type is unknown (i.e. the data could be individual, pension buy-out or Group; i.e. pensioners in insured group pension schemes).
- Weighting: Each of the tables are produced on both a “lives-weighted” basis, where each life has equal weighting, and an “amounts-weighted” basis, where data is weighted according to the amount of the annuity.

The naming convention for the 16 Series tables is of the form P{Gender}{Weighting}16_{Product}. For example, the male amounts table for all products is PMA16 and the female lives table for pension buy-out data is PFL16_PBO.

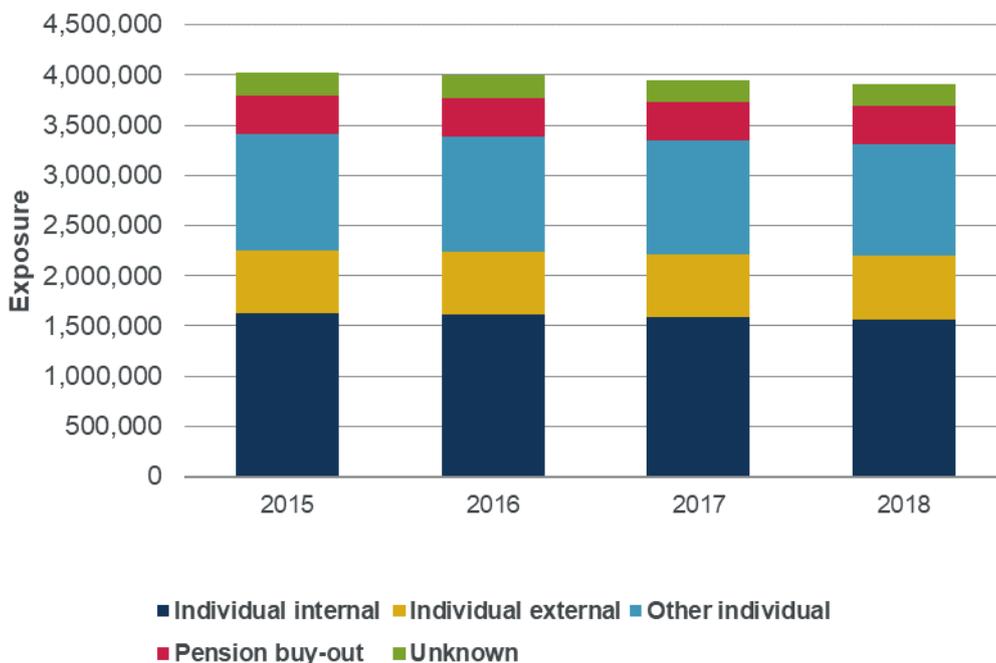
There is a wider range of tables in the 16 Series than in the predecessor 08 Series because we were able to reliably identify the product type for a large proportion of the data. In contrast, the 08 tables included only “all products”.

Data

The 16 Series tables are based on data supplied by UK life insurance companies in respect of the mortality of pension annuitants covering four years, 2015-2018 – this is both more recent and much larger than the 08 dataset.

Chart 1 shows the data volumes, measured by **exposure**, by year in the 2015-2018 dataset; this shows that the overall data volumes are relatively stable, with only a small fall between years. The volumes are also relatively stable for each product type, with Individual internal, other individual and Unknown decreasing slightly; offset by small increases for Individual external and Pension buy-out. The dataset is also highly consistent across the four years in terms of data contributors and data submissions.

Chart 1: Data volumes (life-years exposure) by year for the 2015-2018 dataset



The 16 Series tables have an **effective date** of 1 July 2016 for **initial rates of mortality**, q_x . This was based on the approximate mid-point of the dataset. For use at different dates, the rates may be projected forward or backward using a version of the CMI Mortality Projections Model.



Construction of the tables

The 16 Series tables use a typical CMI approach:

- We have used data for a number of years, in this case four, to avoid volatility that can arise; for example as a result of a particularly harsh winter.
- Data was graduated over age ranges for which we consider the data to be reliable; in this case ages 60 to 95. The remaining data is not used and instead extensions are applied to lower and higher ages; this process involves some judgement.
- Mathematical formulae were used for the **graduations**; the formula for each table was selected using a combination of statistical tests and pragmatic judgement.
- The graduated rates were then extended to lower and higher ages, to produce a complete set of rates from age 20 to 120.

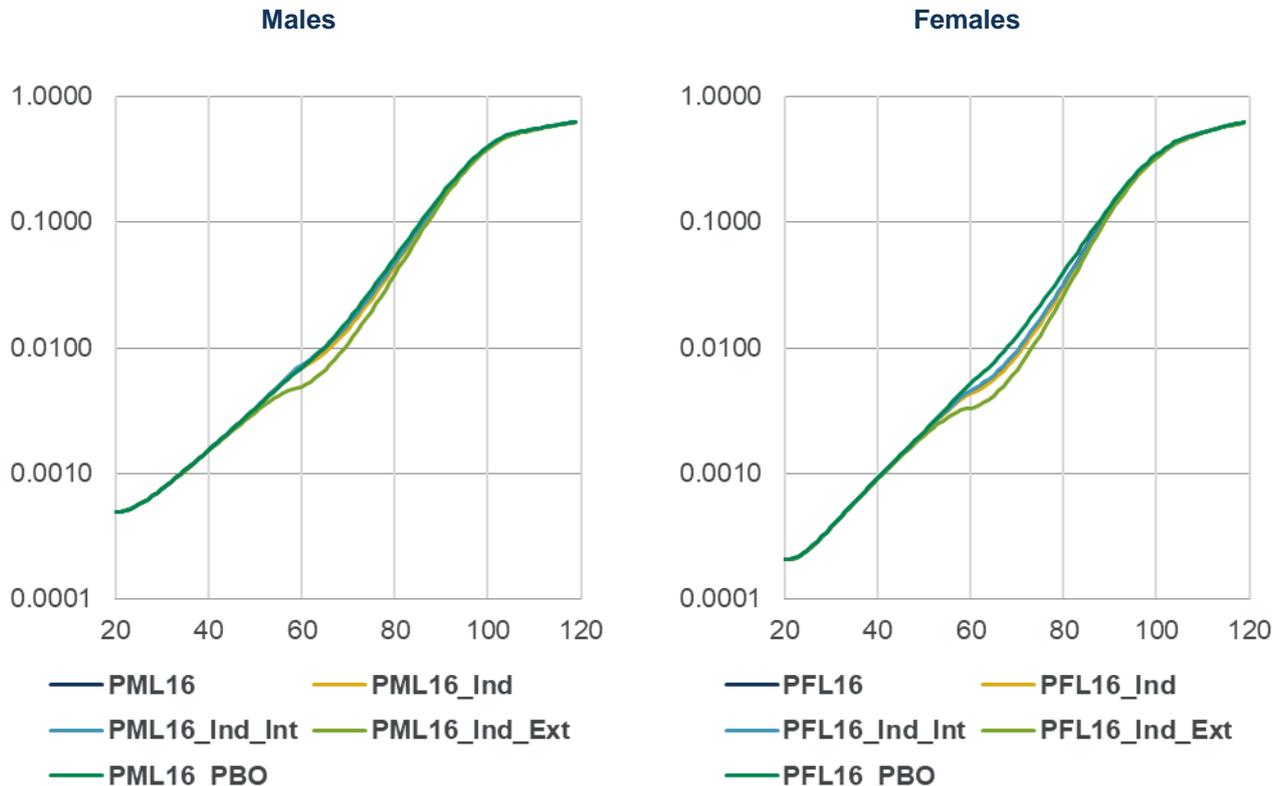
The broad approach is similar to the 08 tables; however, there were some differences in particular:

- The method used to extend the graduated 16 Series rates to advanced ages was the method proposed by the CMI’s High Age Mortality Working Party. This assumes that mortality rates converge towards those of a more reliable “reference” population as age increases; we used national population mortality for the United Kingdom as the reference.
- The extensions of the graduated rates to younger ages have limited financial materiality but are produced for completeness. For the 16 Series tables, the rates are extended so that mortality rates reduce smoothly to reach national population mortality.

Results

Chart 2 shows initial mortality rates q_x between ages 20 and 120, including low and high age extensions, and compare rates for related tables. For both genders, the rates are lowest for the Individual external tables and highest for the Pension buy-out tables.

Chart 2: Mortality rates (q_x) for lives tables (log scale)





Period life expectancies at age 65 for the male and female amounts tables are shown in Table 1. The variation in mortality rates that was seen in Charts 1 and 2 translates to a 1.6 year gap in life expectancy for males between the Individual external and the Pension buy-out tables. For females the difference is higher, at 2.4 years. As might be expected:

- For each table, the female life expectancy is higher than that of males.
- Life expectancies for the All tables sit between those for the different products, for both males and females.
- Life expectancies for the Individual combined tables sit between the Individual internal and Individual external tables for both males and females.

Table 3: Period life expectancies at age 65 for 16 Series Amounts tables on 1 July 2016

	Table	Males	Females
All	PMA16, PFA16	20.77	22.88
Individual combined	PMA16_Ind, PFA16_Ind	21.05	23.32
Individual internal	PMA16_Ind_Int, PFA16_Ind_Int	20.52	22.90
Individual external	PMA16_Ind_Ext, PFA16_Ind_Ext	21.73	23.98
Pension buy-out	PMA16_PBO, PFA16_PBO	20.10	21.59

Using the 16 Series tables

Anyone using the 16 Series tables should consider both the choice of table and how this is adjusted, to ensure the mortality assumptions are appropriate to their portfolio. To help users with these decisions, Working Paper 130 contains indicative graduations of Group business, by duration and by Pensioner type plus analysis of the experience by amount band, in the form of Actual/Expected values. For each of these factors, we received some data – for example, on Pensioner type we could only reliably identify the main life (“pensioners”) and the contingent annuity to their spouse (“widow(er)s”) for a subset of the Individual internal data – but the Committee did not consider each to be sufficiently credible and reliable to produce a formal table.

Mortality rates are also known to vary by socio-economic status. A substantial proportion of the data underlying the 16 Series tables included indicators of socio-economic status, based on the Index of Multiple Deprivation (IMD). The Committee is close to completing its initial analysis of this dataset and expects to report on this in July 2020.

About the CMI

The Continuous Mortality Investigation (CMI) provides authoritative and independent mortality and sickness rate tables for actuaries advising UK life insurers and pension funds.

The CMI operates as a private company which is wholly owned by the Institute and Faculty of Actuaries (IFoA). The company has a board of two directors, appointed by the IFoA, and an Executive Committee that oversees the CMI’s work. The CMI is funded by subscriptions from commercial users. Subscribers have access to all of the outputs produced by the CMI; these are also made available to academics and researchers for non-commercial use¹.

A key area of the CMI’s work is to produce mortality base tables that reflect the most recently available data. The 16 Series tables are the latest CMI mortality tables for UK pension annuitants, produced by the CMI Annuities Committee, and are the focus of this note. The Committee consists of volunteers from a variety of employers, including several of the leading insurance companies; vacancies for new members are widely advertised in the actuarial community when they arise.

¹ Details of how to access the final “16” Series tables, Working Paper 134 and the CMI’s other research can be found on the [CMI section of the IFoA’s website](#). The website also sets out current subscription fees which vary according to the size of the organisation, currently starting at £325 pa per qualified actuary for a small consultancy.



Why are CMI mortality tables needed?

The Office for National Statistics (ONS) publishes population mortality tables for the United Kingdom on an annual basis. However, the shape and level of mortality rates differ for policyholders of insurance companies, and for members of pension schemes, compared with the general population; hence the CMI produces tables that may be better suited to those groups of lives; in particular:

- Pension annuitants tend to have lighter mortality (i.e. they are likely to live longer) than the general population.
- Insurance companies also often use amounts-weighted mortality assumptions, where mortality data is weighted by amount of the annuity, as individuals with higher annuities tend to live longer, but population tables are lives-weighted.

In addition to pension annuities, the CMI also produces mortality tables for other types of insurance products and for members of self-administered pension schemes.

Definitions

A **mortality rate** is the proportion of people, of a given age and gender, that are expected to die in the following year. These can be expressed in different ways but, in particular, an **initial rate of mortality** (q_x) is the probability that a person aged x dies before reaching age $x + 1$.

Exposure is a measure of the number of people in receipt of an annuity at each age and gender during a year. We divide the number of people dying at a particular age by the exposure at that age to calculate the mortality rate. For amounts-weighted tables, we use the amount of annuity being paid instead of the number of people.

The **effective date** of a mortality table is the date at which the mortality rates apply. If actuarial calculations are being carried out at any date other than the effective date, users should consider allowing for changes in mortality between these dates.

A **graduation** of mortality rates is a form of smoothing, to produce rates that progress smoothly between ages. Graduation usually uses a mathematical formula to represent the shape and level of the rates, with parameters for the formula chosen to fit the underlying data.

Life expectancy is a measure of how long – on average – someone of a particular age and gender will live.

Period life expectancy only depends on mortality rates at a point in time, with no allowance for mortality rates to change in future. It is an objective measure that is often reported by the Office for National Statistics. (In contrast, **cohort life expectancy** also depends on assumptions regarding future changes in mortality. Consequently, it is a subjective measure, and is typically used by actuaries who need to use realistic assumptions about what may happen in the future.)

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