SETTING UP MORTALITY RATES IN SUPERVAL

SCOPE:

Actives, Deferreds and Pensioners

CONTEXT:

This document shows how to define mortality rates in SuperVal.

Note that this document is based on Version 9.25 of SuperVal. Any screenshots which may be included from previous versions of SuperVal are not materially different from those in V9.25.

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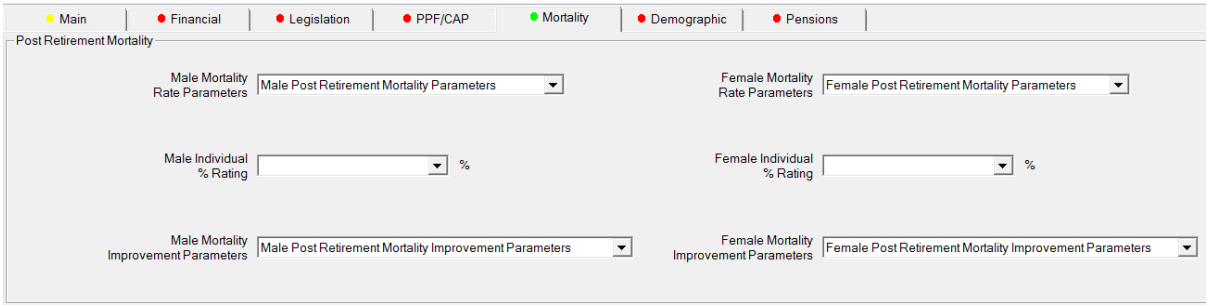
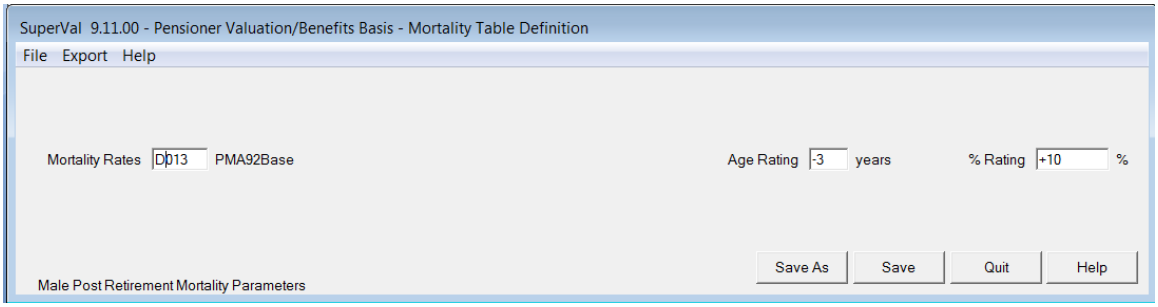
INPUTS

Below is a screenshot of the fields you need to fill in when defining what mortality tables and improvement factors to use in SuperVal. The screenshot is taken from the Mortality Tab from the Pensioners module. Set-up for the Actives & Deferreds modules is similar, except for the fact that you will also need to define pre-retirement mortality (and if applicable ill-health retirement mortality). The fields can be found on the Mortality tabs in all modules.



If users click on the "Add/Edit Mortality Table" button at the bottom of the page, then the Mortality Rate Parameters can be added, defined and named as a set for a specific basis file:



BASIC ADJUSTMENTS TO MORTALITY TABLES

There are several ways in which a (base) mortality table (circled in screenshot above) can be adjusted in SuperVal.

Applying a % Rating Factor (or Scaling)

This is simply done by adjusting the value of q_x for each age x by a constant.

e.g. $q_x' = 1.1 \times q_x$,

where q_x is the base mortality rate, 1.1 is the scaling factor and q_x' is the adjusted mortality rate.

In SuperVal % Rating factors can be defined in the cells indicated, and can either be fixed or member-specific.

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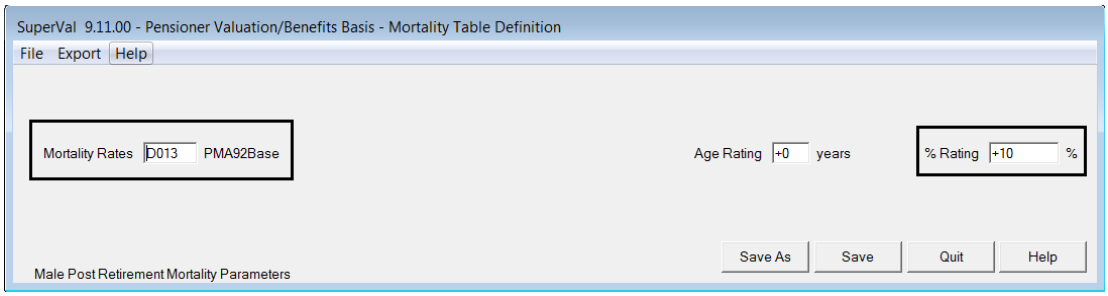
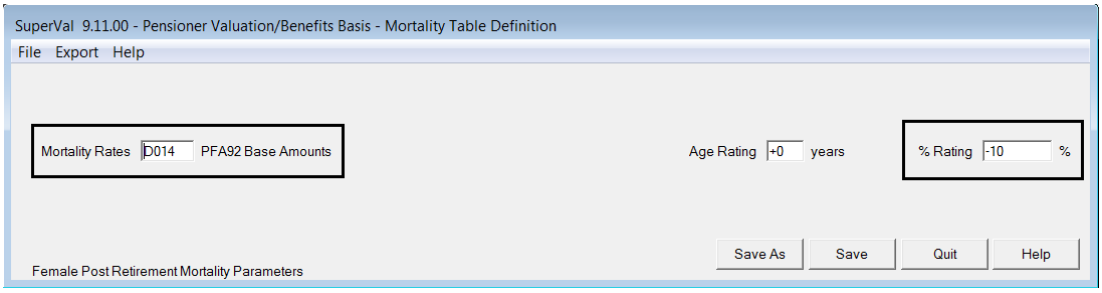
Fixed

In the Males/Females % Rating cells simply enter any additional %. SuperVal will apply 1 plus the entry in the field. In other words to multiply the rates by 1.1 enter 10 for 10% loading or to multiply rates by 0.9 enter minus 10.

"Male Post Retirement Mortality Parameters"



"Female Post Retirement Mortality Parameters"



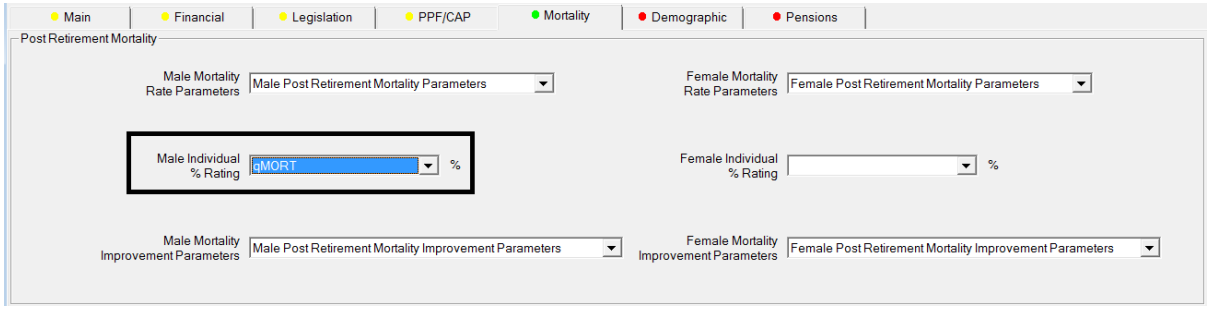
The above mortality set-up is as follows:

Males: **110% PMA92 Base**
Females: **90% PFA92 Base**

Note: In the Mortality tab, the user would need to ensure they select the named parameter sets "Male Post Retirement Mortality Parameters" and "Female Post Retirement Mortality Parameters."

Member-specific

If a percentage loading is required on a member-by-member basis, then a data item can be selected and input on the Mortality tab in the Male/Female Individual % Rating cells. The data item (included in the CSV file) has to be in the form of a number, so if loading of 110% is required then use 10 or if a loading of 90% then use -10.



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Applying an Age Rating

This is simply done by adjusting the value of q_x for each age x as follows:

$q_x' = q_{x+a}$,

where q_x is the base mortality rate, a is the age rating and q_x' is the adjusted mortality rate.

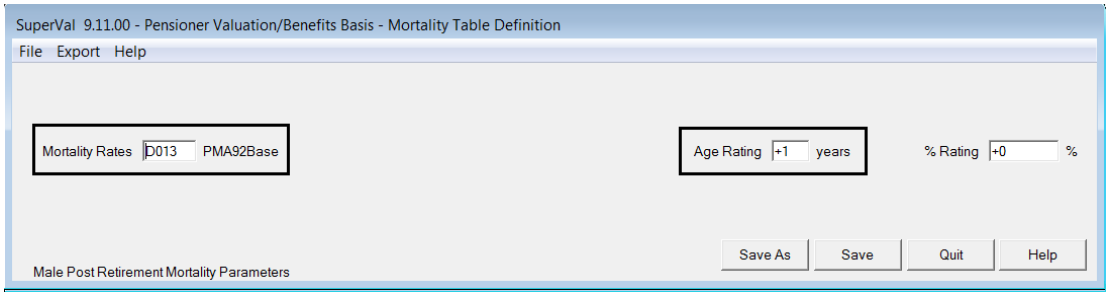
In SuperVal age ratings can be defined in the cells indicated, and must be fixed for each sex (i.e. you cannot presently define member-specific age ratings in SuperVal).

Male / Female Rating

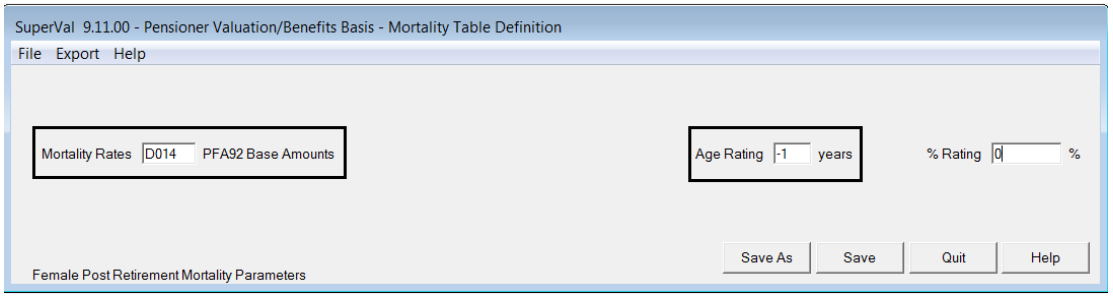
The 'Age Rating' cells make allowance for mortality "lighter" or "heavier" than that specified in the table. The adjustment specified here is made to the (base) mortality table specified.

NB: Non-integer ratings or ratings higher that +9 or -9 years are not allowed.

"Male Post Retirement Mortality Parameters"



"Female Post Retirement Mortality Parameters"



The above mortality set-up is as follows:

Males: **PMA92 Base +1 yr**
Females: **PFA92 Base -1 yr**

Note: In the Mortality tab, the user would need to ensure they select the named parameter sets "Male Post Retirement Mortality Parameters" and "Female Post Retirement Mortality Parameters."

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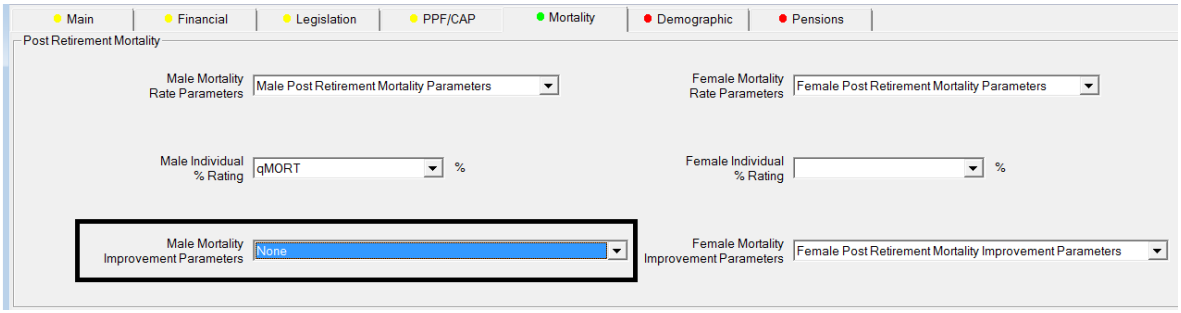
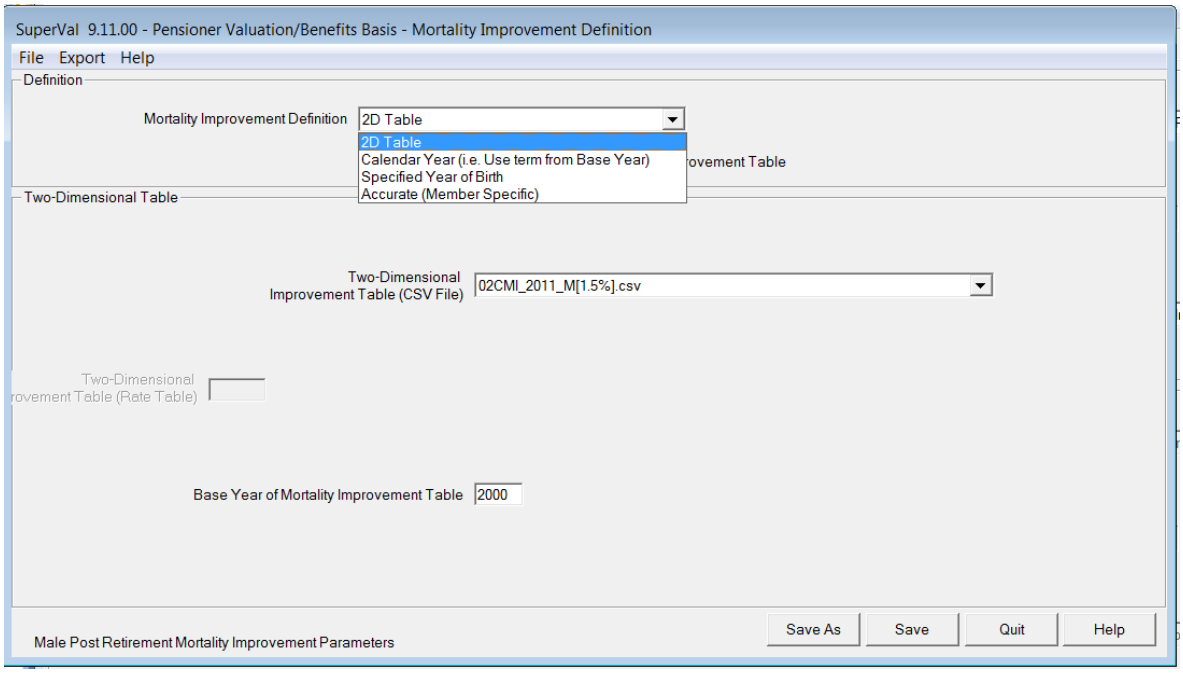
ALLOWING FOR MORTALITY IMPROVEMENTS

SuperVal gives you five different options for the type of mortality improvement you can define:
None – this can be selected even when there is no mortality improvement set up on the Mortality tab



The other options can be seen when defining Mortality improvement tables:



These 5 options can be grouped into three separate categories, as explained below.

Basic Mortality Adjustments

This is where there is one q_x for each age – the value of q_x does NOT vary with DOB (or based on a specified Calendar Year).

In this case, you'd just select option "N – None" and define the mortality table(s) in the 'Male Table' and 'Female Table' cells.

This type of mortality adjustment has already been covered in the previous section. You can allow for improvements via age rating and scaling, as described earlier.

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Adjusting the base mortality table using a 2D table by means of a Reduction Factor Formula

This is done by adjusting the value of q_x for each age x as follows:

$q_x' = q_x \times RF(x,t)$

where q_x is the base mortality rate, RF(x,t) is the reduction factor to apply to a member aged x at time t, and q_x' is the adjusted mortality rate.

One approach suggested by the Continuous Mortality Investigation (CMI) is to use a formula for the reduction factor, set out as follows:

$RF(x,t)=alpha(x)+(1-alpha(x)).(1-beta(x))^{t/PERIOD}$

Note 1: RF(x,t) has a maximum value of 1 (since it reflects an improvement in mortality and hence a reduction in the value of q_x).

Note 2: t in the formula above is the number of years after the base year (e.g. 1980 or 1992).

When setting up these tables, you can specify the values of Alpha, Beta within SuperVal using a 'HX' type table.

The CMI has published two sets of values for Alphas & Betas, which relate to adjusting the '80' series and '92' series base mortality tables. The values can be found in CMI Reports 10 and 17, respectively.

Depending on the improvement method used, you may also need to enter further parameters:

Improvement Method

SuperVal allows three different improvement methods to be applied that incorporate the Alpha and Beta tables.

These are as follows:

- Calendar Year

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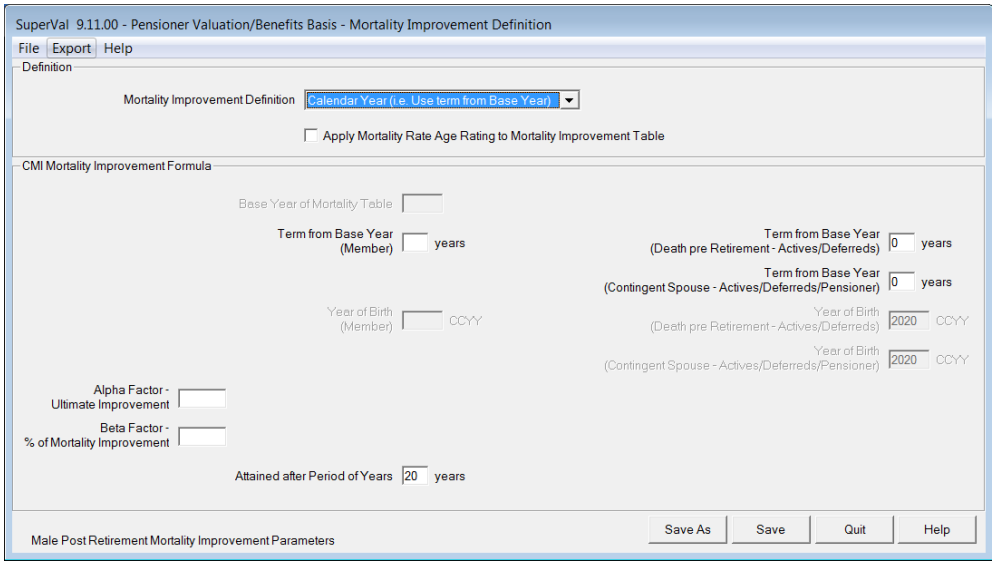
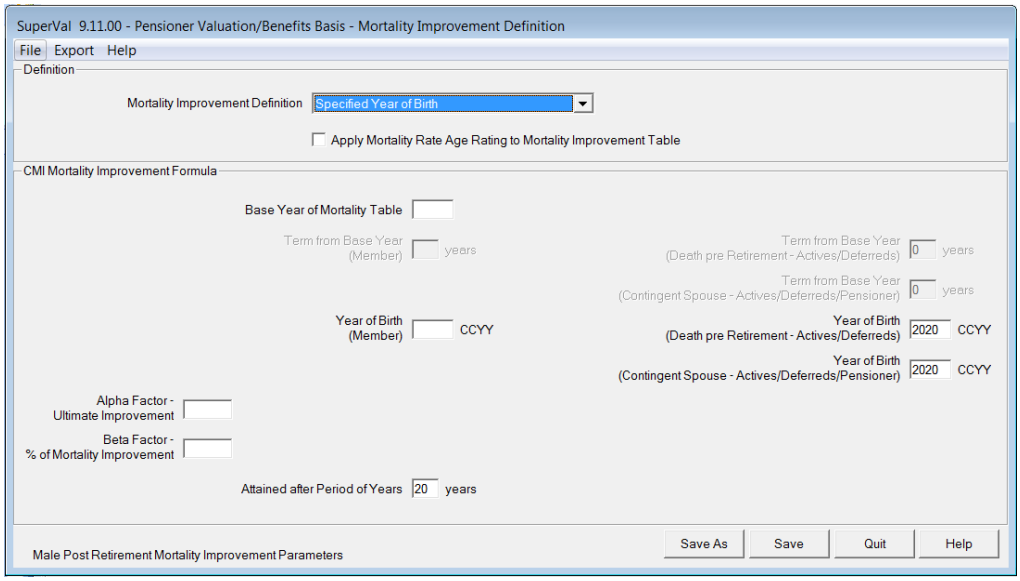
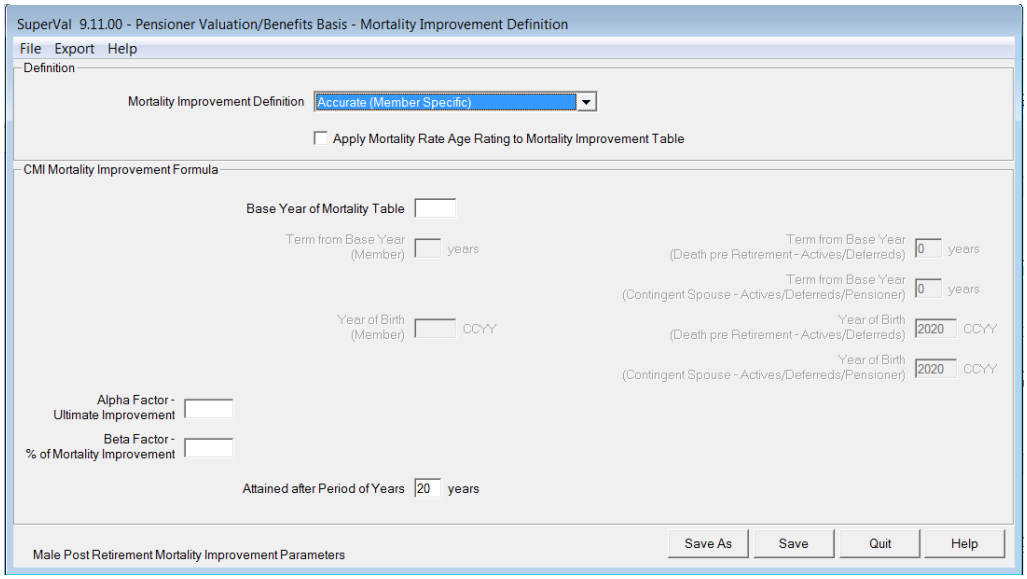


- Specified Year of Birth (applied to all members)



- Accurate – Member Specific Year of Birth



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Mortality Table Base Year

This parameter is only required for the Specified Year of Birth method and (Accurate) Member Specific methods. So this would be 1980 or 1992, say.

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Specifying the Year of Birth or Term from Base Year

For the Enhanced Pensioners set-up, there are four different fields:

- Member (Males & Females)
- Contingent (Males & Females)

The value will depend on the mortality assumed for members and spouses (based on sex)

For the Calendar Year Method, the value to input should be the difference between the Projection Year and the Base Year of the mortality table. So, if you were using PMA92 CY=2020, then the input would be 28 (=2020 – 1992).

For the Specified Year of Birth Method, the value to input is simply the fixed Birth Year that you are using for your mortality projections (e.g. 1945 for PMA92 BY=1945).

For the Actives and Enhanced Deferreds modules there are additional fields, depending on the type of decrement (e.g. death before retirement, withdrawal, retirement etc.).

Alpha and Beta (M&F)

The user simply needs to select the relevant rate table for Alpha & Beta values.

Period (M&F)

The period is 20 years (see CMI Reports)

Examples/Comments

See appendix for examples of set-up for Calendar Year, Specified Year of Birth and Member-specific Year of Birth.

Note 1: For member-specific Year of Birth, SuperVal uses age nearest at the valuation date to work out the relevant RF(x,t) factor to use. This may mean that the YOB is one year out in some cases.

Note 2: If a user is setting up mortality based on the RF(x,t) formula method using the '92' series improvement formulae to adjust **'00'** mortality base tables, the above methodology will NOT calculate mortality rates accurately. In this instance, you would need to input the RF(x,t) values as a 2D table, as described in the following section. The reason for this is that the formula for RF(x,t) shown above is based on improving mortality rates from 1992 onwards, while if you are using the **'00'** series base tables, you will only want to apply improvements after 2000. You CANNOT simply adjust the inputs above using 2000 instead of 1992.

Note 3: The above methodology can NOT allow for cohort effects or underpins. Again, 2D tables are required in this instance.

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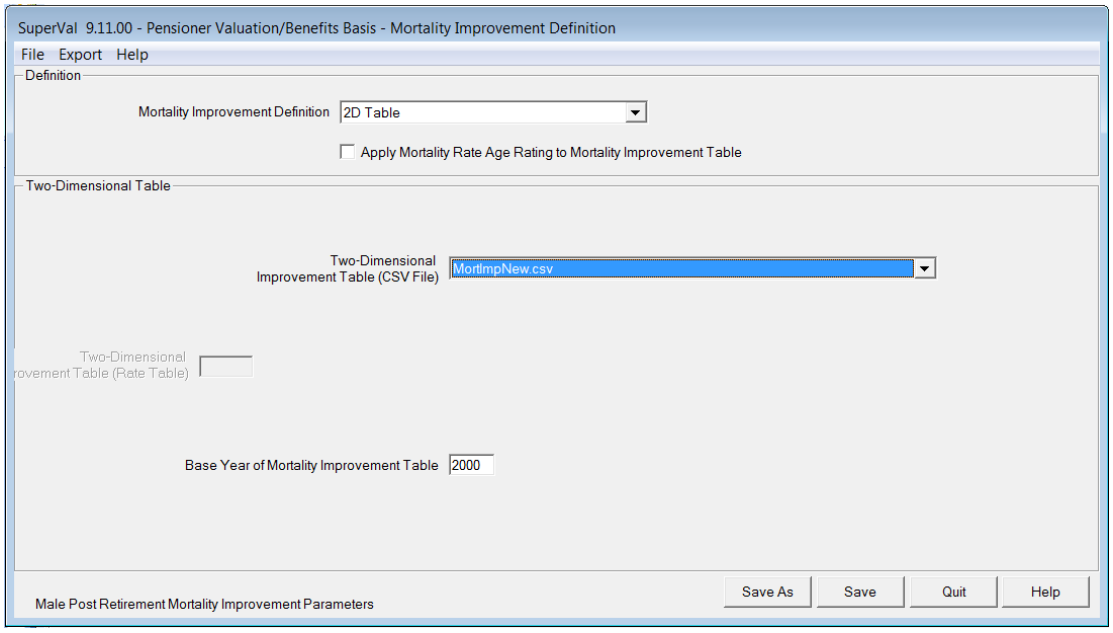
Adjusting the base mortality table by specifying a 2D table

Where the reduction factors do not follow the formula specified in the previous section, a 2-Dimensional Table can be specified in SuperVal (e.g. tables which include allowance for the cohort effect or an underpin to the rate of mortality improvement).



To use this method a .CSV file is required for reduction factors that vary by age and year. This file is stored in the System folder of where the program files are kept (typically a network drive). A sample file is provided with Version 8.30 called "MortImpNew.csv".

Creating your own .CSV file:

- This can be created in Excel but make sure you are pointing inside the data before saving as a .CSV file type
- Ages are Rows, Years are Columns
- Cell A1 must start at Age 0
- If the first column of improvements is the year 2000, then the “Base Year of Mortality Improvement Table” should be set to 2000. If the first column is 2007, then the “Base Year of Mortality Improvement Table” should be 2007, etc.
- There must be 120 rows **and** 120 columns

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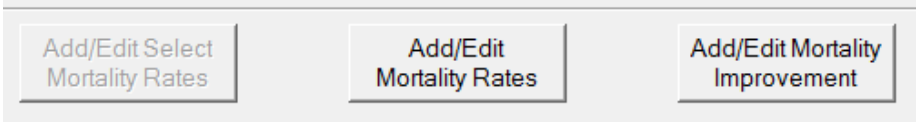
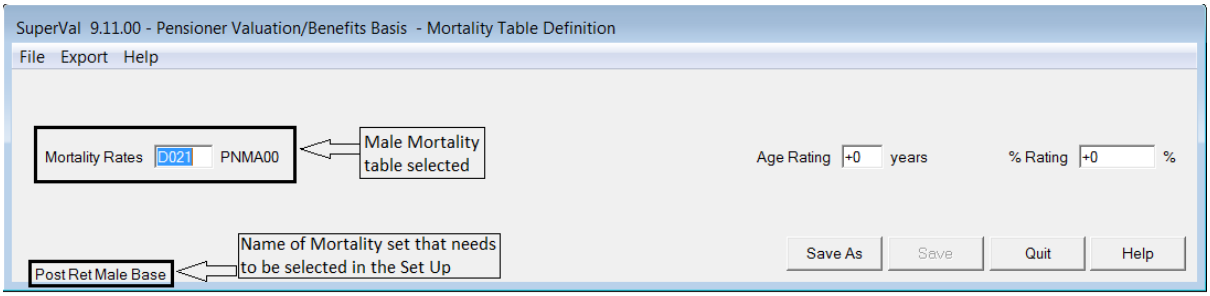
Example Set-up

The following set-up is for:

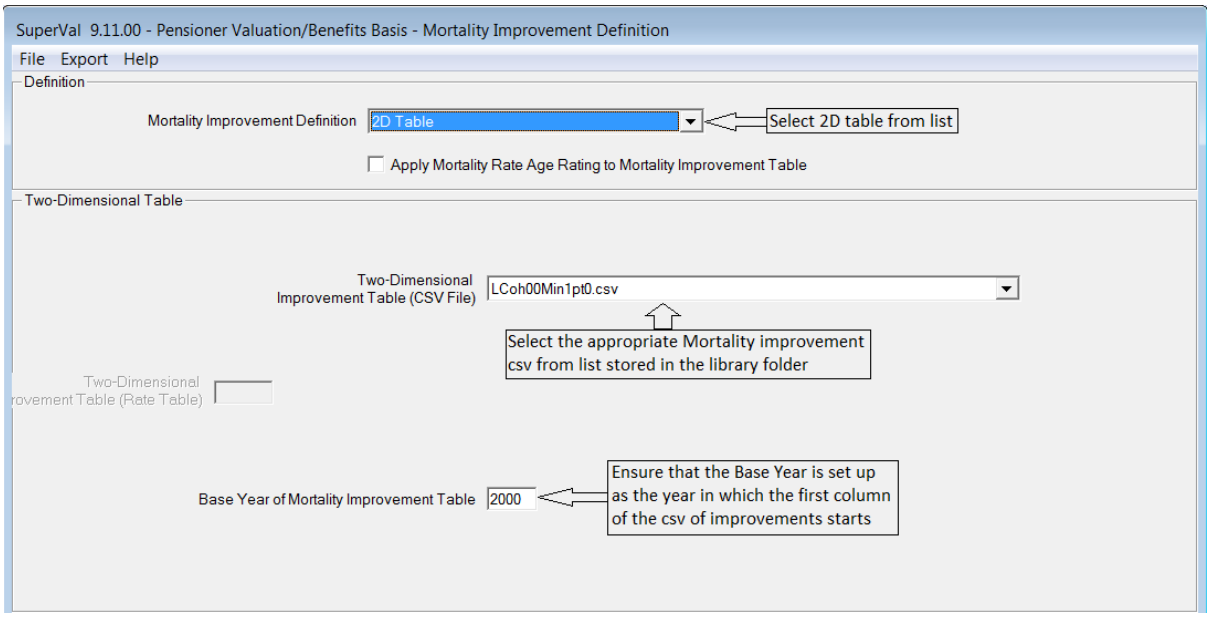
Males: PNMA00 BY=19xx LC min 1% (i.e. member-specific birth year, Long Cohort min imp 1% p.a.)
Females: PNFA00 BY=19xx LC min 1%

Start off by adding the Mortality Rate Parameters with the base table, then add the Mortality Rate Improvements and add these to the basis file.





Likewise with the Female Mortality, and then save and move on to set up definitions for the Mortality improvement tables:



Then the Basis file should choose these two options on the Mortality tab:

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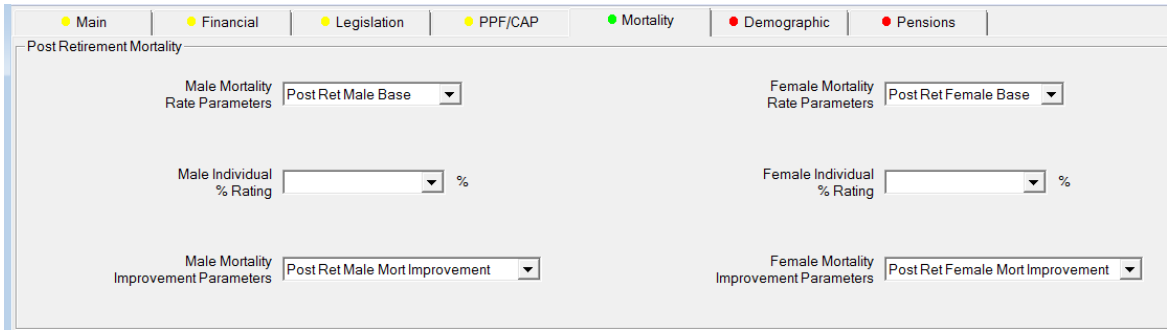
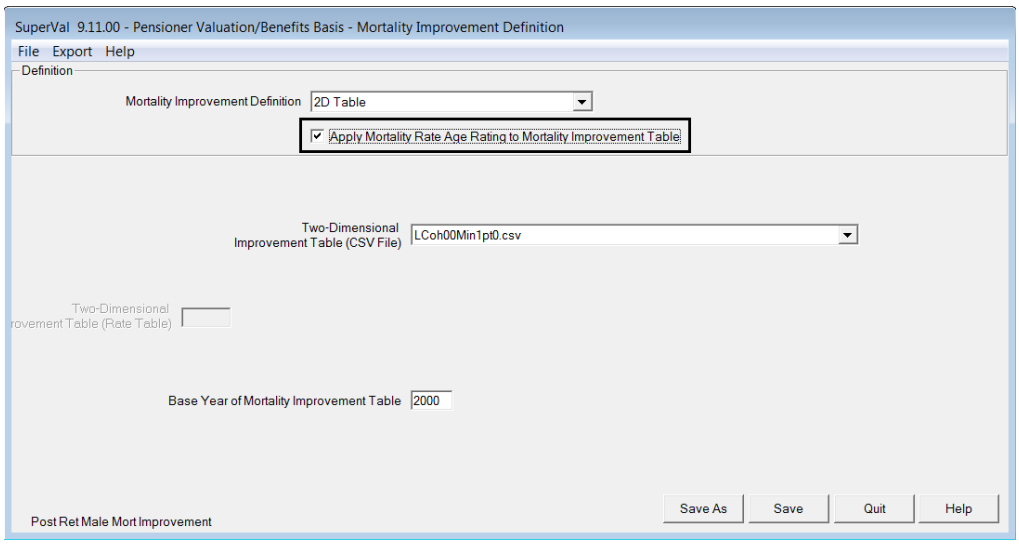


Adjusting the Age Rating of Improvement Factors

If an age rating is being applied to the (base) mortality table, then the same age rating can be applied to the Improvement Factors.

This is done by checking the box for the following field within the Mortality Improvement set:



Example

- A member's age is 60 nearest at valuation date
- Valuation year is 2007
- +2 year age rating is being applied to the base mortality table

If the box is left unchecked, then the age that SuperVal will use at valuation date for improvement factors will be 60.

If the box is checked, then the age that SuperVal will use at valuation date for improvement factors will be 62.

This is shown in the illustration below:

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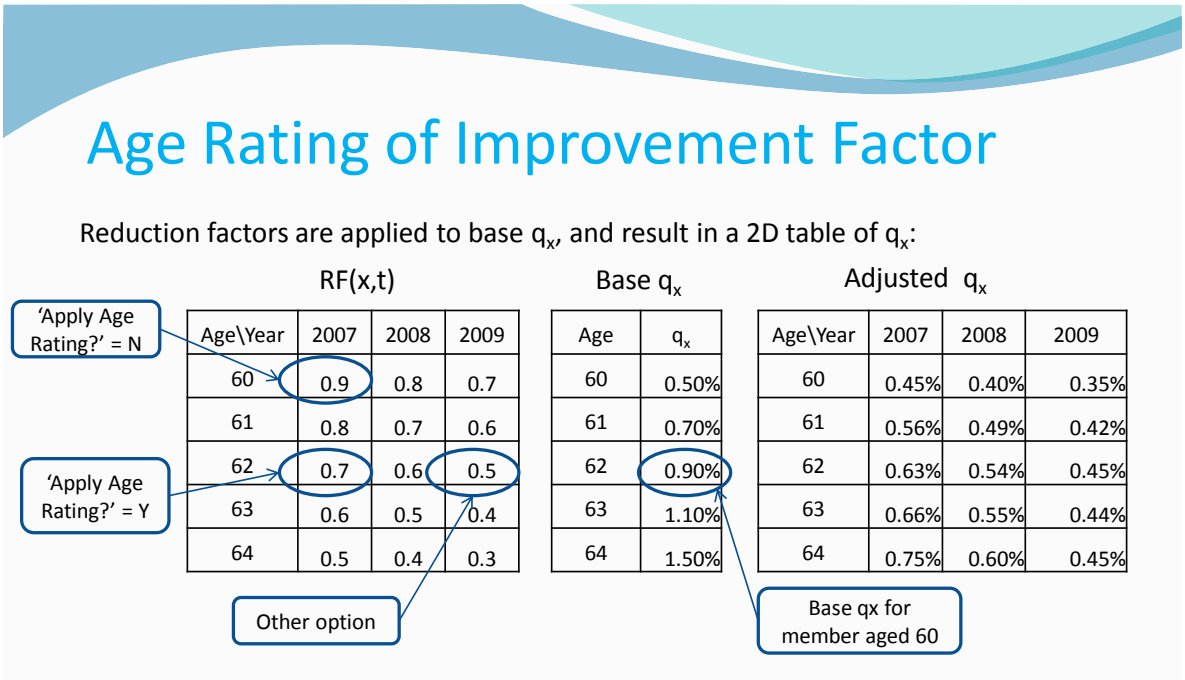

Note – This illustration also shows that SuperVal does not adjust 't'. If you do want to allow for the age rating to affect 't' (shown above as 'other option') , then you'll need to import your own adjusted RF(x,t) tables.

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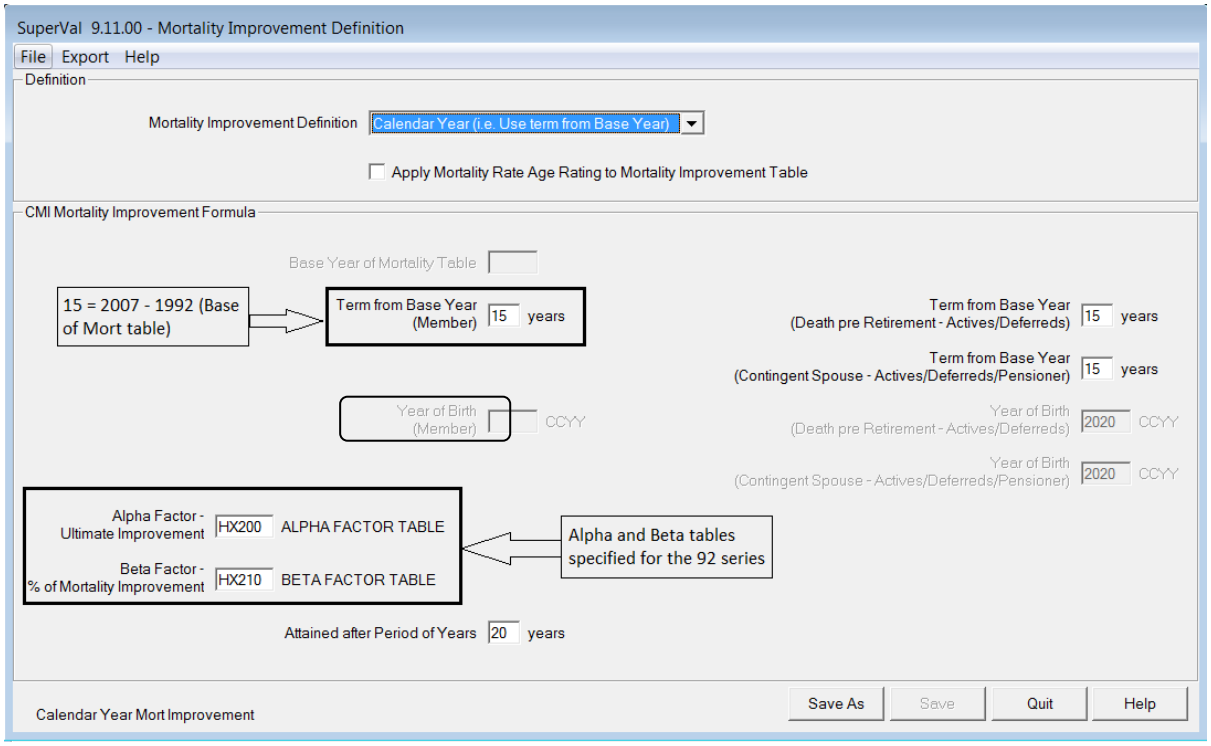
APPENDIX

Sample set-ups for formula-derived 2D tables

N.B. All set-ups are taken from the Enhanced Deferreds Module

a) Calendar Year (based on '92' series base tables & CMI R17 αs & βs ONLY)

Males: **PMA92 (CY=2007)**
Females: **PFA92 (CY=2007)**



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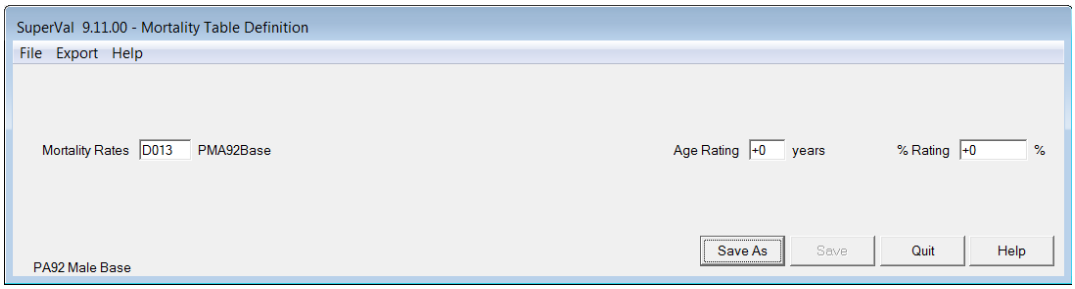

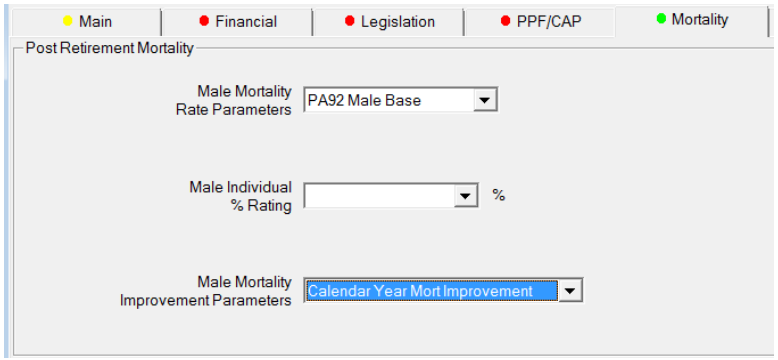

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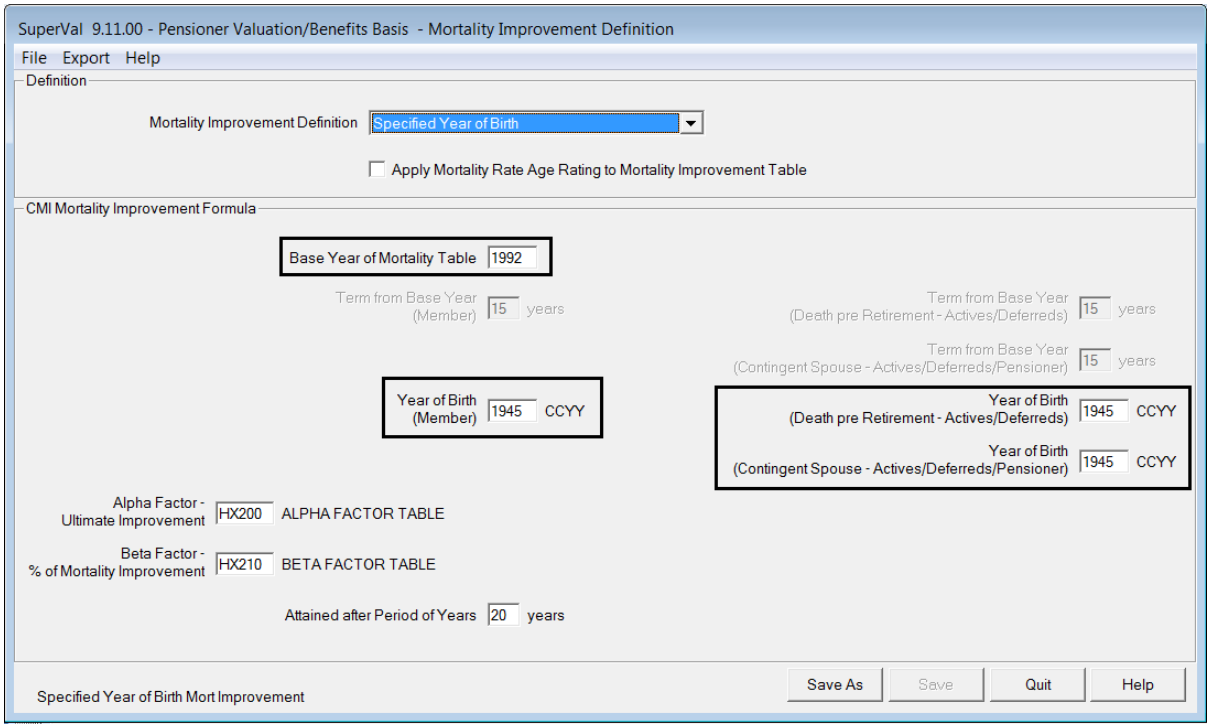
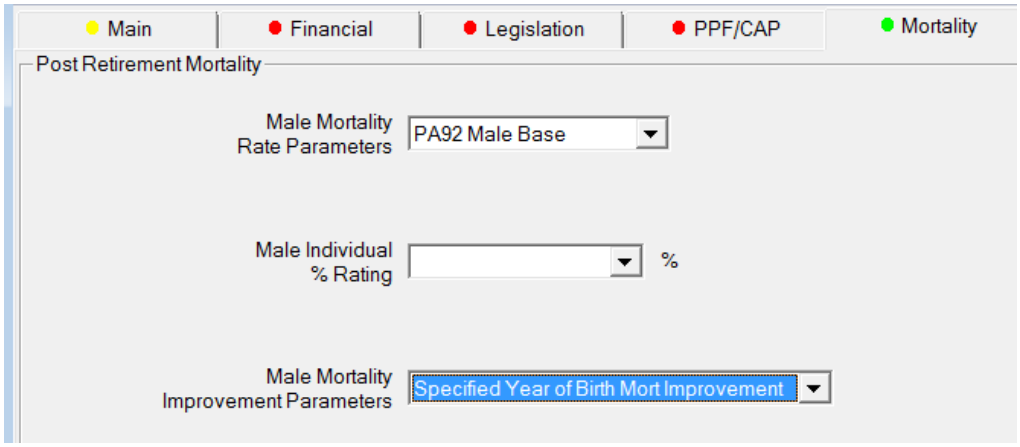
Specified year of birth ('92' series base tables & CMI R17 αs & βs ONLY)

Males: **PMA92 (BY=1945)**
Females: **PFA92 (BY=1945)**





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b) Accurate (member specific) birth year ('92' series base tables & CMI R17 αs & βs ONLY)

Males: **PMA92 (BY=19xx) – i.e. member specific**
Females: **PFA92 (BY=19xx)**