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CMI Tables Program (STP) for Windows

Continuous Mortality Investigation

Version 3.3.1

March 2012

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Acknowledgements

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Contents

Chapter One

Introduction and Background

Version 1.0 - January 1991

The CMI Tables Program (**STP**) has been issued by the Continuous Mortality Investigation of the Institute and Faculty of Actuaries. Its purpose is to allow the user to generate mortality and monetary functions from tables published by these bodies. The program has been developed primarily as a replacement for the previous method of distributing new tables.

The report, "Standard Tables of Mortality based on the 1979-82 experiences" (*C.M.I.R.* **10**, (1990)), introduced twelve new tables of mortality, which were designated the "80" Series. It was considered impractical to publish several printed volumes of mortality and monetary functions per table.

STP has the advantage of being able to produce monetary functions over a wider range of interest rates and of being able to produce its output in a form that is accessible to other PC packages. This means, for example, that many PC spreadsheets will be able to load up **STP** output without any intermediate conversion stage.

Detailed descriptions of the mortality tables used by this program will be found in the above mentioned report in *C.M.I.R.* **10**, and in the published volumes of a(55), A1967-70, PA(90), a(90) and FA1975-78.

As a companion to this program, and to assist those who do not wish to use **STP**, a printed volume of the "80" Series mortality tables and of specimen monetary functions was produced.

Version 2.0 - February 1994

Major enhancements to **STP** were incorporated in Version 2.0.

Permanent Health Insurance (PHI) functions were included. (While this type of business is now more commonly known as Income Protection (IP), **STP** currently retains the PHI terminology.) The functions are based on the new multi-state model for PHI as described in the report, "The analysis of Permanent Health Insurance data" (*C.M.I.R.* **12**, (1991)). The functions calculated by **STP** are built up from the graduated sickness intensities derived in *C.M.I.R.* **12** from the Male Standard Experience for individual PHI policies for 1975-78. The program produces two basic types of PHI output, current claim annuities and "pricing functions", the latter being built up from a combination of claim inception rates and current claim annuities.

The program has been modified to allow AIDS loadings to be added to the basic q_x values of the specified mortality tables. Available AIDS loadings are basis R (from AIDS Bulletin No. 4 (1989)) and bases R6A, R6B and R6C (from AIDS Bulletin No. 5 (1991)). Modified versions of these tables, as specified in letters dated December 1989, September 1993 and October 1996 from the Government Actuary to Appointed Actuaries, are also included.

The third major enhancement is the inclusion of a table editor which enables a user to input or amend mortality tables, tables of AIDS adjustments and PHI inception rates.

Version 3.0 – July 1999

This version of **STP** was released to coincide with the publication of the "92" Series of mortality tables, which are described in *C.M.I.R.* **17**, (1999).

In addition to incorporating these new tables **STP** was re-written to run under Microsoft Windows 95/98 and Windows NT 4.0. Although no new actuarial functions are incorporated in Version 3.0 some traditional Windows "ease of use" features have been added. These include "cut and paste", "print preview" and the ability to work on several calculations at once.

The graphical display has almost eliminated the need for the linear actuarial notation.

Version 3.1 – May 2003

Following publication in December 2002 of CMI Working Paper 1, "An interim basis for adjusting the "92" Series mortality projections for cohort effects", **STP** has been updated so that the three sets of projections described therein can be applied to the "92" Series base tables. Furthermore, the Table Editor has been extended to allow the user to create tables of projection factors that can be applied to any mortality table.

There is now improved support for Windows 2000/XP where the user has limited access to the computer. By default, user files will be saved in an STP subfolder of "My Documents".

Another feature that has been added is the ability to open libraries (.stp files) and tables (.tbl files) by dropping them onto the application directly from Explorer.

Version 3.2 – August 2006

This version of **STP** was released to incorporate the "00" Series of mortality tables, which are described in C.M.I. Working Papers 21 and 22, published on 1 August 2006, (and subsequently *C.M.I.R.* **23**, published on 24 February 2009).

The "00" Series tables also include for the first time a number of "truncated" tables. These relate to deferred annuitants and pensioners and therefore cease at age 75. As a result they intentionally do not extend to a limiting age ω, such that q_{ω}=1. **STP** has therefore been updated to recognise the limited range of meaningful functions that can be calculated from such tables.

No mortality projections were published to accompany the "00" Series tables. **STP** has been adapted to allow the user to apply the original "92" Series projections or the interim ("cohort") projections to the "00" Series annuitant and pensioner base tables. However, this does not imply that these projection bases are necessarily appropriate.

Version 3.3 – February 2009

This version of **STP** was released to incorporate the CMI library of mortality projections, which is described in C.M.I. Working Papers 30 and 37, published on 23 November 2007 and 13 March 2009 respectively. For any base annuitant or pensioner mortality table from the "92", "00" or SAPS "S1" Series it is now possible to choose any projection basis from the library. This means that the 69 possible projection bases incorporated in version 1.1 of the library, volumes 1 to 6, are included in **STP**.

Furthermore, the facility to choose a specific base year for the projections has been added. This allows the user to select one projection basis up to the chosen base year and another

projection basis after the base year. It is also possible to have no projection before or after the selected base year. There has also been a revamp to the screen layout for choosing projection bases.

The "00" Series Combined and Early Pensioner tables published in C.M.I. Working Paper 22 started at age 50. Subsequently, suggested extensions to younger ages for these tables were published in C.M.I. Working Paper 26. **STP** has been updated to include a set of mortality tables that add the C.M.I. Working Paper 26 extensions to the relevant "00" Series table. These tables are differentiated from the official "00" Series tables by means of a suffix "X" (for eXtension) in the table name, e.g. PCFA00X has an age range of 20-120 with the values at ages 50-120 equal to the PCFA00 table and values below age 50 taken from the C.M.I. Working Paper 26 extension to this table.

STP has also been updated to include the SAPS "S1" mortality tables. These were published on 31 October 2008 in C.M.I. Working Paper 35 and are the first mortality tables to be produced from the self-administered pension schemes (SAPS) experience.

Version 3.3.1 – March 2012

This version of **STP** was released to incorporate the additions to the CMI library of mortality projections as contained in library volume 7 (released with version 1.2 of the library, June 2011) and volume 8 (released with version 1.3, November 2011). **STP** now includes the 123 possible projection bases contained in version 1.3 of the library. For further details of the projections, see the User Guide to version 1.3 of the library.

STP has also been updated for compatibility with Windows 7.

Chapter Two

Getting Started

Hardware requirements

In order to use this program you must have:

- Windows XP SP2 or later.
- Approximately 20Mb free hard disk space.

Installation

These procedures relate to new installations only. Existing users upgrading **STP** should refer to any installation guidelines provided with the upgrade. It is strongly recommended to close all Windows programs before running the setup program.

Insert the CD into your drive.

The setup program should run automatically but if AutoRun is disabled then go to the Start Menu, click on Run… and type d:\setup.exe (if d: is the letter of your CD drive).

To proceed with the installation follow the dialog boxes clicking *Next>* to move to the next step.

Figure 2.1 STP installation program

The setup program will install **STP** (the default folder is C:\Program Files\STP) and a Program folder will be created on the Start Menu.

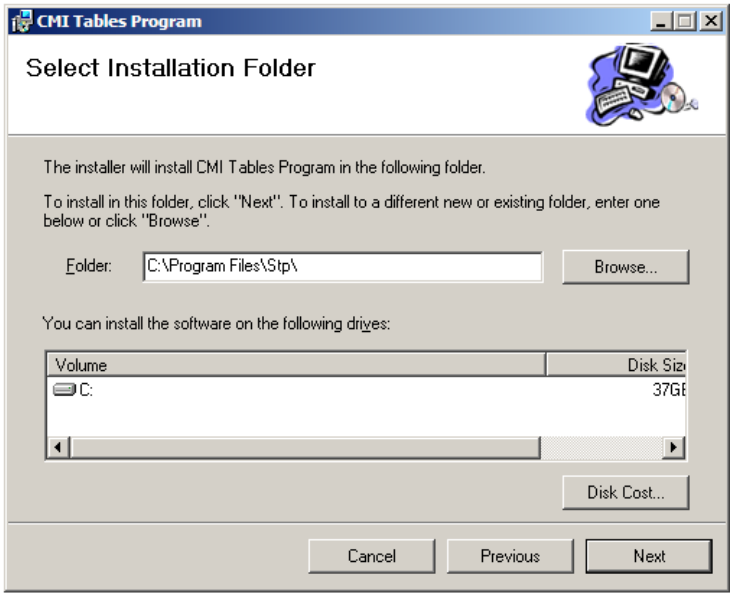


Figure 2.2 Choose program folder

Once the setup has finished copying files you may be prompted to restart your computer.

Setting the licence key

The first time you run **STP** you will be prompted to enter the licence key details that were supplied with the program. Enter these details exactly as printed into the boxes provided.

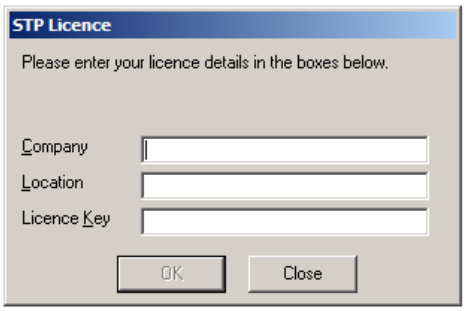


Figure 2.3 Setting the Licence

Installing STP on a network

As with some other Windows programs, **STP** installs all its files in the installation folder. It may not be possible to run the program directly from a network share.

Uninstalling STP

You can, if required, 'uninstall' the current version of **STP** from your machine.

The uninstall process will remove program components from the host machine including all .exe and .dll files. Any files you have created or saved with the program will be retained.

To uninstall **STP**, close the program. Double click on the Add/Remove programs icon from the Control Panel, select CMI Tables Program from the list and click Add/Remove.

Chapter Three

Forms, Libraries and Tables

Forms

A Form is **STP**'s building block. It contains the parameters that define one particular calculation request and can be thought of simply as a specification of one table in a book of actuarial tables. **STP** has its own naming convention for Forms though you can, of course, modify this. Note that the form name is restricted to 50 characters, so an auto-generated form name will be truncated if it is longer than this.

STP uses two types of Form, one for mortality calculations and another for PHI calculations. Once a Form has been created it can be stored in a Library. Both types of Form may be stored in the same Library.

Libraries

It is very likely that you will soon have generated a large number of Forms so, to make life more manageable, **STP** allows you to separate them into Libraries. Each Library is a separate file stored on disk. These files have a name with an extension ".stp". You may, for example, wish to have a Library for PA(90) Forms and another for A1967-70 Forms.

The program comes complete with the following Libraries, installed in the **STP** directory, which will reproduce the tables already published:

- The a(55) table for annuitants
- The A1967-70 table for assured lives
- The a(90) table for annuitants
- The PA(90) table for pensioners
- The FA1975-78 table for female assured lives
- The "80" Series tables of mortality
- The "92" Series tables of mortality
- The "00" Series tables of mortality

Tables

Tables are sets of q_x's, AIDS additions, mortality projections and PHI inception rates. **STP** is supplied with Tables for many of the tables published by the Continuous Mortality Investigation. These Tables include the AIDS tables published by the Institute and Faculty of Actuaries AIDS working party. They are stored in files with a ".tbl" extension, with one file containing a group of Tables all of which were published at the same time.

Using the New Table option on the File menu, users may add their own Tables to those supplied by the program. Each is stored in a separate file with a ".tbl" extension.

Chapter Four

Tutorial

This chapter is intended to provide a quick review of the program functions by taking you step-by-step through the production of one particular mortality Form. It only takes a few minutes to work through the example and it should familiarise you with the interface and the logic of the program.

Running STP

After installing the program, **STP** can be run by clicking once on the Start Menu, selecting Programs, CMI Tables Program and then on **STP**. You should see the main program window as below:

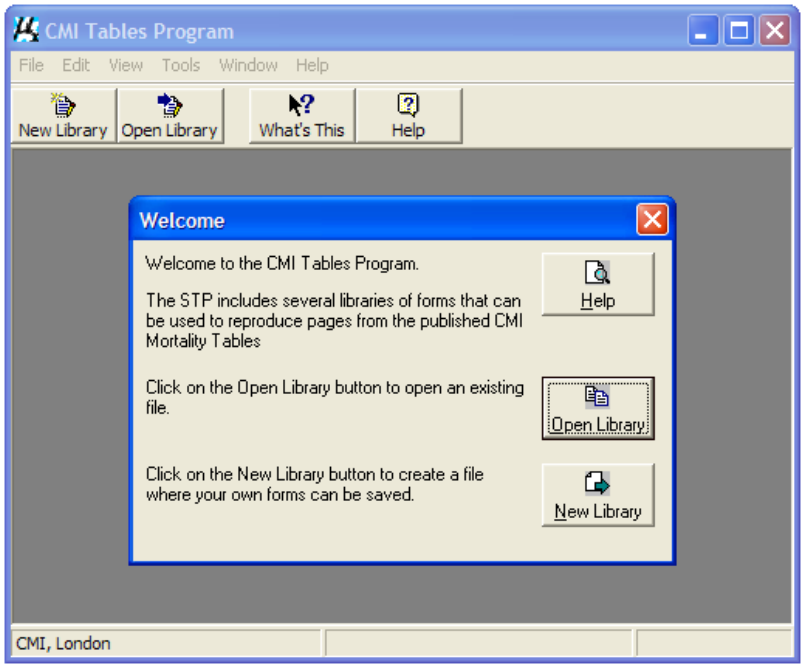


Figure 4.1 Starting STP for the first time

Loading a Library

The first step is to open a Library, as all Forms are contained within them. It is possible to create your own Libraries.

Click on Open Library to bring up a standard Windows file open box. Select one of the Libraries that came with **STP** (these are to be found in a Libraries folder under the directory that **STP** was installed in and have file extension .stp by default). Clicking on the open button will present a dialog box similar to the following:

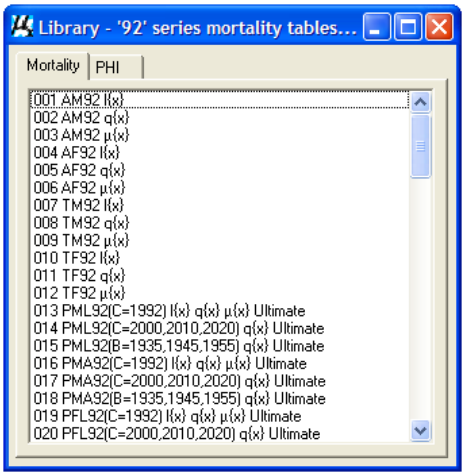
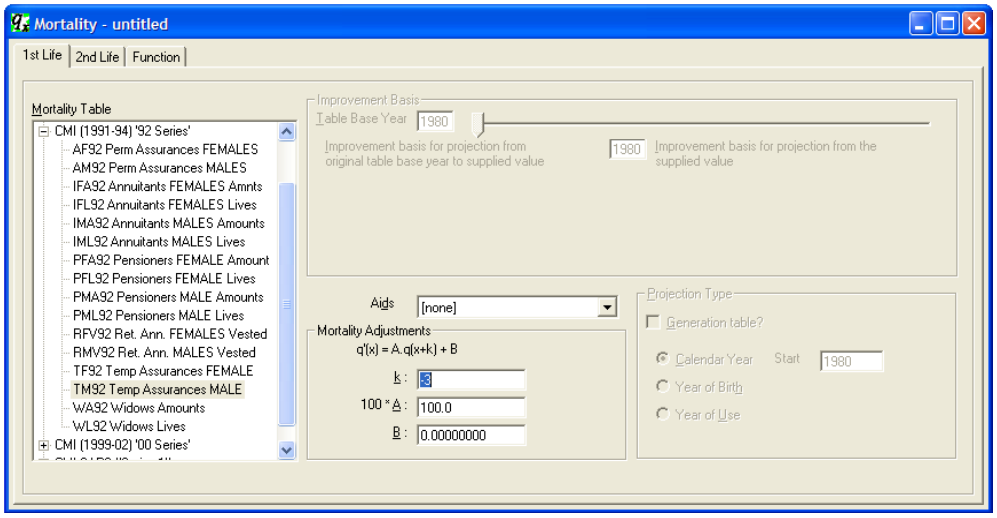


Figure 4.2 Library window

Setting up a Form

1. Select the New Form button. This displays the 1st Life screen as shown in Figure 4.3.
2. On the mortality table tree select CMI (1991-94) '92 Series' and then scroll down to "TM92 Temp Assurances MALE".
3. Move to Mortality Adjustments and set *k* to -3 by entering -3 in the text box.
4. Select [none] for the AIDS Table from the drop-down box.
5. We are going to ignore other adjustments to mortality and accept this window as it is. Your screen should look like the one shown in Figure 4.3.



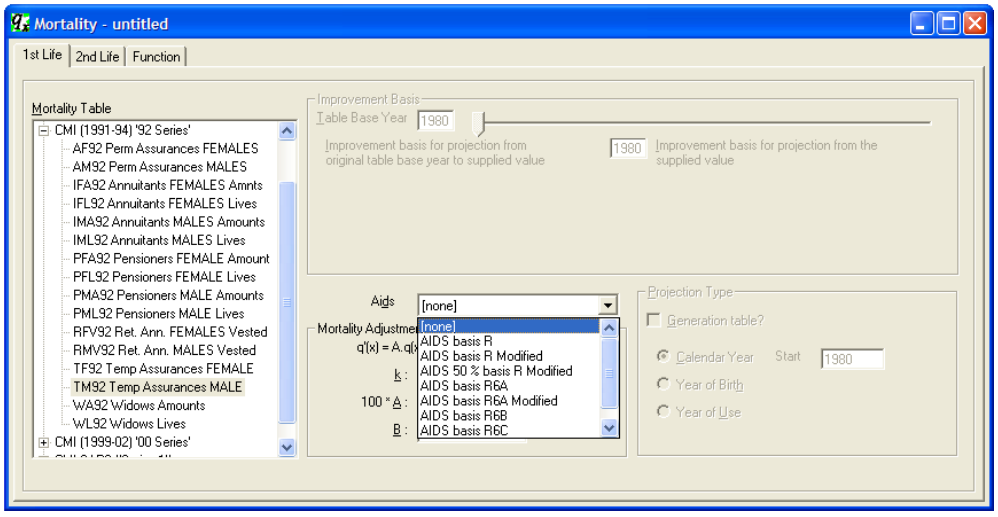


Figure 4.3 Mortality Form Design – 1st Life

6. Click on the 2nd Life tab and check the *Defined?* box at the top of the screen.
7. Select the Mortality Table "TF92 Temp Assurances FEMALE".
8. Select [none] for the AIDS adjustment.
9. As in 4) above set *k* to -3.
10. Click on the Function tab.
11. Select the function $A_{xy:\overline{n}\rceil}$.
12. Select the top Layout option using the option buttons.
13. Ignore the *x* range, *y* range and Select Duration options but select Term or Age Difference as "*x*+*n*" and enter 65 in the text box.
14. Move to Interest rate and set Start to 5, Stop to 6, and Step to 1.

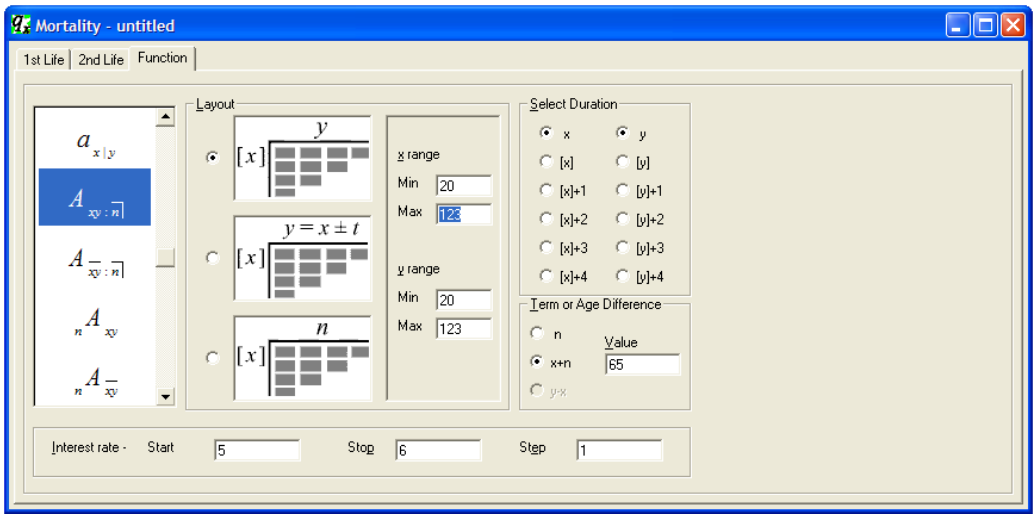


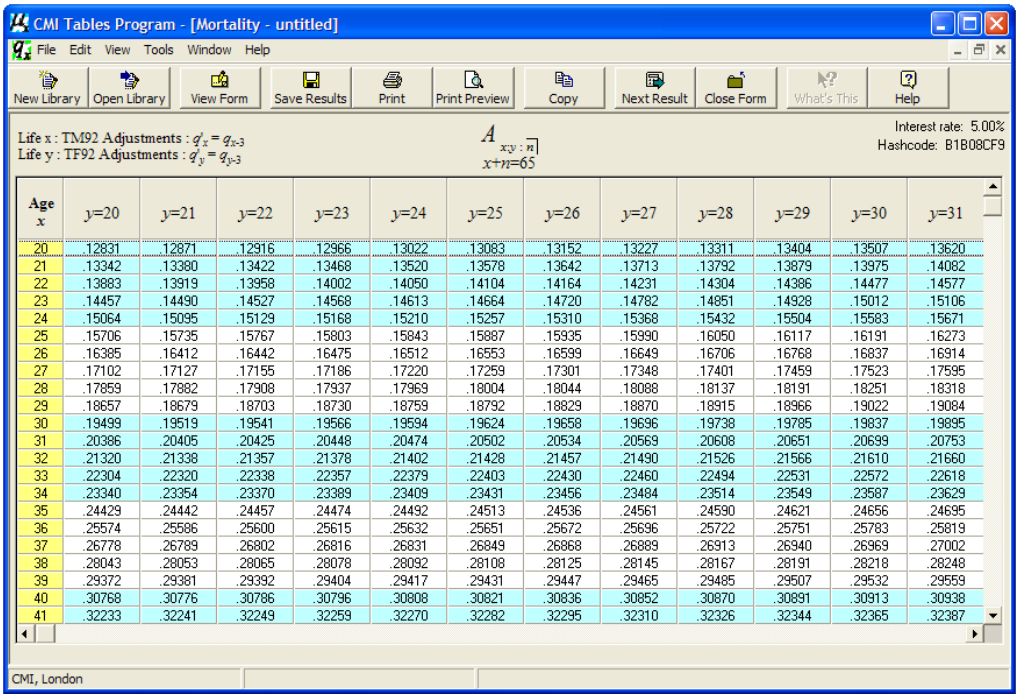
Figure 4.4 Mortality Form Design - Function

15. Your screen now looks like the one in Figure 4.4. Note that the maximum age of the *x* life and the *y* life is 123 even though the maximum age of the mortality table is 120. This is a result of the 3 year age reduction factor (*k* = -3), which was applied to the mortality table.

Calculating

Click on the View Results button on the toolbar. A progress bar will appear on the status bar to indicate the progress of the calculation. The time taken for the computation depends on the speed of your computer but it should be a matter of no more than a few seconds.

When the program has completed its calculation the following Results screen is displayed.



Age x	y=20	y=21	y=22	y=23	y=24	y=25	y=26	y=27	y=28	y=29	y=30	y=31
20	.12831	.12871	.12916	.12966	.13022	.13083	.13152	.13227	.13311	.13404	.13507	.13620
21	.13342	.13380	.13422	.13468	.13520	.13578	.13642	.13713	.13792	.13879	.13975	.14082
22	.13883	.13919	.13958	.14002	.14050	.14104	.14164	.14231	.14304	.14386	.14477	.14577
23	.14457	.14490	.14527	.14568	.14613	.14664	.14720	.14782	.14851	.14928	.15012	.15106
24	.15064	.15095	.15129	.15168	.15210	.15257	.15310	.15368	.15432	.15504	.15583	.15671
25	.15706	.15735	.15767	.15803	.15843	.15887	.15935	.15990	.16050	.16117	.16191	.16273
26	.16385	.16412	.16442	.16475	.16512	.16553	.16599	.16649	.16706	.16768	.16837	.16914
27	.17102	.17127	.17155	.17186	.17220	.17259	.17301	.17348	.17401	.17459	.17523	.17595
28	.17859	.17882	.17908	.17937	.17969	.18004	.18044	.18088	.18137	.18191	.18251	.18318
29	.18657	.18679	.18703	.18730	.18759	.18792	.18829	.18870	.18915	.18966	.19022	.19084
30	.19499	.19519	.19541	.19566	.19594	.19624	.19658	.19696	.19738	.19785	.19837	.19895
31	.20386	.20405	.20425	.20448	.20474	.20502	.20534	.20569	.20608	.20651	.20699	.20753
32	.21320	.21338	.21357	.21378	.21402	.21428	.21457	.21490	.21526	.21566	.21610	.21660
33	.22304	.22320	.22338	.22357	.22379	.22403	.22430	.22460	.22494	.22531	.22572	.22618
34	.23340	.23354	.23370	.23389	.23409	.23431	.23456	.23484	.23514	.23549	.23587	.23629
35	.24429	.24442	.24457	.24474	.24492	.24513	.24536	.24561	.24590	.24621	.24656	.24695
36	.25574	.25586	.25600	.25615	.25632	.25651	.25672	.25696	.25722	.25751	.25783	.25819
37	.26778	.26789	.26802	.26816	.26831	.26849	.26868	.26889	.26913	.26940	.26969	.27002
38	.28043	.28053	.28065	.28078	.28092	.28108	.28125	.28145	.28167	.28191	.28218	.28248
39	.29372	.29381	.29392	.29404	.29417	.29431	.29447	.29465	.29485	.29507	.29532	.29559
40	.30768	.30776	.30786	.30796	.30808	.30821	.30836	.30852	.30870	.30891	.30913	.30938
41	.32233	.32241	.32249	.32259	.32270	.32282	.32295	.32310	.32326	.32344	.32365	.32387

Figure 4.5 Results

You will see that only the calculation at 5% has been performed. Select the command button Next Result. **STP** now repeats the computation but with an interest rate of 6%. The Results window is again displayed but with the Next Result button greyed out, indicating that processing is complete.

Printing and saving your Table

You will have noted that the button bar changes as the screen changes. At this point you will see buttons for Print Preview, Print and Save Results. All these work in the familiar Windows way.

You may save the results of a calculation by operating the Save Results button. Again this will open the normal Windows save screen. You can control the format of the output by using the *Save as type*: drop down box.

Leaving STP

You have now computed a simple function using **STP** and may have printed or saved the output. Although this tour of the program has not introduced you to every available screen and command, it will, hopefully, have given you an idea as to how the program looks and how the calculations are performed.

Although it is recommended that you now continue your tour of the program by yourself, experimenting with each of the options, you can exit the program as follows.

1. Select the Exit option on the File command.
2. You will be presented with a warning message in the centre of the screen informing you that you have an unsaved Form - i.e. that you have not saved your Form to a Library. You do not want to save this one so select the command No and **STP** will exit.

Chapter Five

Using STP

STP uses the standard Windows interface and the experienced Windows user will find the way that the menus and buttons work is quite familiar. However, there are a number of underlying concepts and features that are particular to **STP** and need to be borne in mind when using the program. This chapter will describe these.

Button bars and the context of the current screen

Figure 5.1 Button Bar

Almost all of the features of **STP** are available via the Button Bar. This replicates options available from the tool bar menus but is more convenient to use since, unlike menu options, buttons require just one click to operate them. The buttons on the Button Bar are context sensitive and change as the screens displayed by **STP** change. Only the currently available main options will be displayed on the Button Bar. Greyed out Button Bar options are not available until some user action on the current screen makes their operation appropriate.

The available menu options also depend upon the program context.

Some menu items and buttons retain the same name in different contexts although their operation is different. However, in each case the operation will relate to the currently open window. An obvious example is *Close*. Less obvious are *Save* and *Save As*. When the active screen relates to a Form these will save that Form into the currently open Library. When the active screen displays results then the *Save* button will save the results into a file held on disk. In this case the user will be allowed to choose the file format. Another example is *Properties*. When the active screen is a Library list then this will give the properties of the Library. (Note that this allows you to change the Library description that appears in the title bar of each window.) When the active screen is a Table then the 'properties' relate to that.

Operations you can do on Forms listed in the Library window

A description of Forms, Libraries, and Tables was given in Chapter Three. The Tutorial in Chapter Four will already have given you an idea of how these concepts are used.

Right clicking on a Form (or several selected Forms) that are listed in the Library window will bring up a menu of operations you can select from. Each of these will act on the selected Forms.

Cut will copy the selected Form and then delete it.

Copy will copy the selected Form.

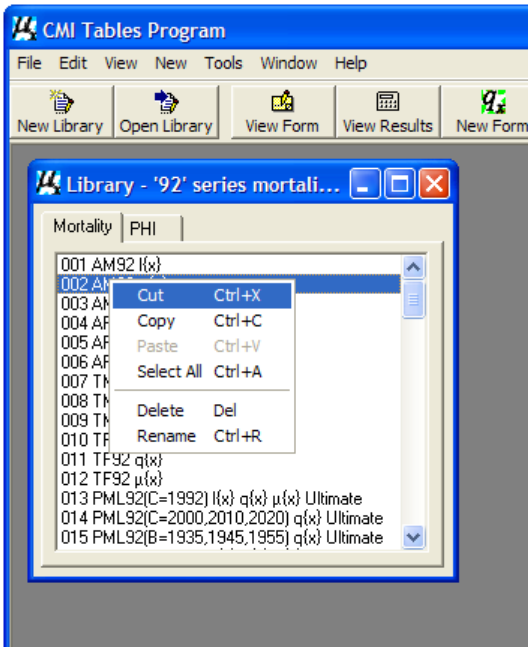


Figure 5.2 Right click on a form

Paste will paste the last Cut or Copied Form into the currently open Library. If a Form of the same name already exists then the new Form will be named "copy [X] of {original Form name}". Note that you can paste a Form into a different Library, not just the one it was copied from.

Select All will select all the Forms in a Library. This can be used in conjunction with various features of **STP** such as Batch Calculate, Delete, Copy and Paste.

Delete will delete the currently selected Forms.

Rename will allow you to rename the currently selected Form.

Other Form operations are available from the Button Bar. *View Form*, *View Results*, *Print Preview* and *Print* will all act on the currently highlighted Form. If more than one Form is highlighted then most of these buttons will be greyed out and the *View Results* button will change to *Batch Calc*. The operation of this button is described in the next section.

Batch processing

If you highlight more than one Form in a Library this option becomes available via the *Batch Calc* button. It allows the calculations defined in the highlighted Forms to be processed at one go with all the results being printed or saved to disk, as selected by the user on the option screen opened at the start of the process.

If you choose to save the results, **STP** will open the text file containing a description of the calculations performed in a Notepad window, when the calculations have been completed. This file will be stored in the same location as the results files and is a record of the calculations done. A description of this file is contained in Appendix B.

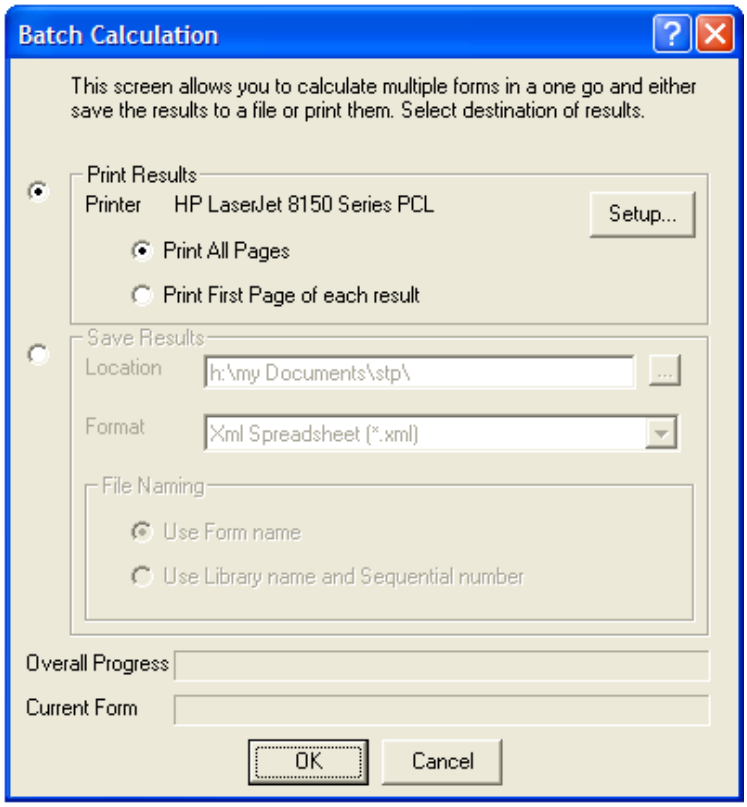


Figure 5.3 Batch processing

Naming forms

The program uses a linear notation to describe the functions calculated in a Form when saving the Form into a Library. This notation is also used for column headings in spreadsheets and other file types that cannot support standard actuarial notation. This notation is described in Appendix C.

Resizing columns on the results screen

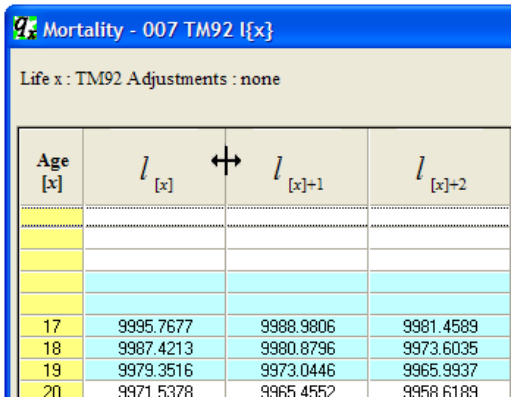


Figure 5.4 Resizing columns

You can alter the width of the columns on the results screen by placing the mouse cursor on the vertical line marking the edge of a column on the title bar and dragging. You will find that all columns containing function results will move simultaneously. Similarly, the widths of the two columns of ages will move together.

Saving results

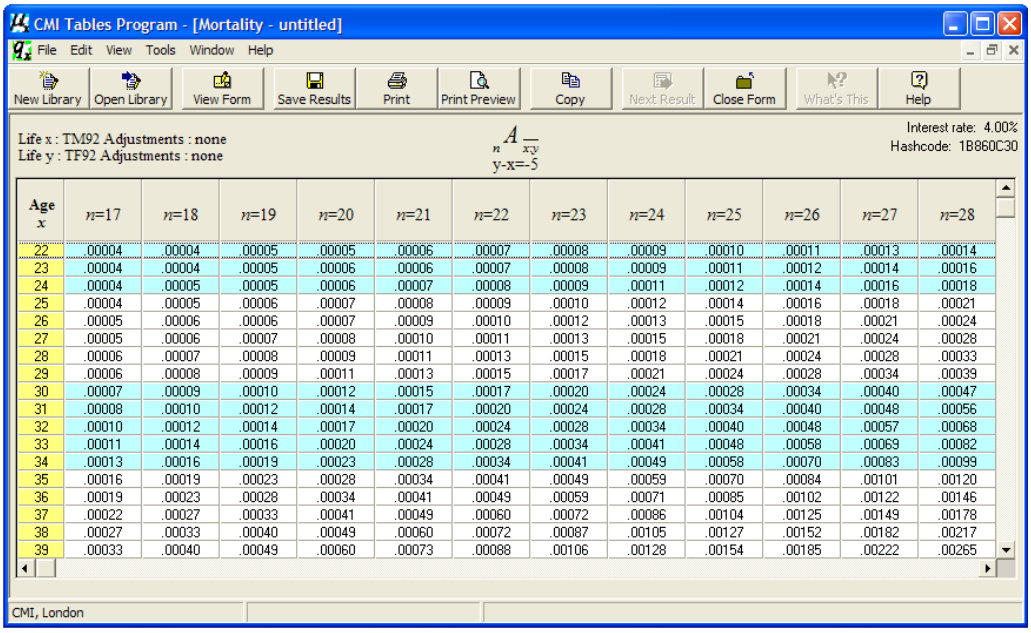


Figure 5.5 Results screen and button bar

After the program has performed a calculation and displayed the results screen you can save the results in three ways.

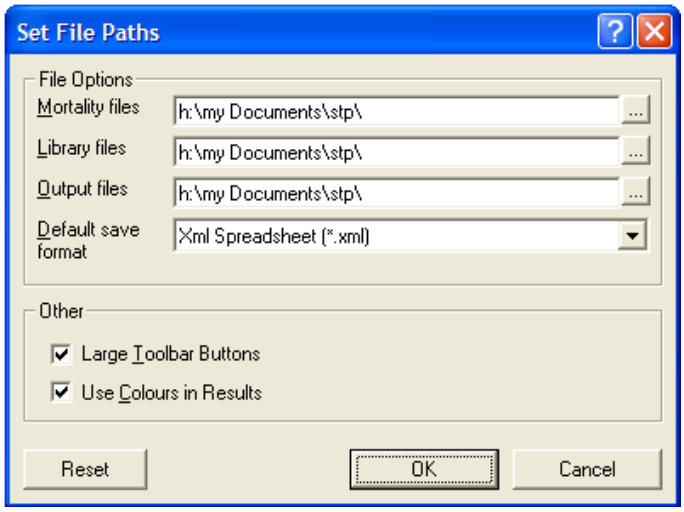
1. You can copy the results to the Windows clipboard using the *Copy* button. These results can be pasted into another Windows application where they can be used for further processing or manipulation. Note that care is required with this operation. For example, if you paste a large two-way table into a Word document then unpredictable effects can be produced as Word tries to split the document into pages.

2. Using the *Save* button you can store the results in a file on disk. The normal Windows Save As screen is used and the format of the file outputted can be specified. Care needs to be taken to choose a format that is appropriate for the application that the results are to be copied into.

3. The results can be printed. This can be done directly using the *Print* button or indirectly via the *Print Preview* button. Both of these options work in the familiar Windows way.

Program options

These are accessed via the Tools/Options menu.



This screen allows you to specify the default settings for **STP**.

Chapter Six

Mortality forms

1st Life tab

This allows you to select a mortality table for the first life. If you are going to calculate single-life functions this is the only mortality table you need select.

The options on the 1st Life tab are detailed below. The window is shown in Figure 6.1.

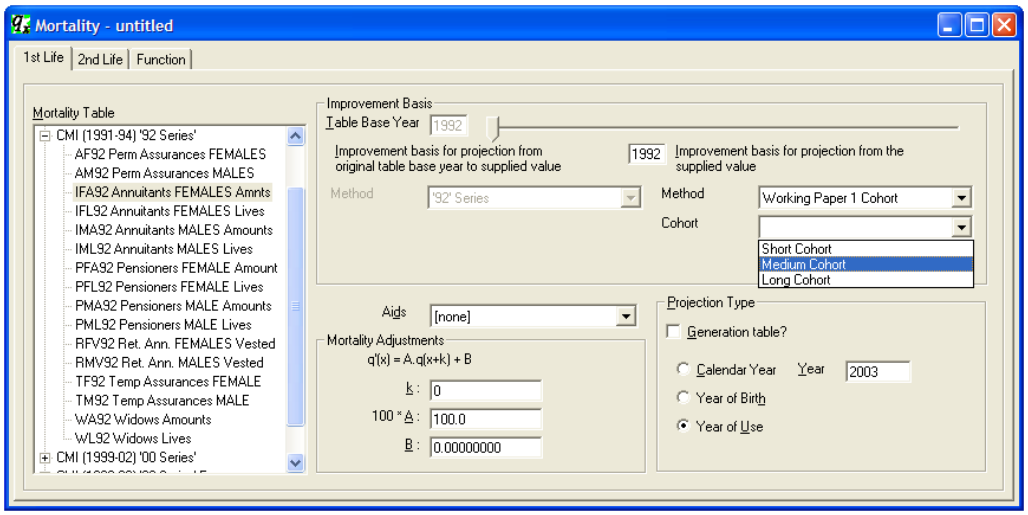


Figure 6.1 1st Life Tab

Mortality Table

This is a simple tree list. The options available in the Projection Type part of the screen vary, depending on the table chosen. You will see that these options change as you scroll up and down the list.

AIDS Table

This list box tabulates the available AIDS adjustment factors to be applied to the mortality table selected above.

The default option is [none]. This will make no adjustment to q_x. Selecting an AIDS table will enable the Projection Type field.

Mortality Adjustments

This text box allow you to specify modifications to the q_x's of the form

$$q_x^{modified} = \frac{A}{100} q_{x+k}^{table} + B$$

where

$q_x^{modified}$ is the new table of q_x

q_x^{table} is the base mortality table

k is an age adjustment which must be a whole number in the range -15 to +15

Warning: Careless choices of parameters A or B will cause the program to overflow. If A or B are chosen such that q_x falls outside the range 0 to 1 then you will be warned that this is happening and q_x will be restricted to the limits of this range.

The age adjustment k is applied after the base set of q_x has been loaded into the program. For example, if a projected Year of Birth table for 1935 is used with k=5 then the q_{25}^{modified} will be $q_{30}^{(B=1935)}$ not $q_{25}^{(B=1940)}$. The same is true for Calendar Year and Year of Use projections.

Projection Type

This field is made available when one or both of the following conditions apply. Firstly, the mortality table is one of the Annuitants, Pensioners or Widows/Dependants tables published in *C.M.I.R.* **10**, *C.M.I.R.* **13,** *C.M.I.R.* **17**, C.M.I. Working Paper 22/ *C.M.I.R.* **23** and C.M.I. Working Paper 35 where the values of q_x are projected to allow for mortality improvements in future years. Alternatively an AIDS table has been selected and the projection allows for the future variation in mortality.

C.M.I.R. **10**, section 4.4 starting on page 55, gives an explanation of the Calendar Year, Year of Birth and Year of Use projection types. An illustration of the differences between these methods is shown in Figure 6.2. This shows the double entry table of q_x with age down the left hand side and calendar year along the top.

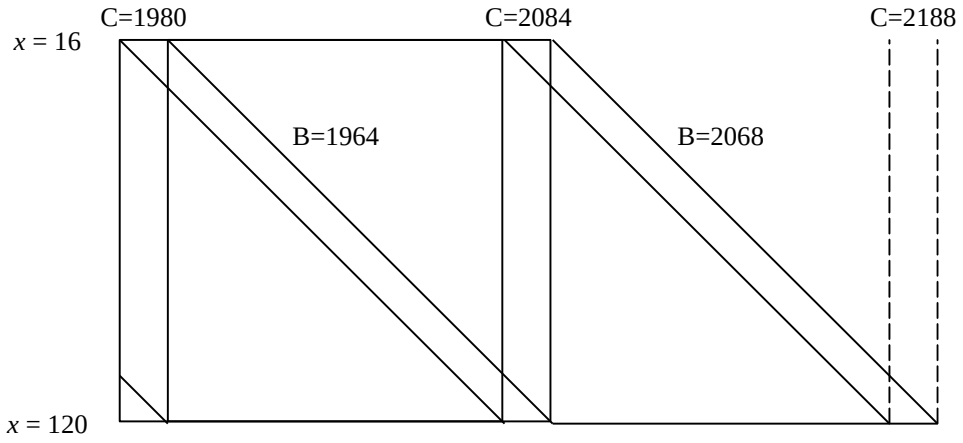


Figure 6.2 Projection Types

The Calendar Year method uses a set of q_x from one column in the table. You choose the year which specifies the column. The Year of Birth method uses a set of q_x from a diagonal. The first long diagonal shown in the diagram relates to lives born in 1964 who are thus aged 16 in 1980. Again you can choose the year appropriate for your needs. The Year of Use method allows you to choose a year from which each Year of Birth cohort is projected separately for each age in order to calculate functions at each age in that year. Thus if the Year of Use is 1980 then an annuity for age 16 is calculated from the set of q_x on the diagonal marked; for age 17 the diagonal starting at that age is used; and so on. This means that the calculation of Year of Use functions is much slower than for the other two types of projection. This is particularly true for joint life functions.

The permitted inputs for the Year parameter vary according to the table selected. For example for an "80" Series table, Year must be in the range 1980 to 2084 for Year of Use and Calendar Year and 1860 to 2068 for Year of Birth. If you choose a Year of Birth prior to 1964 functions can be calculated only from the age reached in 1980.

Thus, if Year of Birth 1940 is chosen, the youngest age at which functions can be calculated is 40. Similar restrictions apply to the "92" Series, "00" Series and SAPS "S1" tables, though of course relating to the year 1992, 2000 or 2002, respectively, rather than 1980.

Where a mortality table allows improvement factors to be applied and an AIDS table has been selected, then both projections will use the same method and year parameters.

Generation Table

When checked, this option will allow the tabulation of Mortality and Commutation functions based on cohorts of q_x for a range of Years. The range may cover Calendar Years or Years of Birth but not Years of Use. The range is specified by entering the lowest year in Start and the highest year in Stop. The Step field determines the intermediate years at which values are calculated. The Generation Table can only be applied to a limited range of single life functions so once this option has been checked then the second life will not be available.

Note: The definition of a mortality table as published by the Institute and Faculty of Actuaries is a set of q_x to a specified number of decimal places, even though a higher number of decimal places may have been calculated using the graduation formula. Even after adjustment or projection each q_x is rounded by **STP** to the relevant number of decimal places for that table. These values of q_x then form the starting point of each calculation.

Improvement Basis

For the "80" Series projected tables only the original "80" Series projection factors are available. For the "92" Series, "00" Series and SAPS "S1" projected tables, however, a choice of any of the projections contained in the CMI library of projections is available. Users are of course also able to create their own mortality improvement factors table (see *Chapter Eight – The Table Editor*).

The base values of q_x from the "80", "92" and "00" Series tables are assumed to apply from 1 July in the relevant year (e.g. values of q_x from the "92" Series tables give the probability that a life aged x on 1 July 1992 will die before attaining age x+1 on 1 July 1993). For the SAPS "S1" tables, the equivalent date is 1 September 2002. However, there is no distinction in the way **STP** applies projections to these tables. For example, the same 2002-2003 factors from a particular projection basis would be used to project a "92" Series table from 2002 to 2003 as would be used for a SAPS "S1" table.

The available projections for use with the "92" Series, "00" Series and SAPS "S1" projected tables have been organised into a hierarchical structure, and are selected by means of drop-down boxes. This is illustrated in the two figures below.

The base year of the selected mortality table is shown greyed out in the box at the top of the screen. However, you can specify another (later) year up to which one projection basis is used and after which another projection basis is used. This can be done by moving the slider or simply typing the required year in the box below the slider.

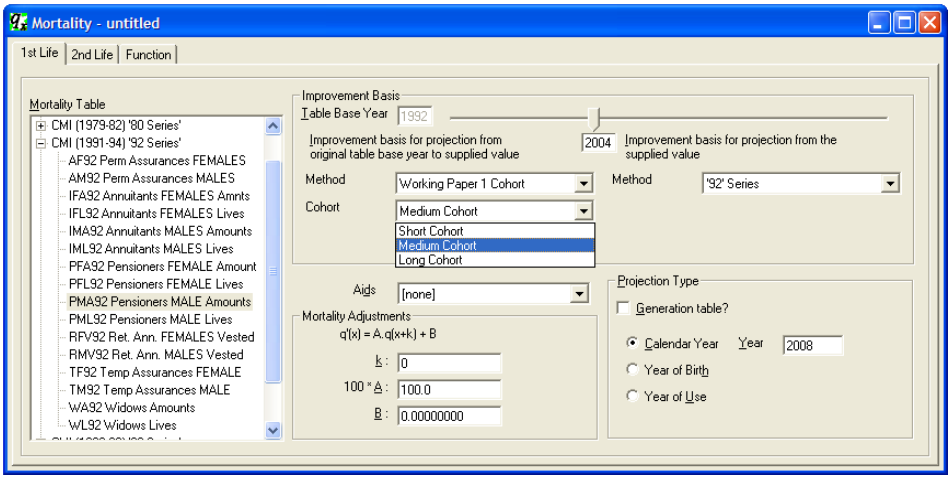


Figure 6.3 Improvement Basis up to chosen year

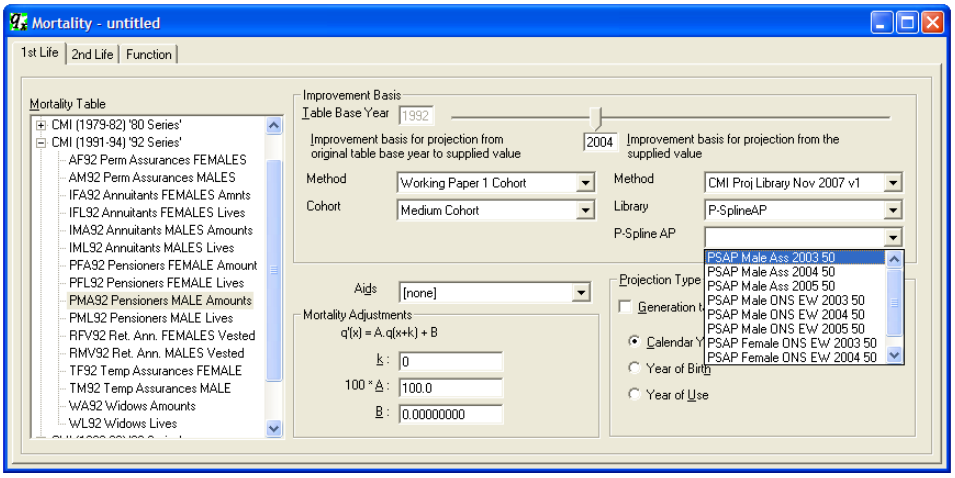


Figure 6.4 Improvement Basis after chosen year

If the supplied value is the same as the Table Base Year then only the right hand projection choice will be active.

The available projection bases, both before and after your supplied value, are summarised in the table below:

Method		
None		
"92" Series		
Working Paper 1 Cohort	**Cohort**	Short, Medium + Long Cohort
CMI Proj Library Nov 2007 v1	**Library**	
	Cohort	"92" Series and Cohort projections from Vol. 1 + all projections from Vol. 2
	ONS 2004	ONS 2004 projections from Vol. 1
	ONS 2006	ONS 2006 projections from Vol. 1
	P-Spline AP	All projections from Vol.3
	P-Spline AC	All projections from Vol.4
	Lee-Carter	All projections from Vol.5
CMI Proj Library v1.1	**Library v1.1**	All projections from Vol.6
CMI Proj Library v1.2	**Library v1.2**	All projections from Vol.7
CMI Proj Library v1.3	**Library v1.3**	All projections from Vol.8

Note that volumes 1 to 5 of the library each focus on projections derived from a particular source or model, whilst volumes 6 to 8 of the library contain projections from a mix of sources or models: ONS / National Population Projections, P-Spline AP, P-Spline AC, Lee-Carter, and the CMI Mortality Projections Model. See Chapter 10 for further details.

Note that **STP** does not have the facility to apply a floor to mortality projections, other than by choosing a projection basis from the Library that already contains a floor. However, it is possible for users to create their own mortality improvement factors (for example in a spreadsheet) and then to import them for use within **STP** (see *Chapter Eight – The Table Editor* for more details).

2nd Life tab

As above. No second life is available if Generation Table has been checked in the first life.

Function tab

This option allows you to select the functions which you want tabulated in your Form. This is the most complex of the screens you are likely to encounter and each of its options is detailed below. An example of the Function Select is shown in Figure 6.5.

Function

This list box tabulates the available functions.

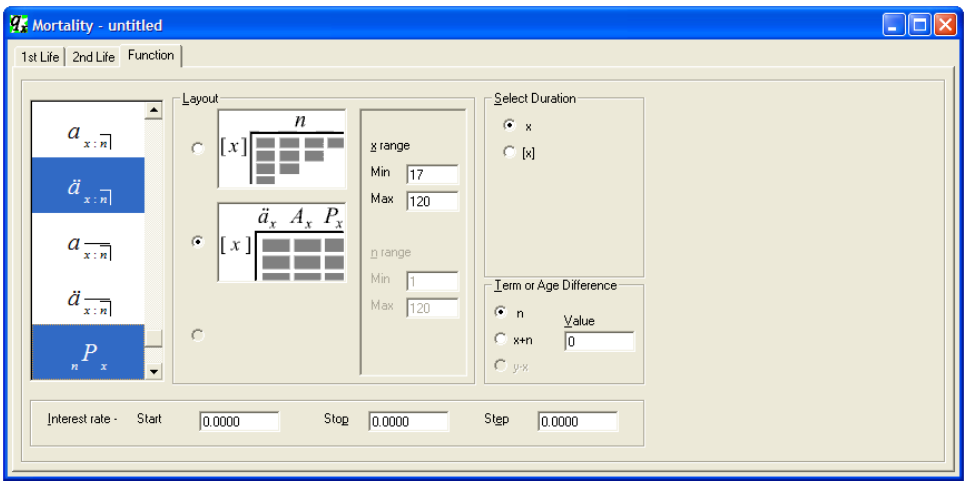


Figure 6.5 Function Selection

Some of the functions can be grouped together for printing purposes in order to reproduce the pages of previously published tables. Select functions are highlighted. Whether or not other functions are highlighted depends on the layout (see below) as well as the selected functions.

Layout

This field determines the appearance of your **STP** output. If you have selected the function l_x for A1967-70(5), say, then you have two presentation options:-

l_x at each of its select durations,

l_x, q_x and μ_x each at one select duration.

In the case of temporary joint-life functions, this option gives you great scope for reducing the volume of your output by printing the results in an order convenient to you. The options you are offered will include one or more of those shown in Figure 6.6.

This field should be considered in conjunction with the next two fields, the options for which you will see changing as you move the layout option button.

Try experimenting with a few combinations to familiarise yourself with the logic of this screen.

The two range fields allow the calculation of the function to be restricted to a small portion of the full table. If only a few values are required then suitable modification to these fields can reduce the calculation time considerably. The x range defines the Minimum and Maximum ages over which the function will be calculated. This is available for all Layout Types. The second range field limits the number of columns tabulated for layouts of Type 3 and 5 again by entering a Minimum and Maximum value.

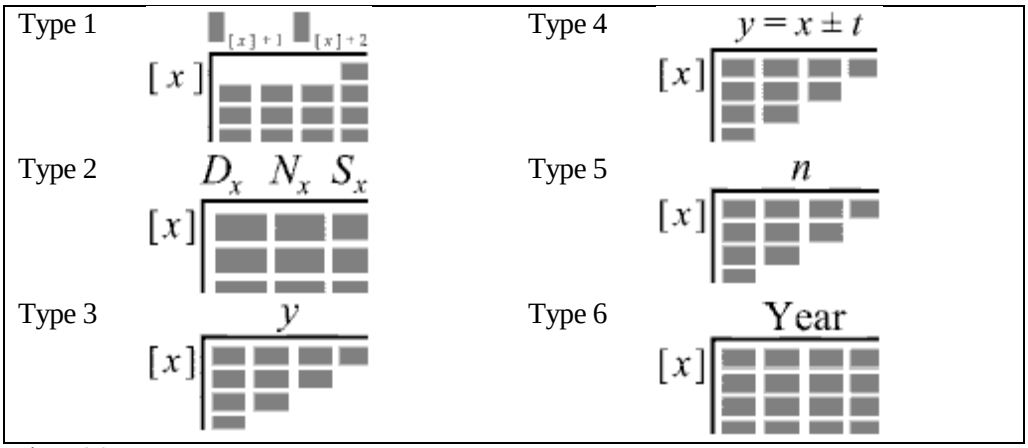


Figure 6.6 Layout Types

Select Duration

The select duration is represented by two columns of option buttons; one if you are tabulating single-life functions.

( ) x	( ) y
( )[x]	( )[y]
( )[x]+1	( )[y]+1
.	.
.	.
.	.

The number of durations in the first column is controlled by the select period of the mortality table. The number of durations for the second life is also the select period of its mortality table, or that of the first life if less.

Let the select periods of the two mortality tables be s_1 and s_2 and the select durations chosen for the calculations be d_1 and d_2. You may choose ultimate mortality for one table and the other table may be ultimate or any of its select durations. However, if select mortality is chosen for both tables, then the select durations, d_1 and d_2, must be equal. For example if $s_1 > s_2$ and $d_1 > s_2$ then only ultimate mortality is available for the second table.

Term or Age Difference

Where a temporary function has been selected, this field determines the unspecified parameter. This will usually be the term n of the function, fixing either n or $x + n$. If, however, a Type 5 layout (see Figure 6.6) has been selected, then the unspecified parameter is the difference $y - x$ between the ages of the two lives.

Interest rate

Here you may enter the rate, or range of rates, of interest that you wish tabulated.

For a single interest rate select the Start field and enter your chosen rate.

For a range of rates enter the lowest rate in the Start field and the highest in Stop field. The Step field determines the intermediate rates at which calculations are made.

Chapter Seven

PHI (Income Protection) Forms

STP produces two types of output for PHI functions. (While this type of business is now more commonly known as Income Protection (IP), **STP** currently retains the PHI terminology.) The first details current claim annuity values. The second shows inception rates and current claim annuity values in a format which will allow the consideration of pricing issues and is called "pricing function" output.

Please note that the notation used by **STP** for PHI functions is described in a separate section starting on page 39.

The Annuity tab

Having loaded a PHI Form from a Library or asked to create a new PHI Form via the New PHI Form you are presented with the screen shown below.

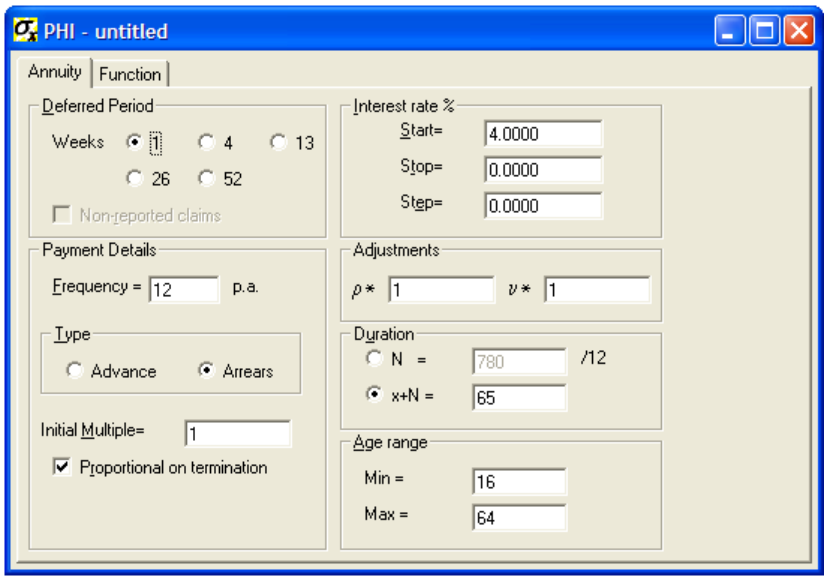


Figure 7.1 Current Claim Annuity Basis

This contains the inputs required to specify the basis for the current claim annuities calculated by **STP**. These annuity values form part of either of the two output formats, whichever is to be chosen.

Deferred Period

- This selects both the deferred period used in the calculations and the graduation formula used to calculate $p_{x,z}^{\overline{SS}}$.

Non-reported claims

- **STP** calculates annuity values using the graduation formulae derived from the sickness experience described in *C.M.I.R.* **12**. Page 27 (Section 3.3) of that report describes "run-in" periods for recovery rates for the D4, D13 and D26 investigations. During this run-in period, the recovery rates start low and increase to join the D1 rates.

One possible reason for the run-in feature is that those who are sick but close to recovery at the end of the deferred period do not tend to claim. These cases are called "non-reported".

You may not wish to assume that your experience follows that of *C.M.I.R.* **12** in this respect. As an alternative, **STP** will not use the "run-in" part of the graduation formula but instead use the D1 values. This results in lower annuity values. You can choose this alternative by checking the Non-reported claims box.

You will not be able to check this box for either D1 or D52. The D1 graduation did not have the run-in feature. The D52 graduation is taken to be the same as the D26 graduation but starting 26 weeks later and picks up values after the run-in period has expired. Figure 7.2 illustrates the way these graduations all run into the D1 rates.

Illustration of recovery rate for different deferred periods for a single age at the start of sickness

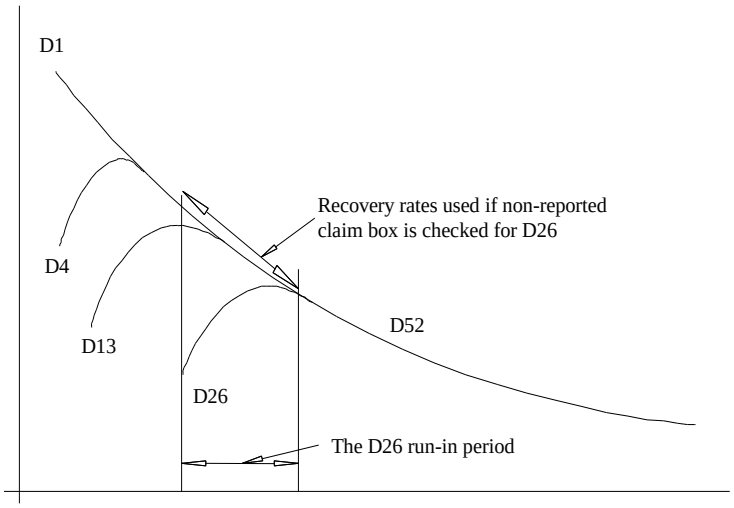


Figure 7.2 Recovery Rates

Interest rate

- Here you may enter the rate, or range of rates, of interest that you wish tabulated.
- For a single interest rate select the Start field and enter your chosen rate.
- For a range of rates enter the lowest rate in the Start field and the highest in the Stop field. The Step field determines the intermediate rates at which calculations are made.

Adjustments

Loosely expressed, **STP** calculates values of $p^{\overline{ss}} = \exp\{-\int(\alpha\rho_y + \beta\nu_y)\,\mathrm{d}\,y\}$ where ρ_y is the recovery intensity and ν_y is the mortality intensity. See *C.M.I.R.* **12** Part A.

Using the *Adjustment* input fields you may enter values for α and β. These values cannot be negative. The default values are 1. The maximum value permitted for both α and β is 10.

Payment Details

- The *Frequency* field allows you to specify the number of annuity payments per annum. This must be an integer between 1 and 500.
- The *Type* option allows you to specify that annuity values are to be calculated as payable in advance or in arrears.
- For each annuity value calculated the *Initial Multiple* text box allows you to specify a factor which is applied to the amount of the first annuity payment. This facility has been included so that, for example, if you choose to print values at durations which do not coincide with an annuity payment you can force the total remaining annuity payments to equate to the outstanding term of the annuity.
- Checking the *Proportional On Termination* box allows you to specify that a proportional annuity payment should be made on the death or recovery of the annuitant.

Note that *Proportional On Termination* cannot be set if the annuity is payable in advance. Note also the comments in the section on Duration Adjustments on page 37 concerning final proportion.

Duration

- Using this option you can choose between annuities that are payable for a fixed duration or payable to a particular age.
- If a fixed duration is chosen this starts from the end of the deferred period and continues for a defined number of annuity payments. This number must be entered into the text box next to the appropriate option button. If you have already chosen, say, 12 payments per annum "/12" will be displayed at the end of this field to remind you that you must input the duration in months. The term chosen can be any number of annuity payments. You are not restricted to durations which are an exact number of years.
- If a particular final age is chosen then you must enter this age in the field next to the "$x + N$" button. Note that the age definition used is exact age at the end of the deferred period. This means that the term of the annuity from the end of the deferred period to the terminal age is an exact number of years. If the annuity is payable in arrears then the last payment will occur at the terminal age. However, if the annuity is payable in advance the last payment will be that due $1/f$ before the terminal age where f is the frequency of payment .

Age range

Here you can set the age range of the functions to be printed. Obviously the minimum age cannot exceed the maximum age. If a fixed annuity term, N, has been chosen then the maximum age is limited to $65 - N$ and no calculations will be possible for older ages. If you require the part of the table relating to these older ages to be calculated, carry out a second calculation with *Duration* set to "$x + N = 65$". Set the minimum age to $65 - N + 1$ and the maximum age to 64.

Function tab

Choose PHI Function

- This screen starts by presenting two choices of functions to output.
- If you choose Current Claim Annuity the output will be a two way table of annuity values. In this case you use the rest of the screen to control the columns to be printed.
- If you choose Pricing Functions you will be presented with a screen which will allow you to set the basis applicable to the calculation in the period before any morbidity benefit vests. The output format for this function is fixed. See page 40 for a description of this output format.

Current Claim Annuity

If this option is chosen then a screen similar to the following one will appear.

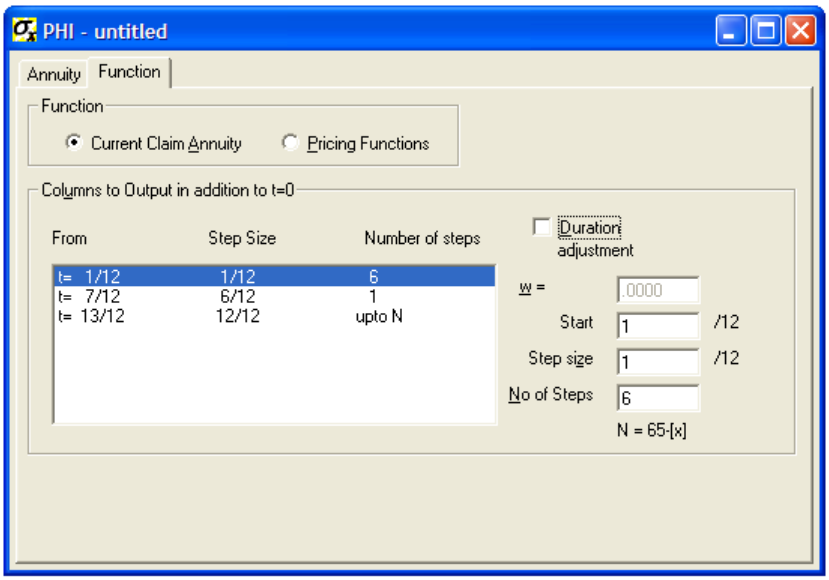


Figure 7.3 Current Claim Annuity Printing

To aid explanation, the scroll box in Figure 7.3 has information displayed in it. In a new Form, the scroll box would have only one line completed. Information shown in this box details durations at which annuity values will be displayed and printed. All durations are measured from the end of the deferred period. Each line in the scroll box represents a group of columns of output. The *From* value shows the duration of the first column to output. The *Step Size* shows the duration increments between columns and the *No of Steps* shows the number of columns in the group. Each succeeding line deals with the next group of columns. If the *No of Steps* says *upto N* then the group continues to the end of the table. In all output you will always get a column for duration $t = 0$. Thus, the first column defined in the first group will be the second column to be output.

You can edit each line in the scroll box. First highlight the required line using the cursor keys or by clicking with the mouse. The values that may be changed are shown in the edit fields to the right of the scroll box. Click on the field you wish to alter and change the value in the normal way. You cannot change the start value of groups other than the first, since these are defined by previous inputs. The step size must be a multiple of the chosen annuity frequency. You will be reminded of this since "/*f*" will be displayed to

the right of the input field, *f* being the number of annuity payments per annum. The last edit field is the number of steps in the group.

You can add lines at the end of the list by putting a number in the *No of Steps* field instead of the words *upto N*. The line being edited is immediately changed and **STP** adds a new line at the end of the list. You will notice that the ↓ and the ↑ direction keys work in the scroll box even though a different edit field may be active. In this case pressing the DEL key will work in the active edit field. If you press SHIFT TAB or click with the mouse you can move the edit cursor into the scroll box. Now pressing the DEL key will delete a line. You will be asked for confirmation of your request.

Duration adjustment

This adjustment is represented by *w* and is used to produce annuity values at durations that do not coincide with an annuity payment. If a *Duration adjustment* is required then you must check the *Duration adjustment* box and specify the size of *w*. This is expressed as a fraction of a payment interval. An immediate payment is signified by 0, whereas 1 specifies that the first payment is a month or a week away depending on the annuity frequency, which is represented by *f*. Setting *w* will ask **STP** to calculate

$$v^{j} \cdot {}_{j}p^{\overline{ss}}_{[x]+t-j,\,d+t-j} \cdot \ddot{a}^{\overline{ss}(f)}_{[x]+t,\,t+d:\overline{N}|} \qquad \text{for annuities in advance}$$

or

$$v^{j} \cdot {}_{j}p^{\overline{ss}}_{[x]+t-j,\,d+t-j} \cdot \left(\tfrac{1}{f} + a^{\overline{ss}(f)}_{[x]+t,\,t+d:\overline{N}|}\right) \qquad \text{for annuities in arrears}$$

where $j = w/f$.

Note that **STP** will not allow an initial delay to be applied to the first output column where $t = 0$.

- A complication arises if you set *w* and have already specified that final proportion is to be paid on recovery or death. Remember that you can only specify final proportion if the annuity is payable in arrears. In this situation **STP** will calculate the value of the benefit payable on death or recovery during the period *w*.
- The *Initial Multiple* if set, will apply to this proportional payment. If you need to make an assumption about the timing or size of this payment which is different to that used above you may be able to use the *Initial Multiple* to adjust the annuity value.

Pricing Functions

If you choose this option **STP** will produce an output consisting of $a^{HS}_{x:n\rceil}$ (see *C.M.I.R.* **12** Part F, formulae (30), (31) and (32) as modified by the errata shown in *C.M.I.R.* **13**, page 132) together with information allowing you to reproduce these values. This information is presented in columns and may also be used in profit test calculations. This output is described on page 40 of this manual.

The inputs shown on the screen below allow you to specify the calculation basis applicable before sickness benefits become payable. The basis after the benefits vest has already been input on the previous screen.

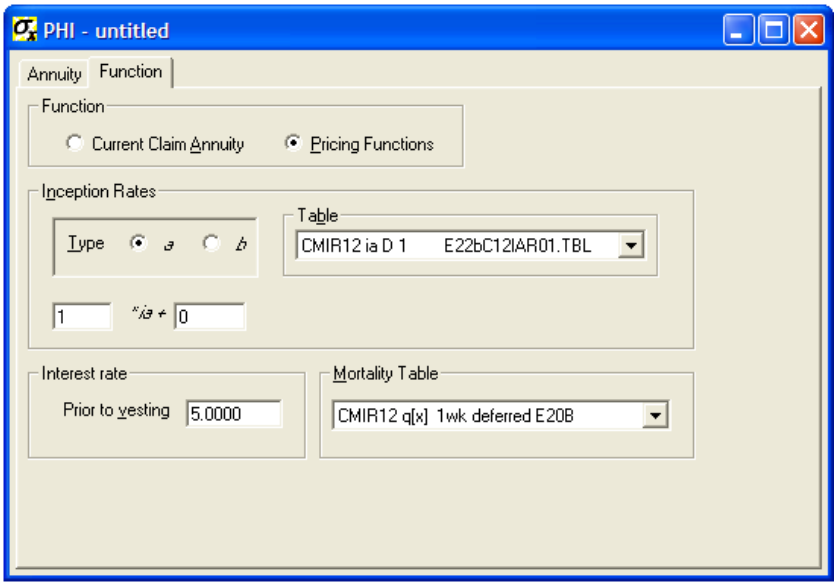


Figure 7.4 Pricing Functions - The basis prior to vesting

Inception Rates

- Start by choosing between type (a) and type (b) inception rates. See *C.M.I.R.* **12** Part E, Section 5.1, page 104 for the formal definitions of these inception rates.

  Type (a) inception rates relate to claims where sickness commences between ages $x - d$ and $x + 1 - d$. On average, the end of the deferred period occurs at age $x + ½$. Type (b) inception rates relate to claims where sickness commences between age x and $x + 1$. On average, the end of the deferred period occurs at age $x + d + ½$.

- Having specified the deferred period (on the previous screen) and inception rate type you will be able to choose between appropriate inception rate tables. This is done via the pop-up scroll box which opens when you click on the arrow in the *Table* box.

- Lastly, you may specify an adjustment to the inception rates of the form $ia'(x,d) = A.\ ia(x,d) + B$ or $ib'(x,d) = A.\ ib(x,d) + B$ where you may input A and B.

Interest rate

Here you may specify the interest rate to be used prior to vesting. Only one rate can be input. If several interest rates were specified for the current claim annuities **STP** will produce output for each of these interest rates with the interest rate prior to vesting remaining constant at the value set.

Mortality Table

This pop-up scroll box allows you to select from all the tables available to **STP**. There is no restriction requiring the select periods of the inception rate tables and the mortality tables to match.

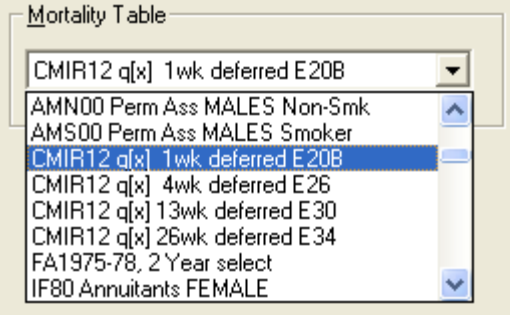


Figure 7.5 Pricing functions - Selecting a mortality table

Although you may select any mortality table (including your own) it is recommended that you use the appropriate *C.M.I.R.* **12** table since this is consistent with the inception rates, recovery intensities and mortality intensities derived from that model and used in other parts of the calculation.

Notation

The notation used by **STP** for PHI functions is that used by *C.M.I.R.* **12** parts D and F. Thus $a^{\overline{ss}}_{[x]+t,t+d:\overline{65-[x]|}}$ is used to denote the present value of an annuity payable annually in arrears to an individual who is currently exact age $[x]+t$ and sick, and has been continuously sick for a duration t since the end of the deferred period. The annuity ceases at age 65 or on earlier recovery or death. $[x]$ denotes the age of the annuitant at the end of the deferred period and `N=` defines the term of the annuity measured from that age. Thus, if the original term was fixed at 20 years $a^{\overline{ss}}_{[x]+t,t+d:\overline{20|}}$ would be used. For values of N which are not fixed this can be generalised to $a^{\overline{ss}}_{[x]+t,t+d:\overline{N|}}$. Comparing with the notation used in *C.M.I.R.* **12** part D, Section 7, page 91 we have

$$a^{\overline{ss}}_{x+t,t+d:\overline{65-x-t|}} = \sum_{h=1}^{65-x-t} v^h \, {}_h p^{\overline{ss}}_{x+t,t+d}$$

where d is the length of the deferred period and ${}_h p^{\overline{ss}}_{x,z}$ is the probability of being continuously sick from age x to age $x+h$, given that at age x the individual was sick with duration z from the start of sickness.

The tables produced show annuity values at durations which are chosen by the user. In order to keep the amount of calculation (and hence computing time) within reasonable bounds the definitions of age and duration used by **STP** are such that succeeding annuity values, for a given starting age, can be calculated from the same vector of values of ${}_h p^{\overline{ss}}_{x,z}$.

Annuities can be specified as payable in advance or in arrear and values can be calculated for any frequency f of payment which is an integral multiple of a year. Thus monthly can be taken as 1/12th and weekly as 1/52nd of a year. The notation is $a^{\overline{ss}(f)}_{[x]+t,t+d:\overline{N|}}$ if the annuity is payable in arrears; if the annuity is payable in advance $\ddot{a}^{\overline{ss}(f)}_{[x]+t,t+d:\overline{N|}}$ is used.

Current Claim Annuity output

This output follows the conventions used for the output of mortality tables by **STP**. The purpose of the output is to provide current claim annuity values to allow the valuation of PHI claims in payment.

The output is a two way table with values depending on age at commencement of payment of a claim (that is, at the end of the deferred period) and the duration of the claim.

If the annuity values are to be calculated to a particular age (e.g. 65) then the form of the output is as shown in Appendix D. Here values are read along a row and then down the last column. It is a feature of the *C.M.I.R.* **12** graduations that once a claim is 5 years old then the value of $p^{\overline{SS}}$ (and hence $a^{\overline{SS}}$) depends only on attained age.

If the annuity values are to be calculated for a fixed term then the convenience of the last column applying for all ages is lost and the table produced extends to include columns for every duration that you have asked to be printed.

The second Current Claim Annuity sample in Appendix D shows the output produced if a duration adjustment has been specified. Here you will see that the column headings have changed to denote the exact duration applicable to each column. Note that in this case the age applicable to the last column is also modified.

Pricing Functions output

The purpose of this output is to allow you to consider the pricing of PHI contracts.

The intention is

1. to present mortality rates, claim inception rates and current claim annuity values which are consistent, one with another, in terms of age and duration and deferred period, and
2. to present this information in a way which is conducive to further manipulation by the user so that a particular problem can be addressed.

In order to accomplish 2. above it is expected that the major use of the output will be as input to spreadsheet or other programs available to the user. For this reason this output, as is the case with all **STP** tables, can be directed to a spreadsheet or a text file held on disk.

Given the purpose of this output, its format is different to other tables produced by **STP** with the tables being accessed along diagonals (rather than rows) as the select period increases. In this way most of the components of the calculation that the user may wish to do for each succeeding age can be picked up from succeeding rows. As an example of the type of calculation that can be performed the last column of output gives values of $a^{HS}_{x,d:\overline{n}\rceil}$ which have been derived from the other columns in the table.

Two examples of the pricing function output produced by **STP** are shown in Appendix D. They use type (a) and type (b) inception rates respectively. The output heading is divided into two boxes which summarise the inputs you made on the two PHI basis screens.

The first column is $[x] + t$. $[x]$ is the exact age at the commencement of the risk. t is the duration and varies for each column. The appropriate value of t is specified in the column heading. Each column or group of columns is described below.

- $l_{[x]}$

This is the select value of $l_{[x]}$ for the chosen mortality table. In terms of the left hand age column, $t = 0$.

- $L_{[x]+t}$

This function is based on the chosen mortality table with

$$L_{[x]+t} = \frac{l_{[x]+t} + l_{[x]+t+1}}{2}$$

- $ia_{[x]+t}$ or $ib_{[x]+t}$

These are the type (a) or type (b) inception rates for lives aged $[x]$ at the commencement of risk and have been at risk for a duration t. In each case these rates are used in conjunction with an $\frac{L_{[x]+t}}{l_{[x]}}$ factor. For type (a) rates the average age at the end of the deferred period (i.e. the start of the claim) is assumed to be $[x]+t+½$. For type (b) rates the average age is assumed to be $[x]+t+d+½$.

- $a^{2}_{x,N}$, $a^{1,2}_{x,N}$ and $a^{2,1}_{x,N}$

These columns correspond to $\bar{a}^{2}_{x,d:\overline{n}\rceil}$, $\bar{a}^{1,2}_{x,d:\overline{n}\rceil}$ and $\bar{a}^{2,1}_{x,d:\overline{n}\rceil}$. They are described in formulae numbered (23), (24) and (25) on pages 243 and 246 of *C.M.I.R.* **12**. However, the functions produced by **STP** are not continuous.

- $a^{HS}_{x,N}$

This column gives values of $a^{HS(d/all)}_{x,d:\overline{n}\rceil}$.

For type (a) inception rates the formula used is

$$v^{(1+d)/2} \cdot \frac{L_{[x]}}{l_{[x]}} \cdot ia_{[x]} \cdot a^{2}_{x,n}$$
$$+ \sum_{t=1}^{n-1} v^{t+½} \cdot \frac{L_{[x]+t}}{l_{[x]}} \cdot ia_{[x]+t} \cdot a^{1,2}_{x+t,N}$$

where n = the terminating age – $[x]$
$N = n – [x + t]$

For type (b) inception rates the formula used is

$$\sum_{t=0}^{n-2} v^{t+d+½} \cdot \frac{L_{[x]+t}}{l_{[x]}} \cdot ib_{[x]+t} \cdot a^{2,1}_{x+t,N}$$
$$+ v^{n-1+\frac{(1+d)}{2}} \cdot \frac{L_{[x]+n-1}}{l_{[x]}} \cdot ib_{[x]+n-1} \cdot a^{2}_{x+n-1,n}$$

These two formulae are equivalent to those shown on page 251 of *C.M.I.R.* **12** which are numbered (30) and (31). Note that the $(1 - d)$ term that appears in the second part of formula (31) does not appear above since the adjustment is made by **STP** in the calculation of $ib_{[x]+n-1}$.

Chapter Eight

The Table Editor

The table editor will allow you to input or amend mortality tables, tables of AIDS adjustments, PHI inception rate tables and tables of mortality improvement factors. The table editor is accessed from the File menu. The *File/New Table* ... command allows you to create a new Table.

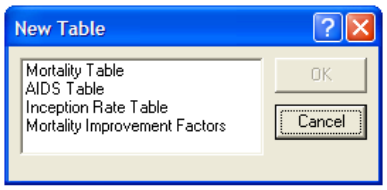


Figure 8.1 The table editor opening screen, showing the choice of tables

Clicking on this option will open the screen shown above. You can then choose between creating a mortality Table, an AIDS Table, a (PHI) inception rate Table or a mortality improvement factor Table.

For each of the Table types you must complete some preliminary information, which details the Table type and some of its control parameters.

Creating a new mortality Table

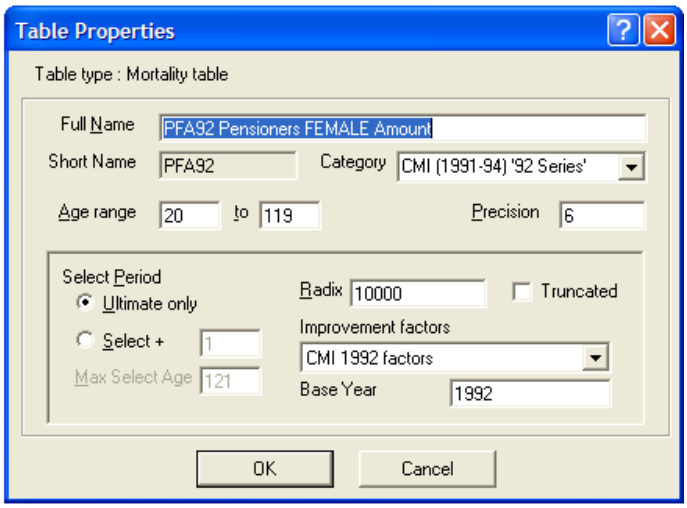


Figure 8.2 Mortality Table Properties

Full Name

This screen starts with the *Full Name* field in which you may enter text (up to 58 characters long) to describe the Table. This description will appear in the list tree of mortality tables, which is seen on the mortality Form. An example is "AM92 Perm Assurances MALES".

Short Name

This field is completed with an abbreviated Table name (up to 8 characters long), which is used as the default for the file name in which the Table will be stored and is also printed as part of the page header on the printed results. An example is AM92.

Category

This is the name of the root branch in the mortality list tree under which the Table will be displayed. You can pick from an existing root or create a new one by typing the new name in the Category field.

Age range

This input gives the upper and lower ages that apply to the Table. The youngest age you can enter is zero. The oldest age is 120. The oldest age you specify will be treated as ω–1for that Table. The program will set q_{ω}=1 unless the Truncated box is ticked (see below).

Precision

This allows you to set the number of decimal places to use when storing and displaying each entry in the Table. The value is restricted to a minimum of 3 and a maximum of 10.

Select Period

You can choose between *Ultimate* and *Select* by selecting the appropriate option button. If you choose Select then you must enter the select period and the maximum age for the select part of the Table. This maximum age cannot be greater than the maximum ultimate age less the number of years in the select period. The select period cannot be less than 1 or more than 5.

Radix

This is the radix of the Table. Note **STP** works to 15 significant figures for its internal calculations. The choice of radix has no effect on the value of monetary functions produced. For commutation functions this is not the case. The column widths of the output are fixed. Numbers which are very large or very small are printed in scientific notation and in this case some precision is lost. If values of commutation functions are required, it is suggested that you examine the output for S_x, for a particular radix, to ensure that overflows are not happening. In general a radix of about 10,000 should produce satisfactory results.

Truncated

This allows a partial table to be input where there is intentionally no ω age. The program will then recognise that the table stops at a particular age, and will not allow functions to be calculated that would require mortality rates above that age (e.g. whole of life functions).

Improvement factors

This drop down box triggers the application of improvement factors to the basic mortality Tables. The 1980 factors are detailed in Section 4.3 of *C.M.I.R.* **10**. The 1992 factors are described in Section 6 of *C.M.I.R.* **17**. The Short, Medium and Long Cohort factors are described in C.M.I. Working Paper 1. All other improvement factors are contained in the C.M.I. library of projections and are described further in the User Guide for the library. Any improvement factor Tables you create will also appear in this list.

On pressing the [OK] button various checks of reasonableness will be applied. If any errors are found a warning box will be displayed and you will be able to correct the input.

Entering data into the Table

Having completed the Table properties you will be presented with a screen similar to the one shown below.

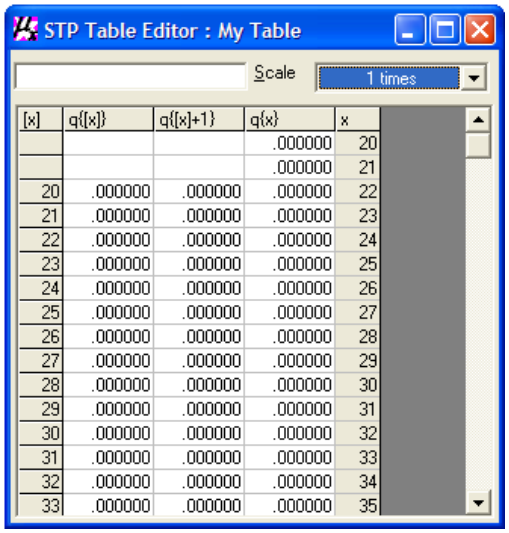


Figure 8.3 Mortality Table Editor

The screen consists mainly of a scroll box in which your blank Table is displayed. The top left hand value in the Table is highlighted by a cursor. The cursor can be moved by using the DIRECTION keys or by clicking with the mouse.

The Table value highlighted by the cursor is displayed in the edit line at the top left of the screen. This value can be edited in the normal way after the edit line is activated by clicking on it or by pressing F2. Pressing the ENTER key will place the new value into the Table.

It is probable that your Table of values will include numbers smaller than 1. This can make the job of entering a new Table tedious since most values will start "0.00....". This can be avoided by using the *Scale* box at the top right of the screen.

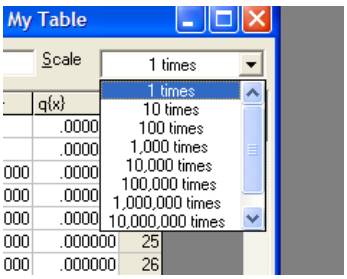


Figure 8.4 The Scale drop down box

This is illustrated above and is revealed by activating the drop down box. Using the up and down arrow keys, or by clicking, you can select an appropriate multiple to apply to the Table. For example, if you specified that values are to be entered to 6 decimal places, a multiple of 1,000,000 would mean that all values are entered as whole numbers. i.e. you only have to enter the significant figures for the values you are inputting.

Perhaps the quickest way to enter numbers is to use the numeric keypad and the ENTER key. Using this procedure, when you get to the end of a column the cursor

jumps up to the start of the next. It is also now possible to copy and paste values from another application, for example a spreadsheet.

When you have entered your Table you may save it using the Save button. This will activate the normal Windows Save dialogue box. Note that the file should be saved with a ".tbl" extension.

If you choose any action which may lose your Table you will be prompted to save it.

Creating a new AIDS Table

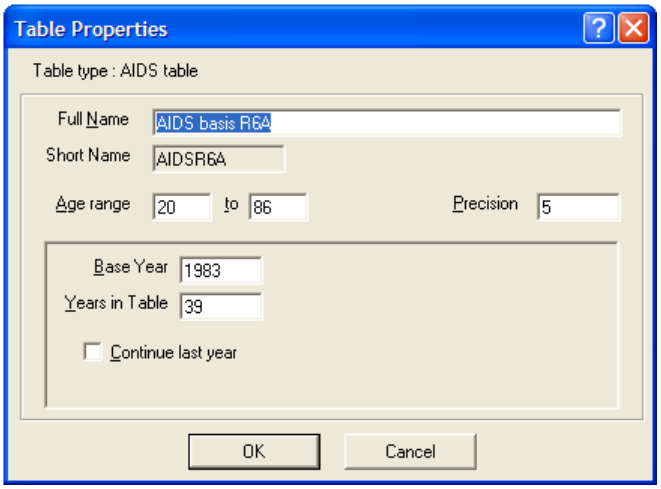


Figure 8.5 AIDS Tables properties

Full Name, *Short Name*, *Age range* and *Precision* all work as described in the previous "Creating a new mortality Table" section.

Base Year

This is the first calendar year in which adjustments are made. The AIDS Table is a two-way table with age down the side and year along the top. The *Base Year* is the first column in the Table.

Years in Table

This controls the number of columns in the Table.

Continue last year

This check box, when toggled "on", tells **STP** to apply AIDS adjustments for the final calendar year entered into the table editor to all subsequent calendar years when the Table is used to calculate functions. It is effectively specifying the final year's entered AIDS adjustments as "ultimate" adjustments and saves the trouble of entering the same column of adjustments many times in situations where adjustments are required to be maintained at peak levels.

Once this screen is completed you may input the Table as described in the last part of the previous ("Creating a new mortality Table") section of this chapter.

Creating a new PHI inception rate Table

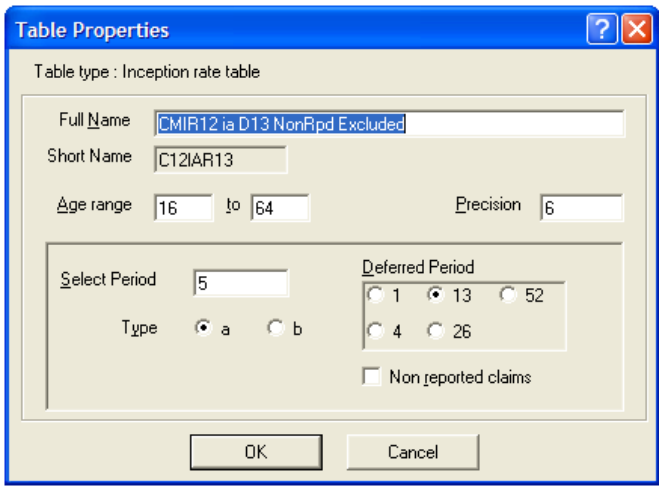


Figure 8.6 PHI Inception Rate properties

Full Name, *Short Name*, *Age range* and *Precision* are entered as in the previous "Creating a new mortality Table" section.

Type

This can be set to (a) or (b). These inception rate types are defined in *C.M.I.R.* **12** Part D Sections 5.4 and 5.5. Type (a) rates give the number of claim inceptions between age x and $x + 1$, i.e. sickness started between age $x - d$ and $x + 1 - d$ where d is the deferred period. Type (b) rates give the number of claim inceptions between age $x + d$ and $x + d + 1$, i.e. sickness started between age x and $x + 1$.

Type (a) rates generally tend to be used for individual business whilst type (b) are generally used for group business.

Deferred Period

Click on (or tab to) the option button that defines the required deferred period.

Non-reported claims

Check this option box if the rates you are to input exclude non-reported claims. See page 33 for a description of non-reported claims.

Select Period

This input defines the select period in numbers of years. Enter the value you require – the maximum is 5. Once this screen is completed you may input the Table as described at the end of the previous "Creating a new mortality Table" section of this chapter.

Creating a new mortality improvement factors Table

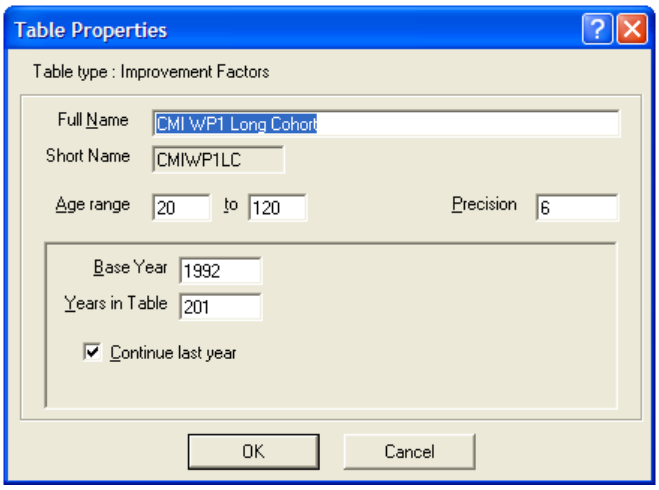


Figure 8.7 Mortality Improvement Factors Tables properties

Full Name, *Short Name*, *Age range* and *Precision* all work as described in the previous "Creating a new mortality Table" section.

Base Year

This is the first calendar year in which adjustments are made. The mortality improvement factors Table is a two-way table with age down the side and year along the top. The *Base Year* is the first column in the Table.

Years in Table

This controls the number of columns in the Table.

Continue last year

This check box, when toggled "on", tells **STP** to apply mortality improvement factors for the final calendar year entered into the table editor to all subsequent calendar years when the Table is used to calculate functions. It is effectively specifying the final year's entered mortality improvement factors as "ultimate" factors and saves the trouble of entering the same column of factors many times in situations where factors are required to be maintained at peak levels.

Once this screen is completed you may input the Table as described in the last part of the earlier ("Creating a new mortality Table") section of this chapter.

Linking mortality improvement factors Tables to mortality Tables

In the **STP** installation folder (usually C:\Program Files\STP\) is a file called **improve.xml**. This file is used to describe the mapping between mortality Tables and improvement factors Tables. It can be opened using a text editor such as Notepad.

To associate a mortality Table (say, 'MORT_01') to an improvement factors Table (say, 'PROJ_01') then the following lines should be added to **improve.xml** after the last <map> line but before the final line </improvements>:

```
<tableSet id="myTables">
   <table id="MORT_01" />
</tableSet>

<improveSet id="myImprovements" type="container" name="My
Improvements" >
   <improveSet id="PROJ_01" type="file" name="Improvements 01"
   constructor="10001" />
</improveSet>

<map tableSet="myTables" improveSet="myImprovements" />
```

The tableSet and improveSet can be extended to include any number of Tables, for example:

```
<tableSet id="myTables">
   <table id="MORT_01" />
   <table id="MORT_02" />
   <table id="MORT_03" />
</tableSet>

<improveSet id="myImprovements" type="container" name="My
Improvements" >
   <improveSet id="PROJ_01" type="file" name="Improvements 01"
   constructor="10001" />
   <improveSet id="PROJ_02" type="file" name="Improvements 02"
   constructor="10002" />
   <improveSet id="PROJ_03" type="file" name="Improvements 03"
   constructor="10003" />
</improveSet>
```

Note that the constructor value has to be a unique number.

The **improve.xml** file allows different combinations of mortality and improvement factors Tables to be mapped. For example, the existing "92" and "00" Series mortality Tables can be mapped to the new improvement factors described using:

```
<map tableSet="92series" improveSet="myImprovements" />
<map tableSet="00series" improveSet="myImprovements" />
```

Opening an existing Table

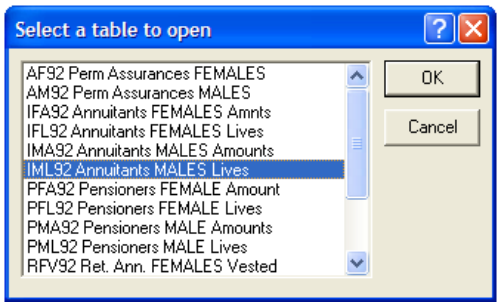


Figure 8.8 Opening a Table

The *File/Open Table ...* command allows you to load a new Table from disk. As is shown above the familiar Windows dialogue box is displayed. Note that the *Files of type* drop down box controls the file types that are listed. If you select a Lotus or Excel spreadsheet type, then these must contain a layout that is familiar to **STP** or they will not load correctly. The best way to create files with these layouts is to ask **STP** to save

blank files in either Lotus or Excel formats and then edit them with the appropriate spreadsheet program.

Note that several Tables may be stored in the same file. This is especially so for the original Tables supplied with the **STP**. These files cannot be modified and resaved under their original names. However, you can change them and then save them under a new name.

Saving a Table

Clicking on the Save button saves the currently loaded Table under its current name, replacing any previous Table of the same name. If a Table of the same name already exists, **STP** prompts you to confirm that you want to replace it.

Clicking on the Save As button will allow you to save the Table with a new name in either **STP**'s internal file format or in Lotus or Excel spreadsheet formats.

Chapter Nine

Testing the Output

STP has been written in Microsoft Visual Basic v.6 and contains many thousands of lines of code. It can calculate forty-one functions for one hundred and fifteen different mortality tables. Joint-life cases can combine any two mortality tables. For the annuitant and pensioner tables derived from the 1991-1994 and 1999-2002 life office and 2000-2006 self-administered pension schemes experiences, one hundred and twenty three different projection methods are offered for the calculation of monetary functions. For all of the tables, each function can be output in up to three different ways. All of this is in addition to an almost limitless choice of interest rates, durations and adjustments to q_x. We have not yet mentioned PHI or AIDS adjustments! **STP** is a complex program. A considerable part of the effort of developing **STP** (perhaps more than 50%) has gone into testing it. Despite this, **STP** cannot be guaranteed to produce answers that are free from error and the user must always be aware of this possibility. The reasons may be any one of, or a combination of, program error, hardware error and user error. Whilst there may be different reasons for producing incorrect answers, the methods of detection of errors are the same.

STP's complexity is a function of the number of different things it will do. For mortality functions at least, calculation of any individual factor is not complex, being the result of applying the techniques all actuaries learn during their training. *Chapter Ten - Formulae and Table Parameters* gives details of how the factors are calculated by the program. For further details refer to the text book on Life Contingencies by Neill. For background on the calculation of PHI functions refer to *C.M.I.R.* **12**.

There are several things that can be done to check the program's output. Amongst these are to recalculate some of the factors, to apply checks of reasonableness and consistency, and to operate the program in a careful and disciplined way.

Recalculation of factors - mortality functions

Every actuary has a favourite way of calculating factors. However, given a PC and a spreadsheet program perhaps the easiest way is to use these tools. **STP** can be asked to generate the basic q_x's in a spreadsheet format. These can be checked against the original published values. It is then a straightforward task to use the spreadsheet to calculate the factors. In this instance the traditional approach using commutation functions is perhaps the most obvious.

In reproducing the factors you must observe the same rounding rules as **STP**. **STP** bases all its calculations on a set of q_x's. These are rounded to the number of decimal places (see Rounding on page 55) associated with the table, before any further calculations are performed. It is particularly important to note that this applies to adjusted q_x's and that rounding is applied after any such adjustments. After the basic set of q_x's have been organised by **STP** all subsequent calculations are performed to 15 significant figures until the answers are printed.

For the "00" Series and SAPS "S1" Series tables, values of μ_x are stored as originally graduated. In all other cases μ_x's are calculated from the q_x's.

You must also be aware of how **STP** applies age adjustments to q_x's. This is done by shifting the base set of q_x's either up or down by the relevant number of years. It is probably clear that this means that $q_{25}^{modified} = q_{30}^{table}$ when an addition of five years is applied to a non-projected mortality table. A less obvious example occurs with the use of a Year of Birth table. Assume that the base table is for 1935. In the example given $q_{25}^{modified}$ will be $q_{30}^{(B=1935)}$ not $q_{25}^{(B=1940)}$. The same is true for Calendar Year and Year of Use projections.

It is normally possible to spot a gross error, for whatever reason, in **STP**'s output by inspection of the results. This is particularly so with a careful choice of inputs. The easiest areas of the output tables to check in this respect are the extremities. Let ω be the terminal age for each table. Then, for each table, it is assumed that $q_\omega = 1$, so that $p_\omega = 0$, $l_{\omega+1} = 0$, $d_\omega = l_\omega$, $\ddot{a}_\omega = 1$, $a_\omega = 0$ and $A_\omega = v$

Further :

$D_\omega = N_\omega = S_\omega = d_\omega v^\omega$

and

$C_\omega = M_\omega = R_\omega = d_\omega v^{\omega+1}$

There are many identities that can be used to compare tables. The relationship

$A_{\{status\}} = 1 - d.\ddot{a}_{\{status\}}$

(where d is the rate of discount) is well known. Other examples are listed below.

- Set the term n to 1 for term functions. In this case many functions become a combination of p, q, and v. Another test for term functions is to set n to be large. In this case the answers should be identical to the whole-of-life functions.
- Setting all the q_x's to zero by using the mortality adjustments will reduce the annuity functions to the equivalent compound interest factors.
- For joint-life functions, it is usually possible to find a factor that can be approximated by a suitable single-life function. For example, a last survivor annuity for ages 20 and 100 should be the same as a single life annuity for a life aged 20. For the same lives and a joint-life annuity, the equivalent factor would be that for a life aged 100.
- The recursive nature of the monetary functions means that is nearly always possible to calculate a factor for age x from the factor for age $x + 1$.

Reasonableness and consistency - PHI functions

As with mortality functions a suitable choice of inputs can be a useful check of output. Here are some examples relating to current claim annuities.

- Set the ρ and ν adjustment factors to zero i.e. no lives fall sick or die. Then the program output will correspond to annuities certain.
- Setting the interest rate to zero will mean the output annuity values are the durations of the terms outstanding. If these settings are made in the pricing functions inputs, the values of a^2, $a^{2,1}$ and $a^{1,2}$ will increase by one for each age up the table. This is apparent from their integral definitions.

- Annuity values from an $x + N = fixed$ calculation for a specific x and N may be cross checked against values at age x of an annuity for fixed term N.
- For annuities with a proportional payment on termination set the interest rate to zero. These values will be the limit of annuities without proportion, at zero interest, for large frequencies of payment.
- Values for annuities including non-reported claims can be cross checked against values excluding them. For durations greater than the run-in period of 4/52.18 years these will be the same.

Procedures for operating STP

A major reason for testing the program output is to ensure that no user errors have been introduced. These can range from simple input errors (e.g. asking for the wrong rate of interest to be used) to not understanding what the program is doing or what the program is being asked to do. Misinterpretation of the output is also a possibility. The chance of this or any other error remaining undetected can be significantly reduced by using **STP** in a careful and disciplined way. To this end the following procedure is recommended, at least until the user is convinced that **STP** is doing what is wanted and is doing it correctly.

1. Reproduce known results for the function and layout required. This can be done by generating previously published tables or results that the user has already tested. Note the hash codes for these tables and compare them with the hash codes either included in the list files on **STP**'s distribution disk, or otherwise previously recorded. Hash codes are eight digit hexadecimal numbers calculated from the values that make up the whole table, taking into account each value's position in the table. To a high degree of probability the hash code is unique for each table. This code can be used to make sure that you have reproduced the same results, and hence gave the same inputs, as on a previous occasion without looking at every value in a table.
2. Select a suitable reproduced set of results and then introduce a small change. This might be a new interest rate or a new mortality table. Generally this is one change, the effect of which you would hope to be able to estimate.
3. If you are dealing with a big change or a set of results of a type you have not previously produced you are advised to reproduce some of the results from first principles as described above.
4. Use checks of reasonableness and consistency as described above.
5. Once you are happy that the results are what you expected and are correct, make a note of the hash code so that you know when you have reproduced the same results again.

Chapter Ten

Formulae and Table Parameters

This chapter gives details of the calculations performed by **STP**. Inevitably this reproduces information contained in the references and in other places in this manual. However the aim is to put in one place all the details (including references) of how **STP** works.

Rounding

STP bases all its mortality calculations on a set of q_x's. These are rounded to the number of decimal places associated with that particular table before any further calculations are performed. The q_x's may have had mortality or AIDS adjustments applied to them, or may have been subject to improvement projections. It is particularly important to note that rounding is applied after any such projections or adjustments.

Formulae for mortality functions

STP uses commutation functions for all its intermediate calculations when calculating both joint-life and single-life functions. This method was chosen since it proved to be the quickest method of calculating complete tables of values for all ages. These commutation functions are computed from the q_x's using the recursive equations listed below. The starting values for these formulae are defined as follows. Let ω be the terminal age for each table. Then, for each table, it is assumed that $q_\omega = 1$, so that $p_\omega = 0$, $l_{\omega+1} = 0$, $d_\omega = l_\omega$, $\ddot{a}_\omega = 1$, $a_\omega = 0$ and $A_\omega = v$.

Further :

$$D_\omega = N_\omega = S_\omega = l_\omega v^\omega$$

and

$$C_\omega = M_\omega = R_\omega = d_\omega v^{\omega+1}$$

Mortality functions

l_0 = Radix

$l_{x+1} = l_x(1-q_x)$

$l_{[x]+t} = \dfrac{l_{[x]+t+1}}{1-q_{[x]+t}}$, $0 \le t <$ Select Period

$l_{xy} = l_x \; l_y$

$l_{[xy]} = l_{[x]} \; l_{[y]}$

$l_{[x]+½} = \dfrac{l_{[x]}+l_{[x]+1}}{2}$

$d_{[x]} = q_{[x]} \; l_{[x]}$

The calculation of μ_x

The calculation of μ_x is dependent on the table selected and so is not reproduced in detail here. For the "00" Series and SAPS "S1" Series tables, the graduated values of μ_x have been stored within **STP**. The values for all other tables are calculated from q_x using the definitions in the prefaces of the published tables. For x close to the limiting ages of the tables problems are

encountered using the central difference formulae quoted in the older tables since this requires values of q_x for $x \geq \omega$, ω being defined by $q_\omega = 1$. In the past it had been the practice to temporarily set ω to a higher value and use these values of q_x in the formula. For the "80" and "92" Series tables a special formula was devised to define μ_x for high ages without altering ω. This formula was applied to the older tables in order for **STP** to generate the values of μ_x for all ages up to $\omega - 1$. Although μ_ω is in theory calculable, it was decided that since no formula for any CMI tables has been published for this age thus far, a suitable approximation to this value would be the integer greater than $\mu_{\omega-1}$.

Single life commutation functions

$$
\begin{aligned}
D_{[x]+t} &= v^{x+t} l_{[x]+t} \\
N_{[x]+t} &= N_{[x]+t+1} + D_{[x]+t} \\
S_{[x]+t} &= S_{[x]+t+1} + N_{[x]+t} \\
C_{[x]+t} &= v^{x+t+1} d_{[x]+t} \\
M_{[x]+t} &= M_{[x]+t+1} + C_{[x]+t} \\
R_{[x]+t} &= R_{[x]+t+1} + M_{[x]+t}
\end{aligned}
$$

It should be noted that $[x] + t = x + t$ for all t greater than or equal to the select period of the table.

Single life monetary functions – Assurances

$$
\begin{aligned}
A_{[x]} &= \frac{M_{[x]}}{D_{[x]}} \\
{}_nE_{[x]} &= \frac{D_{[x]+n}}{D_{[x]}} \\
{}_nA_{[x]} &= \frac{M_{[x]} - M_{[x]+n}}{D_{[x]}} \\
A_{[x]:\overline{n}\rceil} &= \frac{M_{[x]} - M_{[x]+n} + D_{[x]+n}}{D_{[x]}}
\end{aligned}
$$

Single life monetary functions – Annuities

$$
\begin{aligned}
\ddot{a}_{[x]} &= \frac{N_{[x]}}{D_{[x]}} \\
a_{[x]:\overline{n}\rceil} &= \frac{N_{[x]+1} - N_{[x]+n+1}}{D_{[x]}} \\
\ddot{a}_{[x]:\overline{n}\rceil} &= \frac{N_{[x]} - N_{[x]+n}}{D_{[x]}} \\
a_{\overline{[x]:\overline{n}\rceil}} &= a_{\overline{n}\rceil} + \frac{D_{[x]+n}}{D_{[x]}} a_{[x]+n} \\
\ddot{a}_{\overline{[x]:\overline{n}\rceil}} &= \ddot{a}_{\overline{n}\rceil} + \frac{D_{[x]+n}}{D_{[x]}} \ddot{a}_{[x]+n}
\end{aligned}
$$

Single life monetary functions – Premiums

$$P_{[x]} = \frac{M_{[x]}}{N_{[x]}}$$

$${}_nP_{[x]} = \frac{M_{[x]} - M_{[x]+n}}{N_{[x]} - N_{[x]+n}}$$

$$P_{[x]:\overline{n}\rceil} = \frac{M_{[x]} - M_{[x]+n} + D_{[x]+n}}{N_{[x]} - N_{[x]+n}}$$

Formulae for ultimate or select + t ($0 \le t <$ select period) durations can be derived by suitable modification of the above single life functions.

Joint life monetary functions – Assurances

For simplicity all joint-life functions are specified for ultimate durations. Suitable modifications can be made for select or select + t durations. All of these factors are defined in terms of commutation functions. Whilst these are calculated by **STP** they are not output. The definitions of the commutation functions are given in the next section.

$$A_{xy} = \frac{M_{xy}}{D_{xy}}$$

$$A^1_{xy} = \frac{M^1_{xy}}{D_{xy}}$$

$$A_{\overline{xy}} = \frac{M_x}{D_x} + \frac{M_y}{D_y} - \frac{M_{xy}}{D_{xy}}$$

$$A_{xy:\overline{n}\rceil} = \frac{M_{xy} - M_{x+n:y+n} + D_{x+n:y+n}}{D_{xy}}$$

$$A_{\overline{xy:n}\rceil} = \frac{M_x - M_{x+n} + D_{x+n}}{D_x} + \frac{M_y - M_{y+n} + D_{y+n}}{D_y} - \frac{M_{xy} - M_{x+n:y+n} + D_{x+n:y+n}}{D_{xy}}$$

$${}_nA_{xy} = \frac{M_{xy} - M_{x+n:y+n}}{D_{xy}}$$

$${}_nA_{\overline{xy}} = \frac{M_x - M_{x+n}}{D_x} + \frac{M_y - M_{y+n}}{D_y} - \frac{M_{xy} - M_{x+n:y+n}}{D_{xy}}$$

$${}_nA^1_{xy} = \frac{M^1_{xy} - M^1_{x+n:y+n}}{D_{xy}}$$

Joint life monetary functions – Annuities

$$a_{xy} = \frac{N_{x+1:y+1}}{D_{xy}}$$

$$a_{\overline{xy}} = \frac{N_{x+1}}{D_x} + \frac{N_{y+1}}{D_y} - \frac{N_{x+1:y+1}}{D_{xy}}$$

$$\ddot{a}_{xy} = \frac{N_{xy}}{D_{xy}}$$

$$\ddot{a}_{\overline{xy}} = \frac{N_x}{D_x} + \frac{N_y}{D_y} - \frac{N_{xy}}{D_{xy}}$$

$$a_{x|y} = \frac{N_{y+1}}{D_y} - \frac{N_{x+1:y+1}}{D_{xy}}$$

$$a_{xy:\overline{n}|} = \frac{N_{x+1:y+1} - N_{x+n+1:y+n+1}}{D_{xy}}$$

$$\ddot{a}_{xy:\overline{n}|} = \frac{N_{xy} - N_{x+n:y+n}}{D_{xy}}$$

$$a_{\overline{xy:n}|} = a_{\overline{n}|} + \frac{N_{x+n+1:y+n+1}}{D_{xy}}$$

$$\ddot{a}_{\overline{xy:n}|} = \ddot{a}_{\overline{n}|} + \frac{N_{x+n:y+n}}{D_{xy}}$$

$$a_{\overline{xy:n}|} = \frac{N_{x+1} - N_{x+n+1}}{D_x} + \frac{N_{y+1} - N_{y+n+1}}{D_y} - \frac{N_{x+1:y+1} - N_{x+n+1:y+n+1}}{D_{xy}}$$

$$\ddot{a}_{\overline{xy:n}|} = \frac{N_x - N_{x+n}}{D_x} + \frac{N_y - N_{y+n}}{D_y} - \frac{N_{xy} - N_{x+n:y+n}}{D_{xy}}$$

where the joint life commutation functions are defined as follows

$$D_{xy} = v^{\frac{x+y}{2}} \; l_{xy}$$

$$N_{xy} = N_{x+1:y+1} + D_{xy}$$

$$C_{xy} = v^{\frac{x+y}{2}+1} \; (l_{xy} - l_{x+1:y+1})$$

$$M_{xy} = M_{x+1:y+1} + C_{xy}$$

$$C^1_{xy} = v^{\frac{x+y}{2}+1} \; d_x \; l_{y+\frac{1}{2}}$$

$$M^1_{xy} = M^1_{x+1:y+1} + C^1_{xy}$$

Formulae for PHI functions

Note on notation: In this section the notation of *C.M.I.R.* **12** has been followed.

STP requires probabilities of lives remaining sick for the calculation of PHI functions. The probability of survival while still sick is denoted as ${}_t p^{\overline{ss}}_{x,z}$. This is the probability that a person who is sick, aged *x* with duration of sickness *z* years, remains sick for a further period of *t* years.

It can be calculated from the formula

$${}_t p^{\overline{ss}}_{x,z} = exp\left(-\int_0^t \left\{ \rho_{x+u,z+u} + \nu_{x+u,z+u} \right\} \mathrm{d}u \right)$$

where $\rho_{x,z}$ is the recovery intensity at age *x* and duration *z* and $\nu_{x,z}$ is the mortality intensity at age *x* and duration *z*. **STP** relies on the method of direct integration of the graduation formulae of $\rho_{x,z}$ and $\nu_{x,z}$ to derive the value of ${}_t p^{\overline{ss}}_{x,z}$ used in the calculation of current claim annuities. The method is detailed in *C.M.I.R.* **13**, "Calculation of continuation tables...." on pages 123-130.

Current claim annuities

For a current claim annuity of 1 per annum, payable f^{th}ly in advance, from the end of the deferred period *d*, for a term of *n* years, the formula is

$$\ddot{a}^{\overline{ss}(f)}_{[x],d:\overline{n}\rceil} = \sum_{u=1}^{n\cdot f} \frac{1}{f} \cdot v^t \cdot {}_t p^{\overline{ss}}_{[x],d}$$

where $t = \dfrac{u-1}{f}$

For the corresponding annuity payable in arrears the formula is

$$a^{\overline{ss}(f)}_{[x],d:\overline{n}\rceil} = \sum_{u=1}^{n\cdot f} \frac{1}{f} \cdot v^{t'} \cdot {}_{t'} p^{\overline{ss}}_{[x],d}$$

where $t' = \dfrac{u}{f}$

For current claim annuities relating to durations other than the start of the claim (i.e. the end of the deferred period), the appropriate duration is substituted for *d* in the values of ${}_t p^{\overline{ss}}_{[x],d}$

Proportion on termination

For annuities payable in arrears which include a proportional payment on recovery or death, the value of the extra payment is calculated analogously to complete annuities in the mortality case. **STP** uses various approximations for the calculation. These include the trapezium rule and similar interval division techniques to perform numerical integration of $p^{\overline{ss}}$.

Duration adjustment

For a duration adjustment of size *w*, where $0 \le w \le 1$

$$^{adjusted}\ddot{a}^{\overline{ss}(f)}_{[x],d:\overline{n}\rceil} = v^j \cdot {}_j p^{\overline{ss}}_{[x],d} \cdot \ddot{a}^{\overline{ss}(f)}_{[x],d:\overline{n}\rceil}$$

in the case of annuities payable in advance

and $^{adjusted}a^{\overline{ss}(f)}_{[x],d:\overline{n}\rceil} = v^j \cdot {}_j p^{\overline{ss}}_{[x],d} \cdot \left(\dfrac{1}{f} + a^{\overline{ss}(f)}_{[x],d:\overline{n}\rceil}\right)$

for annuities payable in arrears

where $j = \dfrac{w}{f}$

Initial multiple

The formula for a current claim annuity can be expressed as a summation as shown earlier in this section. The initial multiple is the factor by which the first term of the summation is multiplied. When there is no adjustment this takes the default value 1.

Formulae for pricing functions

For type (a) inception rates, with annuity payments made *f* times per annum in arrears we have

$$a^{HS(f)}_{x:\overline{n}\rceil} \cong v^{\frac{1+d}{2}} \cdot \frac{L_{[x]}}{l_{[x]}} \cdot ia^{d}_{[x]} \cdot a^{2(f)}_{x,d:\overline{n}\rceil} + \sum_{t=1}^{n-1} v^{t+\frac{1}{2}} \cdot \frac{L_{[x]+t}}{l_{[x]}} \cdot ia^{d}_{[x]+t} \cdot a^{1,2(f)}_{x+t,d:\overline{N}\rceil}$$

where

n = Terminating age $- x$

N = Terminating age $- x - t$

$$a^{2(f)}_{x+t,d:\overline{n}\rceil} \approx \frac{1}{1-d} \int_{d}^{1} a^{\overline{ss}(f)}_{x+t+u,d:\overline{N-u}\rceil} \mathrm{d}u$$

$$a^{1,2(f)}_{x+t,d:\overline{n}\rceil} \approx \int_{0}^{1} a^{\overline{ss}(f)}_{x+t+u,d:\overline{N-u}\rceil} \mathrm{d}u$$

A repeated Simpson's formula has been used to calculate these integrals. The number of intervals was chosen to be 4 or 32, depending on age, and the integrand annuity values have been calculated by the current claim annuities' formulae as outlined previously in this chapter.

The corresponding formula for type (b) inception rates is

$$a^{HS(f)}_{x:\overline{n}\rceil} \cong \sum_{t=0}^{n-2} v^{t+d+\frac{1}{2}} \cdot \frac{L_{[x]+n}}{l_{[x]}} \cdot ib^{d}_{[x]+t} \cdot a^{2,1(f)}_{x+t,d:\overline{N}\rceil} + v^{n-1+\frac{1+d}{2}} \cdot \frac{L_{[x]+n-1}}{l_{[x]}} \cdot (1-d) \cdot ib^{d}_{[x]+n-1} \cdot a^{2(f)}_{x+n-1,d:\overline{n}\rceil}$$

where $a^{2,1(f)}_{x+t,d:\overline{N}\rceil} = \int_{d}^{t+d} a^{\overline{ss}(f)}_{x+t+u,d:\overline{N-u}\rceil} \mathrm{d}u$

The formulae relating to annuities payable in advance are the same except for the changes of a^{2}, $a^{1,2}$, $a^{2,1}$ type terms replaced by $\ddot{a}^{2}$, $\ddot{a}^{1,2}$, $\ddot{a}^{2,1}$ type terms respectively. The definitions of these follow analogously.

The derivation of these formulae is detailed in *C.M.I.R.* **12**, Part F, Sections, 6 & 7 [Note *C.M.I.R.* **12** Errata listed in *C.M.I.R.* **13**].

Table parameters

The A1924-29 tables for assured lives

Year of publication	: 1933
Investigation type	: Assured lives
Experience period	: 1924-1929
Sex	: Males
Lives or amounts	: Lives
Age range of table	: 10 – 99
Select period	: 3
Highest select age at entry	: 80
No of decimal places in q_x	: 5
Radix	: 9999999
Reference	: Mortality of assured lives 1924-29

The A1949-52 tables for assured lives

Year of publication	: 1957
Investigation type	: Assured lives
Experience period	: 1949-1952
Sex	: Males
Lives or amounts	: Lives
Age range of table	: 10 – 99
Select period	: 2
Highest select age at entry	: 80
No of decimal places in q_x	: 5
Radix	: 999999
Reference	: A1949-52 tables for assured lives

The a(55) tables for annuitants

Year of publication	: 1953
Investigation type	: Annuitants
Experience period	: 1946-48
Sex	: Both
Lives or amounts	: Lives
Age range of table	: 20 – 114(males), 116(females)
Select period	: 1
Highest select age at entry	: 99
Projection method	: Project basic rates forward, and then construct a table of mortality rates where the rate for each age is the projected rate applicable to the calendar year in which that age on average would be attained by entrants in 1955.
No of decimal places in q_x	: 5 up to age 100 and 3 thereafter.
Radix	: 999999
References	: The a(55) tables for annuitants *C.M.I.R.* **5** – "a(55) table : q_x at high ages"

Notes	: The values of commutation functions may not agree exactly with those published because of the later publication of q_x at high ages and the precision of these numbers. No values were published for select $\mu_{[x]}$ so the program sets these values to zero.

The A1967-70 and A1967-70(5) tables for assured lives

Year of publication	: 1975
Investigation type	: Assured lives
Experience period	: 1967-1970
Sex	: Males
Lives or amounts	: Lives
Age range of table	: 0 – 121
Select period	: 2 and 5
Highest select age at entry	: 80
No of decimal places in q_x	: 8
Radix	: 34489
Reference	: A1967-70 tables for assured lives
Notes	: The original publication of this table gave q_x to age 109. The calculation of the monetary functions printed in the table requires values of q_x at ages above 109. For **STP** the values of q_x have been calculated to age 120 and q_{121} has been set to 1. **STP** then reproduces all of the monetary functions exactly. Values of μ_x were calculated using the formulae given in the preface to the PA(90) table for pensioners.

The PA(90) tables for pensioners

Year of publication	: 1979
Investigation type	: Pensioners
Experience period	: 1967-1970
Sex	: Both
Lives or amounts	: Amounts
Age range of table	: 20 – 117
Select period	: Ultimate only
Projection method	: Calendar year 1990
No of decimal places in q_x	: 8
Radix	: Male : 211.229757, Female : 144.695533
Reference	: PA(90) tables for pensioners

Notes	:	Values of q_x were originally published to 6 decimal places. In order to reproduce the calculation of commutation functions, **STP** uses values of q_x stored to 8 decimal places. At young ages in the female table q_x is constant. Up to age 28, μ_x, as provided by the difference formula given in the preface to this table, is also constant. In the published tables this same constant value is carried on up to age 31, whereas the difference formula produces lower values. **STP** reproduces the published values for these ages.

The a(90) tables for annuitants

Year of publication	:	1979
Investigation type	:	Annuitants
Experience period	:	1967-1970
Sex	:	Both
Lives or amounts	:	Lives
Age range of table	:	20 - 117
Select period	:	1
Highest select age at entry	:	116
Projection method	:	Calendar year 1990
No of decimal places in q_x	:	8
Radix	:	Male : 190.311672, Female : 131.401371
Reference	:	a(90) tables for annuitants
Notes	:	The calculation of commutation functions required 8 decimal places, as for PA(90).

The FA1975-78 tables for female assured lives

Year of publication	:	1983
Investigation type	:	Assured lives
Experience period	:	1975-1978
Sex	:	Females
Lives or amounts	:	Lives
Age range of table	:	0 – 120
Select period	:	2
Highest select age at entry	:	118
No of decimal places in q_x	:	8
Radix	:	1000
Reference	:	FA1975-78 mortality tables for female assured lives
Notes	:	Again values of q_x were stored to 8 decimal places to reproduce values of μ_x in the published tables.

The "80" Series tables

The AM80, AM80(5) and AF80 tables for assured lives

Year of publication	:	1990
Investigation type	:	Assured lives
Experience period	:	1979-1982
Sex	:	Both
Lives or amounts	:	Lives

Age range of table	: 0 – 120
Select period	: 2 except for AM80(5) which is 5
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **10**

The TM80 tables for temporary assured lives

Year of publication	: 1990
Investigation type	: Temporary assured lives
Experience period	: 1979-1982
Sex	: Males
Lives or amounts	: Lives
Age range of table	: 0 – 120
Select period	: 5
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **10**

The IM80 and IF80 tables for annuitants

Year of publication	: 1990
Investigation type	: Annuitants
Experience period	: 1979-1982
Sex	: Both
Lives or amounts	: Lives
Age range of table	: 16 – 120
Select period	: 1
Highest select age at entry	: 100
Projection method	: Calendar year, year of birth, year of use for any year in a specified range.
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **10**

The PMA80, PML80, PFA80 and PFL80 tables for pensioners

Year of publication	: 1990
Investigation type	: Pensioners
Experience period	: 1979-1982
Sex	: Both
Lives or amounts	: Both
Age range of table	: 16 – 120
Select period	: Ultimate only
Projection method	: Calendar year, year of birth, year of use for any year in a specified range.
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **10**

The WA80 and WL80 tables for widows

Year of publication	: 1990
Investigation type	: Widows of pensioners

Experience period	: 1979-1982
Sex	: Female
Lives or amounts	: Both
Age range of table	: 16 – 120
Select period	: Ultimate only
Projection method	: Calendar year, year of birth, year of use for any year in a specified range.
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **10**

The PCMA80, PCML80, PCFA80 and PCFL80 tables for pensioners

Year of publication	: 1993
Investigation type	: Pensioners - Combined normal and early
Experience period	: 1979-1982
Sex	: Both
Lives or amounts	: Both
Age range of table	: 16 – 120
Select period	: Ultimate only
Projection method	: Calendar year, year of birth, year of use for any year in a specified range.
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **13**

***C.M.I.R.* 12 tables E20b, E26, E30, E34 of mortality**

Year of publication	: 1991
Investigation type	: PHI Standard mortality
Experience period	: 1975-78
Sex	: Male
Age range of table	: 16 – 64
Select period	: 5 years
Highest select age at entry	: 64
No of decimal places in q_x	: 6
Radix	: E20b – 1228621 E26 – 1199541 E30 – 1173173 E34 – 1158392
Reference	: *C.M.I.R.* **12**
Notes	: These tables represent aggregate mortality derived from combining the mortality of the sick (as derived from the investigation) with an assumption for the mortality of the healthy which was taken to be AM80 for select duration 0. Table E20b represents the mortality applicable to 1 week deferred business. Similarly tables E26, E30 and E34 represent the mortality of 4, 13 and 26 week business respectively. See C.M.I.R 12, Part E Section 1.

***C.M.I.R.* 12 tables of inception rates**

Type (a) - rates based on reported claims

Year of publication	: 1991
Investigation type	: PHI Standard mortality
Experience period	: 1975-78
Sex	: Male
Age range of table	: 16 – 64
Select period	: 5 years, method B values used at ultimate durations
Highest select age at entry	: 64
No of decimal places in q_x	: 6
Reference	: *C.M.I.R.* **12**
Deferred periods	: 1 week, table E22b 4 weeks, table E27 13 weeks, table E31 26 weeks, table E35a 52 weeks, table E35b

Type (a) - rates with an allowance for non-reported claims

These rates may be derived from the rates based on reported claims by use of the factor $r^d(y)$, which represents the proportion of claims that are reported for select age *y*. A formulaic definition of $r^d(y)$ is given in *C.M.I.R.* **13**, "Calculation of continuation tables ...", Non-reported claims, page 129.

Type (b) rates both with and without an allowance for non-reported claims

C.M.I.R. **12** Part E, Section 5.1, page 104 contains the formal definitions of type (a) and type (b) inception rates. Section 5.4, page 105 sets out the relationship to derive type (b) inception rates from type (a) values.

STP defines

$$ib^{d}_{[x]+t} = q.ia^{d}_{[x]+t} + \frac{L_{[x]+t+1}}{L_{[x]+t}}.d.ia^{d}_{[x]+t+1}$$

where

$q = 1$ if $t = 0$

$q = 1 - d$ if $t > 0$

and *d*, the deferred period, has been measured in multiples of $1/52$.

The "92" Series tables

The AM92 and AF92 tables for assured lives

Year of publication	: 1999
Investigation type	: Assured lives
Experience period	: 1991-1994
Sex	: Both
Lives or amounts	: Lives
Age range of table	: 17 – 120
Select period	: 2
Highest select age at entry	: 90

No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **17**

The TM92 and TF92 tables for temporary assured lives

Year of publication	: 1999
Investigation type	: Temporary assured lives
Experience period	: 1991-1994
Sex	: Both
Lives or amounts	: Lives
Age range of table	: 17 – 120
Select period	: 5
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **17**

The IMA92, IML92, IFA92 and IFL92 tables for immediate annuitants

Year of publication	: 1999
Investigation type	: Immediate annuitants
Experience period	: 1991-1994
Sex	: Both
Lives or amounts	: Both
Age range of table	: 17 – 120
Select period	: 1
Highest select age at entry	: 100
Projection method	: Calendar year, year of birth, year of use for any year in a specified range.
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **17**

The PMA92, PML92, PFA92 and PFL92 tables for pensioners

Year of publication	: 1999
Investigation type	: Pensioners
Experience period	: 1991-1994
Sex	: Both
Lives or amounts	: Both
Age range of table	: 20 – 120
Select period	: Ultimate only
Projection method	: Calendar year, year of birth, year of use for any year in a specified range.
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **17**

The RMV92 and RFV92 tables for retirement annuitants

Year of publication	: 1999
Investigation type	: Retirement annuitants
Experience period	: 1991-1994
Sex	: Both
Lives or amounts	: Lives

Age range of table	: 17 – 120
Select period	: Ultimate only
Projection method	: Calendar year, year of birth, year of use for any year in a specified range.
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **17**

The WA92 and WL92 tables for widows

Year of publication	: 1999
Investigation type	: Widows of pensioners
Experience period	: 1991-1994
Sex	: Female
Lives or amounts	: Both
Age range of table	: 17 – 120
Select period	: Ultimate only
Projection method	: Calendar year, year of birth, year of use for any year in a specified range.
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: *C.M.I.R.* **17**

The "00" Series tables

The AMC00 and AFC00 tables for assured lives

Year of publication	: 2006
Investigation type	: Assured lives
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Smoker status	: Combined
Age range of table	: 17 – 120
Select period	: 2
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 21

The AMN00 and AFN00 tables for assured lives

Year of publication	: 2006
Investigation type	: Assured lives
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Smoker status	: Non-smokers
Age range of table	: 17 – 120
Select period	: 2
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 21

The AMS00 and AFS00 tables for assured lives

Year of publication	: 2006
Investigation type	: Assured lives
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Smoker status	: Smokers
Age range of table	: 17 – 120
Select period	: 2
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 21

The TMC00 and TFC00 tables for temporary assured lives

Year of publication	: 2006
Investigation type	: Temporary assured lives
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Smoker status	: Combined
Age range of table	: 17 – 120
Select period	: 5
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 21

The TMN00 and TFN00 tables for temporary assured lives

Year of publication	: 2006
Investigation type	: Temporary assured lives
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Smoker status	: Non-smokers
Age range of table	: 17 – 120
Select period	: 5
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 21

The TMS00 and TFS00 tables for temporary assured lives

Year of publication	: 2006
Investigation type	: Temporary assured lives
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Smoker status	: Smokers
Age range of table	: 17 – 120
Select period	: 5
Highest select age at entry	: 90
No of decimal places in q_x	: 6
Radix	: 10000

Reference : CMI Working Paper 21

The IML00 and IFL00 tables for immediate annuitants

Year of publication : 2006
Investigation type : Immediate annuitants
Experience period : 1999-2002
Sex : Both
Lives or amounts : Lives
Age range of table : 60 – 120
Select period : 1 for females, ultimate only for males
Highest select age at entry : 100 (for females only)
No of decimal places in q_x : 6
Radix : 10000
Reference : CMI Working Paper 22

The PNMA00, PNML00, PNFA00 and PNFL00 tables for pensioners

Year of publication : 2006
Investigation type : Pensioners
Experience period : 1999-2002
Sex : Both
Lives or amounts : Both
Pensioner type : Normals
Age range of table : 20 – 120
Select period : Ultimate only
No of decimal places in q_x : 6
Radix : 10000
Reference : CMI Working Paper 22

The PEMA00, PEML00, PEFA00 and PEFL00 tables for pensioners

Year of publication : 2006
Investigation type : Pensioners
Experience period : 1999-2002
Sex : Both
Lives or amounts : Both
Pensioner type : Earlies
Age range of table : 50 – 120
Select period : Ultimate only
No of decimal places in q_x : 6
Radix : 10000
Reference : CMI Working Paper 22

The PCMA00, PCML00, PCFA00 and PCFL00 tables for pensioners

Year of publication : 2006
Investigation type : Pensioners
Experience period : 1999-2002
Sex : Both
Lives or amounts : Both
Pensioner type : Combined
Age range of table : 50 – 120
Select period : Ultimate only
No of decimal places in q_x : 6
Radix : 10000
Reference : CMI Working Paper 22

The RMD00 and RFD00 tables for retirement annuitants

Year of publication	: 2006
Investigation type	: Retirement annuitants
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Pensioner type	: Deferred
Age range of table	: 17 – 75
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 22

The RMV00 and RFV00 tables for retirement annuitants

Year of publication	: 2006
Investigation type	: Retirement annuitants
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Pensioner type	: Vested
Age range of table	: 50 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 22

The RMC00 and RFC00 tables for retirement annuitants

Year of publication	: 2006
Investigation type	: Retirement annuitants
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Pensioner type	: Combined
Age range of table	: 17 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 22

The PPMD00 and PPFD00 tables for personal pensioners

Year of publication	: 2006
Investigation type	: Personal pensioners
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Pensioner type	: Deferred
Age range of table	: 17 – 75
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 22

The PPMV00 and PPFV00 tables for personal pensioners

Year of publication	: 2006
Investigation type	: Personal pensioners
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Pensioner type	: Vested
Age range of table	: 50 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 22

The PPMC00 and PPFC00 tables for personal pensioners

Year of publication	: 2006
Investigation type	: Personal pensioners
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Lives
Pensioner type	: Combined
Age range of table	: 17 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 22

The WA00 and WL00 tables for widows

Year of publication	: 2006
Investigation type	: Widows of pensioners
Experience period	: 1999-2002
Sex	: Female
Lives or amounts	: Both
Age range of table	: 17 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 22

The PEMA00X, PEML00X, PEFA00X and PEFL00X tables for pensioners

Year of publication	: 2007
Investigation type	: Pensioners
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Both
Pensioner type	: Earlies, extended to younger ages
Age range of table	: 20 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 26

The PCMA00X, PCML00X, PCFA00X and PCFL00X tables for pensioners

Year of publication	: 2007
Investigation type	: Pensioners
Experience period	: 1999-2002
Sex	: Both
Lives or amounts	: Both
Pensioner type	: Combined, extended to younger ages
Age range of table	: 20 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 26

The SAPS "S1" Series tables

The S1PFL, S1PFA, S1PML and S1PMA tables for self-administered pensioners

Year of publication	: 2008
Investigation type	: Pensioners
Experience period	: 2000-2006
Sex	: Both
Lives or amounts	: Both
Pensioner type	: All (excluding dependants)
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1PFA_L and S1PMA_L tables for self-administered pensioners

Year of publication	: 2008
Investigation type	: Pensioners
Experience period	: 2000-2006
Sex	: Both
Lives or amounts	: Amounts
Pensioner type	: All (excluding dependants), Light
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1PFA_H and S1PMA_H tables for self-administered pensioners

Year of publication	: 2008
Investigation type	: Pensioners
Experience period	: 2000-2006
Sex	: Both
Lives or amounts	: Amounts
Pensioner type	: All (excluding dependants), Heavy
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1DFL and S1DFA tables for dependants of self-administered pensioners

Year of publication	: 2008
Investigation type	: Dependants of pensioners
Experience period	: 2000-2006
Sex	: Female
Lives or amounts	: Both
Pensioner type	: Dependants
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1DFA_L tables for dependants of self-administered pensioners

Year of publication	: 2008
Investigation type	: Dependants of pensioners
Experience period	: 2000-2006
Sex	: Female
Lives or amounts	: Amounts
Pensioner type	: Dependants, Light
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1DFA_H tables for dependants of self-administered pensioners

Year of publication	: 2008
Investigation type	: Dependants of pensioners
Experience period	: 2000-2006
Sex	: Female
Lives or amounts	: Amounts
Pensioner type	: Dependants, Heavy
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1NFA and S1NMA tables for self-administered pensioners

Year of publication	: 2008
Investigation type	: Pensioners
Experience period	: 2000-2006
Sex	: Both
Lives or amounts	: Amounts
Pensioner type	: Normal Health
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1NFA_L and S1NMA_L tables for self-administered pensioners

Year of publication	: 2008
Investigation type	: Pensioners
Experience period	: 2000-2006
Sex	: Both
Lives or amounts	: Amounts
Pensioner type	: Normal Health, Light
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1NFA_H and S1NMA_H tables for self-administered pensioners

Year of publication	: 2008
Investigation type	: Pensioners
Experience period	: 2000-2006
Sex	: Both
Lives or amounts	: Amounts
Pensioner type	: Normal Health, Heavy
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

The S1IFA and S1IMA tables for self-administered pensioners

Year of publication	: 2008
Investigation type	: Pensioners
Experience period	: 2000-2006
Sex	: Both
Lives or amounts	: Amounts
Pensioner type	: Ill-Health
Age range of table	: 16 – 120
Select period	: Ultimate only
No of decimal places in q_x	: 6
Radix	: 10000
Reference	: CMI Working Paper 35

AIDS tables

Adjustments may be made to q_x's from mortality tables to take account of AIDS projections. For example modified rates for AIDS projections in Calendar Year 1999 would be of the form

$$q_x^{modified} = q_x + q_x^{AIDS\,(C=1999)}$$

The AIDS tables available are:

AIDS	basis R
AIDS	basis R Modified
AIDS	50% basis R Modified
AIDS	basis R6A
AIDS	basis R6A Modified
AIDS	One third of basis R6A
AIDS	basis R6B
AIDS	basis R6C

The "Modified" type tables do not have q_x^{AIDS} values falling off after peaks in the corresponding source table as Calendar Year increases. Basis R is described in AIDS Bulletin No. 4, published by the Institute of Actuaries, 1989. Bases R6A, R6B and R6C are described in AIDS Bulletin No. 5, published in 1991.

Improvement Bases

Projection	CMI Library Version	CMI Library Volume
From CMIR 10:		
Original "80" Series	-	-
From CMIR 17:		
Original "92" Series	1.0	1
From CMI Working Paper 1:		
Short Cohort	1.0	1
Medium Cohort	1.0	1
Long Cohort	1.0	1
Adjusted Interim Cohort Projections:		
Medium Cohort_1% minimum	1.0	2
90% Medium Cohort	1.0	2
50% Medium Cohort_50% Long Cohort	1.0	2
(50% Medium Cohort_50% Long Cohort)_1.5% minimum	1.0	2
(120% Long Cohort)_2.5% minimum	1.0	2
ONS 2004-based National Population Projections:		
ONS_2004_Male_EWNI_Principal	1.0	1
ONS_2004_Male_EWNI_High life expectancy	1.0	1
ONS_2004_Male_EWNI_Low life expectancy	1.0	1
ONS_2004_Male_S_Principal	1.0	1
ONS_2004_Male_S_High life expectancy	1.0	1
ONS_2004_Male_S_Low life expectancy	1.0	1
ONS_2004_Female_UK_Principal	1.0	1
ONS_2004_Female_UK_High life expectancy	1.0	1
ONS_2004_Female_UK_Low life expectancy	1.0	1

Projection	CMI Library Version	CMI Library Volume
ONS 2006-based National Population Projections:		
ONS_2006_Male_EWNI_Principal	1.0	1
ONS_2006_Male_EWNI_High life expectancy	1.0	1
ONS_2006_Male_EWNI_Low life expectancy	1.0	1
ONS_2006_Male_S_Principal	1.0	1
ONS_2006_Male_S_High life expectancy	1.0	1
ONS_2006_Male_S_Low life expectancy	1.0	1
ONS_2006_Female_UK_Principal	1.0	1
ONS_2006_Female_UK_High life expectancy	1.0	1
ONS_2006_Female_UK_Low life expectancy	1.0	1
ONS 2008-based National Population Projections:		
ONS_2008_Male_EWNI_Principal	1.2	7
ONS_2008_Male_EWNI_High life expectancy	1.2	7
ONS_2008_Male_EWNI_Low life expectancy	1.2	7
ONS_2008_Male_S_Principal	1.2	7
ONS_2008_Male_S_High life expectancy	1.2	7
ONS_2008_Male_S_Low life expectancy	1.2	7
ONS_2008_Female_EWNI_Principal	1.2	7
ONS_2008_Female_EWNI_High life expectancy	1.2	7
ONS_2008_Female_EWNI_Low life expectancy	1.2	7
ONS_2008_Female_S_Principal	1.2	7
ONS_2008_Female_S_High life expectancy	1.2	7
ONS_2008_Female_S_Low life expectancy	1.2	7
ONS 2010-based National Population Projections:		
ONS_2010_Male_EWNI_Principal	1.3	8
ONS_2010_Male_EWNI_High life expectancy	1.3	8
ONS_2010_Male_EWNI_Low life expectancy	1.3	8
ONS_2010_Male_S_Principal	1.3	8
ONS_2010_Male_S_Low life expectancy	1.3	8
ONS_2010_Male_S_High life expectancy	1.3	8
ONS_2010_Female_EWNI_Principal	1.3	8
ONS_2010_Female_EWNI_High life expectancy	1.3	8
ONS_2010_Female_EWNI_Low life expectancy	1.3	8
ONS_2010_Female_S_Principal	1.3	8
ONS_2010_Female_S_High life expectancy	1.3	8
ONS_2010_Female_S_Low life expectancy	1.3	8
P-Spline Age-Period Projections:		
PSAP_Male_Ass_2003_50	1.0	3
PSAP_Male_Ass_2004_50	1.0	3
PSAP_Male_Ass_2005_50	1.0	3
PSAP_Male_Ass_2006_50	1.1	6
PSAP_Male_ONS_EW_2003_50	1.0	3
PSAP_Male_ONS_EW_2004_50	1.0	3
PSAP_Male_ONS_EW_2005_50	1.0	3
PSAP_Male_ONS_EW_2006_50	1.1	6

Projection	CMI Library Version	CMI Library Volume
PSAP_Male_ONS_EW_2007_50	1.1	6
PSAP_Female_ONS_EW_2003_50	1.0	3
PSAP_Female_ONS_EW_2004_50	1.0	3
PSAP_Female_ONS_EW_2005_50	1.0	3
PSAP_Female_ONS_EW_2006_50	1.1	6
PSAP_Female_ONS_EW_2007_50	1.1	6
P-Spline Age-Cohort Projections:		
PSAC_Male_Ass_2003_50	1.0	4
PSAC_Male_Ass_2004_50	1.0	4
PSAC_Male_Ass_2005_50	1.0	4
PSAC_Male_Ass_2006_50	1.1	6
PSAC_Male_ONS_EW_2003_50	1.0	4
PSAC_Male_ONS_EW_2004_50	1.0	4
PSAC_Male_ONS_EW_2005_50	1.0	4
PSAC_Male_ONS_EW_2006_50	1.1	6
PSAC_Male_ONS_EW_2007_50	1.1	6
PSAC_Male_ONS_EW_2008_50	1.2	7
PSAC_Male_ONS_EW_2009_50	1.2	7
PSAC_Male_ONS_EW_2010_50	1.3	8
PSAC_Female_ONS_EW_2003_50	1.0	4
PSAC_Female_ONS_EW_2004_50	1.0	4
PSAC_Female_ONS_EW_2005_50	1.0	4
PSAC_Female_ONS_EW_2006_50	1.1	6
PSAC_Female_ONS_EW_2007_50	1.1	6
PSAC_Female_ONS_EW_2008_50	1.2	7
PSAC_Female_ONS_EW_2009_50	1.2	7
PSAC_Female_ONS_EW_2010_50	1.3	8
Lee-Carter Projections:		
LC_Male_Ass_2003_Central	1.0	5
LC_Male_Ass_2004_Central	1.0	5
LC_Male_Ass_2005_Central	1.0	5
LC_Male_Ass_2006_Central	1.1	6
LC_Male_ONS_EW_2003_Central	1.0	5
LC_Male_ONS_EW_2004_Central	1.0	5
LC_Male_ONS_EW_2005_Central	1.0	5
LC_Male_ONS_EW_2006_Central	1.1	6
LC_Male_ONS_EW_2007_Central	1.1	6
LC_Male_ONS_EW_2008_Central	1.2	7
LC_Male_ONS_EW_2009_Central	1.2	7
LC_Male_ONS_EW_2010_Central	1.3	8
LC_Female_ONS_EW_2003_Central	1.0	5
LC_Female_ONS_EW_2004_Central	1.0	5
LC_Female_ONS_EW_2005_Central	1.0	5
LC_Female_ONS_EW_2006_Central	1.1	6
LC_Female_ONS_EW_2007_Central	1.1	6
LC_Female_ONS_EW_2008_Central	1.2	7

Projection	CMI Library Version	CMI Library Volume
LC_Female_ONS_EW_2009_Central	1.2	7
LC_Female_ONS_EW_2010_Central	1.3	8
Projections from CMI Mortality Projections Model:		
CMI_2009_ML [1.00%]_Midpoint50%	1.2	7
CMI_2009_ML [1.00%]_Midpoint75%	1.2	7
CMI_2009_ML [2.00%]_Midpoint50%	1.2	7
CMI_2009_FL [1.00%]_Midpoint50%	1.2	7
CMI_2009_FL [1.00%]_Midpoint75%	1.2	7
CMI_2009_FL [2.00%]_Midpoint50%	1.2	7
CMI_2010_ML [1.00%]_Midpoint50%	1.2	7
CMI_2010_ML [1.00%]_Midpoint75%	1.2	7
CMI_2010_ML [2.00%]_Midpoint50%	1.2	7
CMI_2010_FL [1.00%]_Midpoint50%	1.2	7
CMI_2010_FL [1.00%]_Midpoint75%	1.2	7
CMI_2010_FL [2.00%]_Midpoint50%	1.2	7
CMI_2011_ML (1.0%), 50%	1.3	8
CMI_2011_ML (2.0%), 50%	1.3	8
CMI_2011_ML (2.0%), 75%	1.3	8
CMI_2011_FL (1.0%), 50%	1.3	8
CMI_2011_FL (1.0%), 75%	1.3	8
CMI_2011_FL (2.0%), 50%	1.3	8

References

C.M.I. (1933) Mortality of Assured Lives 1924-29.

C.M.I. (1953) The a(55) Tables for Annuitants.

C.M.I. (1957) A1949-52 Tables for Assured Lives.

C.M.I. (1975) A1967-70 Tables for Assured Lives.

Neill A (1977) Life Contingencies. Heinemann.

C.M.I. (1979) a(90) Tables for Annuitants.

C.M.I. (1979) PA(90) Tables for Pensioners.

C.M.I. (1981) a(55) Tables: q_x at High Ages. *C.M.I.R.* **5**, 47.

C.M.I. (1983) FA1975-78 Mortality Tables for Female Assured Lives.

Walden J (1986) File Formats for Popular PC Software - A Programmer's Reference. John Wiley & Sons Inc.

AIDS Working Party (1989). AIDS Bulletin No. 4.

G.A.D. (1989) Reserves for HIV and AIDS. Dear Appointed Actuary letter 7 December 1989.

C.M.I. (1990) Standard Tables of Mortality Based on the 1979-82 Experiences. *C.M.I.R.* **10**.

C.M.I. (1991) The analysis of Permanent Health Insurance data. *C.M.I.R.* **12**.

AIDS Working Party (1991). AIDS Bulletin No. 5.

C.M.I. (1993) *C.M.I.R.* **12** Errata. *C.M.I.R.* **13**, 131.

C.M.I. (1993) Calculation of continuation tables and allowance for non-reported claims based on the PHI experience 1975-78. *C.M.I.R.* **13**, 123.

C.M.I. (1993) Mortality tables based on the Combined Pensioners Experience, 1979-82. *C.M.I.R.* **13**, 77.

G.A.D. (1993) Reserving for AIDS. Dear Appointed Actuary letter 30 September 1993.

G.A.D. (1996) Recommended AIDS reserving policy. Dear Appointed Actuary letter 29 October 1996.

C.M.I. (1998) Proposed new tables for life office pensioners, normal, male and female, based on the 1991-94 experiences. *C.M.I.R.* **16**, 113.

C.M.I. (1999) Standard tables of mortality based on the 1991-94 experiences. *C.M.I.R.* **17**.

C.M.I. (2002) An interim basis for adjusting the "92" Series mortality projections for cohort effects. C.M.I. Working Paper 1.

C.M.I. (2006) The Graduation of the CMI 1999-2002 Mortality Experience: Final "00" Series Mortality Tables – Assured Lives. Working Paper 21.

C.M.I. (2006) The Graduation of the CMI 1999-2002 Mortality Experience: Final "00" Series Mortality Tables – Annuitants and Pensioners. Working Paper 22.

C.M.I. (2007) Extensions to Younger Ages of the "00" Series Tables of Mortality. Working Paper 26.

C.M.I. (2007) The CMI Library of Mortality Projections. Working Paper 30.

C.M.I. (2008) The graduations of the CMI Self-Administered Pension Schemes 2000-2006 mortality experience. Final "S1" Series of Mortality Tables. Working Paper 35.

C.M.I. (2009) Graduation of the 1999-2002 Mortality Experience - the "00" Series Tables. *C.M.I.R.* **23**.

C.M.I. (2009) Version 1.1 of the CMI Library of Mortality Projections. Working Paper 37.

C.M.I. (2011) User guide to version 1.3 of the CMI Library of Mortality Projections

[All references are published by The Institute and Faculty of Actuaries unless otherwise stated.]

Appendix A

Files included with the STP package

Program

STP.EXE	The **STP** program
BWCORE.DLL	Runtime library
BWSTORAGE.DLL	Runtime library
STPCORE.DLL	Runtime library
STPCALCULATION.DLL	Runtime library

Files of Tables containing q_x's, AIDS adjustments, mortality improvement factors and PHI inception rates.

CMIOLD.TBL	A1924-29 assured lives A1949-52 assured lives a(55) immediate annuitants, males a(55) immediate annuitants, females A1967-70 male assured lives A1967-70 male assured lives, five-year select PA(90) pensioners, males PA(90) pensioners, females a(90) annuitants, males a(90) annuitants, females FA1975-78 female assured lives.
CMIR10.TBL	Permanent assurances, females, two-year select, 1980 Permanent assurances, males, two-year select, 1980 Permanent assurances, males, five-year select, 1980 Immediate annuitants, females, one-year select, 1980 Immediate annuitants, males, one-year select, 1980 Pensioners, females, amounts, 1980 Pensioners, females, lives, 1980 Pensioners, males, amounts, 1980 Pensioners, males, lives, 1980 Temporary assurances, males, 1980 Widows, amounts, 1980 Widows, lives, 1980
CMIR12.TBL	PHI Mortality rates 1 week deferred basis, five year select (E20b) 4 week deferred basis, five year select (E26) 13 week deferred basis, five year select (E30) 26 week deferred basis, five year select (E34)

PHI Inception rates
- Type (a) D1 (E22b)
- Type (a) D4 (E27)
- Type (a) D4 Non-Reported
- Type (a) D13 (E31)
- Type (a) D13 Non-Reported
- Type (a) D26 (E35a)
- Type (a) D26 Non-Reported
- Type (a) D52 (E35b)
- Type (b) D1
- Type (b) D4
- Type (b) D4 Non-Reported
- Type (b) D13
- Type (b) D13 Non-Reported
- Type (b) D26
- Type (b) D26 Non-Reported
- Type (b) D52

CMIR13.TBL
- Combined Pensioners, females, amounts, 1980
- Combined Pensioners, females, lives, 1980
- Combined Pensioners, males, amounts, 1980
- Combined Pensioners, males, lives, 1980

CMIR17.TBL
- Permanent assurances, females, two-year select, 1992
- Permanent assurances, males, two-year select, 1992
- Immediate annuitants, females, amounts, one-year select, 1992
- Immediate annuitants, females, lives, one-year select, 1992
- Immediate annuitants, males, amounts, one-year select, 1992
- Immediate annuitants, males, lives, one-year select, 1992
- Pensioners, females, amounts, 1992
- Pensioners, females, lives, 1992
- Pensioners, males, amounts, 1992
- Pensioners, males, lives, 1992
- Retirement annuitants, females, vested, 1992
- Retirement annuitants, males, vested, 1992
- Temporary assurances, females, five-year select, 1992
- Temporary assurances, males, five-year select, 1992
- Widows, amounts, 1992
- Widows, lives, 1992

AIDS.TBL
- Basis R
- Basis R Modified
- 50% Basis R Modified
- Basis R6A
- Basis R6A Modified
- One third Basis R6A
- Basis R6B
- Basis R6C

CMIWP1.TBL
- CMI WP1 Short Cohort
- CMI WP1 Medium Cohort
- CMI WP1 Long Cohort

CMIWP21.TBL	Permanent assurances, females, combined, two-year select, 2000
	Permanent assurances, females, non-smokers, two-year select, 2000
	Permanent assurances, females, smokers, two-year select, 2000
	Permanent assurances, males, combined, two-year select, 2000
	Permanent assurances, males, non-smokers, two-year select, 2000
	Permanent assurances, males, smokers, two-year select, 2000
	Temporary assurances, females, combined, five-year select, 2000
	Temporary assurances, females, non-smokers, five-year select, 2000
	Temporary assurances, females, smokers, five-year select, 2000
	Temporary assurances, males, combined, five-year select, 2000
	Temporary assurances, males, non-smokers, five-year select, 2000
	Temporary assurances, males, smokers, five-year select, 2000
CMIWP22.TBL	Immediate annuitants, females, one-year select, 2000
	Immediate annuitants, males, 2000
	Pensioners, females, combined, amounts, 2000
	Pensioners, females, combined, lives, 2000
	Pensioners, females, early, amounts, 2000
	Pensioners, females, early, lives, 2000
	Pensioners, females, normal, amounts, 2000
	Pensioners, females, normal, lives, 2000
	Pensioners, males, combined, amounts, 2000
	Pensioners, males, combined, lives, 2000
	Pensioners, males, early, amounts, 2000
	Pensioners, males, early, lives, 2000
	Pensioners, males, normal, amounts, 2000
	Pensioners, males, normal, lives, 2000
	Personal pensioners, females, combined, 2000
	Personal pensioners, females, deferred, 2000
	Personal pensioners, females, vested, 2000
	Personal pensioners, males, combined, 2000
	Personal pensioners, males, deferred, 2000
	Personal pensioners, males, vested, 2000
	Retirement annuitants, females, combined, 2000
	Retirement annuitants, females, deferred, 2000
	Retirement annuitants, females, vested, 2000
	Retirement annuitants, males, combined, 2000
	Retirement annuitants, males, deferred, 2000
	Retirement annuitants, males, vested, 2000
	Widows, amounts, 2000
	Widows, lives, 2000
CMIWP26.TBL	Pensioners, females, combined, amounts, 2000
	Pensioners, females, combined, lives, 2000
	Pensioners, females, early, amounts, 2000
	Pensioners, females, early, lives, 2000
	Pensioners, males, combined, amounts, 2000
	Pensioners, males, combined, lives, 2000
	Pensioners, males, early, amounts, 2000
	Pensioners, males, early, lives, 2000

CMIWP35.TBL	Pensioners, females, all, lives, 2002 Pensioners, females, all, amounts, 2002 Pensioners, females, all, amounts, light, 2002 Pensioners, females, all, amounts, heavy, 2002 Pensioners, males, all, lives, 2002 Pensioners, males, all, amounts, 2002 Pensioners, males, all, amounts, light, 2002 Pensioners, males, all, amounts, heavy, 2002 Dependants, females, lives, 2002 Dependants, females, amounts, 2002 Pensioners, females, normal health, amounts, 2002 Pensioners, females, normal health, amounts, light, 2002 Pensioners, females, normal health, amounts, heavy, 2002 Pensioners, males, normal health, amounts, 2002 Pensioners, males, normal health, amounts, light, 2002 Pensioners, males, normal health, amounts, heavy, 2002 Pensioners, females, ill-health, amounts, 2002 Pensioners, males, ill-health, amounts, 2002
PRJNOV07.TBL	Original "92" Series *CMI WP1* Short Cohort Medium Cohort Long Cohort *Adjusted Interim Cohort Projections* Medium Cohort_1% minimum 90% Medium Cohort 50% Medium Cohort_50% Long Cohort (50% Medium Cohort_50% Long Cohort)_1.5% minimum (120% Long Cohort)_2.5% minimum *ONS 2004-based National Population Projections* ONS_2004_Male_EWNI_Principal ONS_2004_Male_EWNI_High life expectancy ONS_2004_Male_EWNI_Low life expectancy ONS_2004_Male_S_Principal ONS_2004_Male_S_High life expectancy ONS_2004_Male_S_Low life expectancy ONS_2004_Female_UK_Principal ONS_2004_Female_UK_High life expectancy ONS_2004_Female_UK_Low life expectancy *ONS 2006-based National Population Projections* ONS_2006_Male_EWNI_Principal ONS_2006_Male_EWNI_High life expectancy ONS_2006_Male_EWNI_Low life expectancy ONS_2006_Male_S_Principal ONS_2006_Male_S_High life expectancy ONS_2006_Male_S_Low life expectancy ONS_2006_Female_UK_Principal

ONS_2006_Female_UK_High life expectancy
ONS_2006_Female_UK_Low life expectancy

P-Spline Age-Period Projections
PSAP_Male_Ass_2003_50
PSAP_Male_Ass_2004_50
PSAP_Male_Ass_2005_50
PSAP_Male_ONS_EW_2003_50
PSAP_Male_ONS_EW_2004_50
PSAP_Male_ONS_EW_2005_50
PSAP_Female_ONS_EW_2003_50
PSAP_Female_ONS_EW_2004_50
PSAP_Female_ONS_EW_2005_50

P-Spline Age-cohort Projections
PSAC_Male_Ass_2003_50
PSAC_Male_Ass_2004_50
PSAC_Male_Ass_2005_50
PSAC_Male_ONS_EW_2003_50
PSAC_Male_ONS_EW_2004_50
PSAC_Male_ONS_EW_2005_50
PSAC_Female_ONS_EW_2003_50
PSAC_Female_ONS_EW_2004_50
PSAC_Female_ONS_EW_2005_50

Lee-Carter Projections
LC_Male_Ass_2003_Central
LC_Male_Ass_2004_Central
LC_Male_Ass_2005_Central
LC_Male_ONS_EW_2003_Central
LC_Male_ONS_EW_2004_Central
LC_Male_ONS_EW_2005_Central
LC_Female_ONS_EW_2003_Central
LC_Female_ONS_EW_2004_Central
LC_Female_ONS_EW_2005_Central

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P-Spline Age-Period Projections
PSAP_Male_Ass_2006_50
PSAP_Male_ONS_EW_2006_50
PSAP_Male_ONS_EW_2007_50
PSAP_Female_ONS_EW_2006_50
PSAP_Female_ONS_EW_2007_50

P-Spline Age-cohort Projections
PSAC_Male_Ass_2006_50
PSAC_Male_ONS_EW_2006_50
PSAC_Male_ONS_EW_2007_50
PSAC_Female_ONS_EW_2006_50
PSAC_Female_ONS_EW_2007_50

Lee-Carter Projections
LC_Male_Ass_2006_Central

LC_Male_ONS_EW_2006_Central
LC_Male_ONS_EW_2007_Central
LC_Female_ONS_EW_2006_Central
LC_Female_ONS_EW_2007_Central

PRJFEB11.TBL

P-Spline Age- cohort Projections
PSAC_Male_ONS_EW_2008_50
PSAC_Male_ONS_EW_2009_50
PSAC_Female_ONS_EW_2008_50
PSAC_Female_ONS_EW_2009_50

Lee-Carter Projections
LC_Male_ONS_EW_2008_Central
LC_Male_ONS_EW_2009_Central
LC_Female_ONS_EW_2008_Central
LC_Female_ONS_EW_2009_Central

ONS 2008-based National Population Projections
ONS_2008_Male_EWNI_Principal
ONS_2008_Male_EWNI_High life expectancy
ONS_2008_Male_EWNI_Low life expectancy
ONS_2008_Male_S_Principal
ONS_2008_Male_S_High life expectancy
ONS_2008_Male_S_Low life expectancy
ONS_2008_Female_EWNI_Principal
ONS_2008_Female_EWNI_High life expectancy
ONS_2008_Female_EWNI_Low life expectancy
ONS_2008_Female_S_Principal
ONS_2008_Female_S_High life expectancy
ONS_2008_Female_S_Low life expectancy

CMI Projections
CMI_2009_ML [1.00%]_Midpoint50%
CMI_2009_ML [2.00%]_Midpoint50%
CMI_2009_ML [1.00%]_Midpoint75%
CMI_2010_ML [1.00%]_Midpoint50%
CMI_2010_ML [2.00%]_Midpoint50%
CMI_2010_ML [1.00%]_Midpoint75%
CMI_2009_FL [1.00%]_Midpoint50%
CMI_2009_FL [2.00%]_Midpoint50%
CMI_2009_FL [1.00%]_Midpoint75%
CMI_2010_FL [1.00%]_Midpoint50%
CMI_2010_FL [2.00%]_Midpoint50%
CMI_2010_FL [1.00%]_Midpoint75%

PRJDEC11.TBL

P-Spline Age- cohort Projections
PSAC_Male_ONS_EW_2010_50
PSAC_Female_ONS_EW_2010_50

Lee-Carter Projections
LC_Male_ONS_EW_2010_Central
LC_Female_ONS_EW_2010_Central

ONS 2008-based National Population Projections
ONS_2010_Male_EWNI_Principal
ONS_2010_Male_EWNI_High life expectancy
ONS_2010_Male_EWNI_Low life expectancy
ONS_2010_Male_S_Principal
ONS_2010_Male_S_High life expectancy
ONS_2010_Male_S_Low life expectancy
ONS_2010_Female_EWNI_Principal
ONS_2010_Female_EWNI_High life expectancy
ONS_2010_Female_EWNI_Low life expectancy
ONS_2010_Female_S_Principal
ONS_2010_Female_S_High life expectancy
ONS_2010_Female_S_Low life expectancy

CMI Projections
CMI_2011_ML (1.0%), 50%
CMI_2011_ML (2.0%), 50%
CMI_2011_ML (2.0%), 75%
CMI_2011_FL (1.0%), 50%
CMI_2011_FL (2.0%), 50%
CMI_2011_FL (1.0%), 75%

The help file

STP.CHM

Library files and associated hash code lists

A6770.STP	A1967-70 Forms
A6770.HSH	A1967-70 hash codes for Forms
A55.STP	a(55) Forms
A55.HSH	a(55) hash codes for Forms
A90.STP	a(90) Forms
A90.HSH	a(90) hash codes for Forms
PA90.STP	PA(90) Forms
PA90.HSH	PA(90) hash codes for Forms
FA197578.STP	FA1975-78 Forms
FA197578.HSH	FA1975-78 hash codes for Forms
80SERIES.STP	"80" Series Forms
80SERIES.HSH	"80" Series hash codes for Forms
92SERIES.STP	"92" Series Forms
92SERIES.HSH	"92" Series hash codes for Forms
00SERIES.STP	"00" Series Forms
00SERIES.HSH	"00" Series hash codes for Forms

Note : all files with extensions HSH are ASCII text files and can be sent directly to a printer or a file viewing (e.g. a word processor) facility.

Other files

IMPROVE.XML	Parameter file for tables of improvement factors.
README.TXT	List of modifications to program not included in manual.
STP.CFG	Parameter file which controls calculation of μ_x for each non-"00" or "S1" Series table.
MANUAL.PDF	The STP manual.

Appendix B

The Batch Calculate Forms Index

Using the Batch Calc button can generate a large amount of either printed or saved output. In order to help you keep track of this, **STP** produces an Index that records details of the tasks it has performed. The format of this report, called an Index, is slightly different depending on whether you ask for printed or saved output.

Printed output

In this case the Index will be opened in Notepad at the end of the printed output produced by **STP**. An example of a printed Index page is given below. The Form Library is the description and the file name of the Library from which Forms are being processed. Date and time have the expected meanings and relate to the time the processing started. The Column headed "No" represents the Form number within the Library. In this example only Forms 1 and 2 from the Manual.STP Library was processed. The column headed "Form Name" gives the description of the Form. Although the same Form was processed several times each was for a different interest rate, as shown by the "Int rate" column. For each Form and interest rate processed the hash code is recorded. This is also shown at the foot of the printed pages of Tables to help identification. Each page produced in this process is numbered and the first page number for each new Table is given in the last column. The last piece of information recorded is the total run time, including printing, of this **STP** process. In this case it was eleven seconds.

```
CMI Tables Program
======================

Form Library : STP Manual (C:\Program Files\STP\Libraries\Manual.STP)

Date : 01/11/1999          Time : 11:59

 No Form Name                                                    Int Rate  Hash Cd  Page Number
-------------------------------------------------------------------------------------------------
  1 IFA92Base ä{x} A{x} P{x} Ultimate i=1.%-5.%                   1.0000   E30BB8F9 1
  1 IFA92Base ä{x} A{x} P{x} Ultimate i=1.%-5.%                   2.0000   FA05C114 2
  1 IFA92Base ä{x} A{x} P{x} Ultimate i=1.%-5.%                   3.0000   4EE99EE1 3
  1 IFA92Base ä{x} A{x} P{x} Ultimate i=1.%-5.%                   4.0000   6FDEB9C8 4
  1 IFA92Base ä{x} A{x} P{x} Ultimate i=1.%-5.%                   5.0000   2EB0E3C2 5
  2 IMA92(U=2000) ä{x} A{x} P{x} Ultimate i=1.%-5.%               1.0000   E9689DA7 6
  2 IMA92(U=2000) ä{x} A{x} P{x} Ultimate i=1.%-5.%               2.0000   BB5DC11B 7
  2 IMA92(U=2000) ä{x} A{x} P{x} Ultimate i=1.%-5.%               3.0000   9865CE57 8
  2 IMA92(U=2000) ä{x} A{x} P{x} Ultimate i=1.%-5.%               4.0000   7F795267 9
  2 IMA92(U=2000) ä{x} A{x} P{x} Ultimate i=1.%-5.%               5.0000   45352DC8 10

Time to complete calculations : 0:00:11
-------------------------------------------------------------------------------------------------
```

Saved output

Saving output to files generates a text file recording similar information to that given for printed output. An example is given below. This also shows how warning messages

are given if an error condition occurs during processing. Note that if you interrupt the "saving" by pressing ESC at any time an Index file is still produced but the record of the last Form to be processed will be missing. The main difference is that instead of page numbers, file names (which contain the relevant output) are recorded for each Form and interest rate processed.

```
CMI Tables Program
======================

Form Library : STP Manual (C:\Program Files\STP\Libraries\Manual.STP)

Date : 04/11/1999          Time : 12:42

 No Form Name                                                Int rate  Hash Cd  File Name
-------------------------------------------------------------------------------------------------
  1 IML92Base a{x&n} a{x|n} ä{x|n} Select n=45 i=4.%         4.0000 * 93C56771 C:\Program Files\STP\
                                                                               Results\IML92Base
                                                                               a{x&n} a{x_n} ä{x_n}
                                                                               Select n=45 i=4.%.WK1
  2 TM92 TF92 A{x&y&n} Ultimate x+n=65 i=5.%-6.%             5.0000   B1B08CF9 C:\Program Files\STP
                                                                               \Results\TM92 TF92
                                                                               A{x&y&n} Ultimate
                                                                               x+n=65 i=5.%-6.% at
                                                                               5.%.WK1
  2 TM92 TF92 A{x&y&n} Ultimate x+n=65 i=5.%-6.%             6.0000   12670C6E C:\Program Files\STP
                                                                               \Results\TM92 TF92
                                                                               A{x&y&n} Ultimate
                                                                               x+n=65 i=5.%-6.% at
                                                                               6.%.WK1

Time to complete calculations : 0:00:04
-------------------------------------------------------------------------------------------------
NOTE: * indicates the adjustments applied to qx caused its value to fall outside the range 0 to 1
```

Note the "File Name" column has been wrapped for clarity.

File naming conventions - Saved output

The file containing the Index information has the same name as the Library but with an extension TXT. This will be saved into the results directory. In this example the Index file is called Manual.txt. If this file already exists when you start this command **STP** asks you if you want to Append or Overwrite this file.

The results are saved in separate files using one of two naming schemes.

1. <Form Name> at <Interest Rate>.<File type>
2. <Library Name> <Sequential number>.<File type>

where

<Form Name> is the name of the Form in the Library.

<Interest Rate> is the rate used for this calculation if multiple rates were selected.

<File type> is the file extension and can be either WK1, XLS, HTM, XML, TXT or CSV depending on the file format selected.

<Library name> is the filename of the Library excluding the STP extension.

<Sequential number> is a number chosen to ensure the filename is unique.

Appendix C

The Linear Actuarial Notation

STP versions 1 and 2 were DOS programs which were designed to print to standard ASCII character printers. The standard capabilities of these printers could not print actuarial symbols and it was not practical for **STP** to support the special graphical printing capabilities of a wide range of printer. As an alternative a linear notation for actuarial symbols, limited to the standard ASCII character set, was developed.

STP version 3 is a Windows program and displays and prints actuarial symbols using the standard Windows interface. However, when using the *Copy* and *Paste* functions between Windows programs and when saving Forms to Libraries the old linear notation is still used. For example, the actuarial symbols in column headings when pasting into a spreadsheet are shown in the linear notation. This chapter explains this notation, which is the same as that used for **STP** versions 1 and 2.

Annuities

The symbol a{status} represents an annuity payable so long as the status persists. The symbol "a{status} represents an annuity payable in advance while the status persists. The symbols used to define the status are:

x	a life aged *x* being alive
y	a life aged *y* being alive
n	a term certain of *n* years

These symbols may be combined by using the operators:

!	NOT
&	AND
|	OR

The status is delimited by the {} characters. Using this notation a{x} represents the present value of an annuity payable throughout life to a life aged x at the outset, a{x&y} is a joint-life annuity payable while x and y are both alive, and a{x|y} is a joint-life annuity payable while either x or y is alive, i.e. a last survivor annuity. By analogy a{x&n} is an annuity payable so long as both x is alive and the term certain n has not expired, i.e. a single-life temporary annuity.

The order of 'binding' of the operators is important. ! (NOT) has precedence over & (AND) and | (OR). Thus {!x&y} means "x is dead and y is alive", not "x and y are not both alive", which would be {!(x&y)}. In this latter case parentheses override the normal precedence of the operators. No precedence as between & and | is defined. Thus {x&y|n} is ambiguous and must either be resolved as {(x&y)|n} or {x&(y|n)}. However, the operators & and | are transitive so that {x&y&n} and {x|y|n} are both unambiguous. The annuity functions produced by the program are:

"a{x}	=	$\ddot{a}_x$
a{x&y}	=	a_{xy}

"a{x&y}	=	$\ddot{a}_{xy}$
a{x|y}	=	$a_{\overline{xy}}$
"a{x|y}	=	$\ddot{a}_{\overline{xy}}$
a{!x&y}	=	$a_{x\|y}$
a{x&n}	=	$a_{x:\overline{n}\rceil}$
"a{x&n}	=	$\ddot{a}_{x:\overline{n}\rceil}$
a{x|n}	=	$a_{\overline{x:\overline{n}}\rceil}$
"a{x|n}	=	$\ddot{a}_{\overline{x:\overline{n}}\rceil}$
a{x&y&n}	=	$a_{xy:\overline{n}\rceil}$
"a{x&y&n}	=	$\ddot{a}_{xy:\overline{n}\rceil}$
a{(x&y)|n}	=	$a_{\overline{xy:\overline{n}}\rceil}$
"a{(x&y)|n}	=	$\ddot{a}_{\overline{xy:\overline{n}}\rceil}$
a{(x|y)&n}	=	$a_{\overline{xy}:\overline{n}\rceil}$
"a{(x|y)&n}	=	$\ddot{a}_{\overline{xy}:\overline{n}\rceil}$

Assurances

The symbol A{status} represents the present value of an assurance which becomes payable when the status first ceases. The notation used to define the status is as described for annuities. Thus A{x&y} represents an assurance payable when the status "x and y are both alive" ceases, i.e. on the first death of x and y. The symbol A{x|y} represents an assurance payable when the status "x or y is alive" ceases, i.e. on the second death. Assurances are calculated as if payable at the end of the year in which the status ceases.

For some assurance functions, payments are made only if the status ends during a specified period. An example of this is a term assurance. For these cases the notation is extended to take the form {period}A{status}. Examples of the use of this are:

{n}A{x} = $A^{1}_{x:\overline{n}\rceil}$ = ${}_{n}A_{x}$

i.e. an assurance payable on the death of x if this occurs before the term n has expired.

{y}A{x} = A^{1}_{xy}

i.e. an assurance payable on the death of x if this occurs before the death of y.

Providing the status exists at time 0, the relationship A{status} = 1 – d "a{status} is true. In this way this notation mirrors the normal actuarial notation where $A_x = 1 - d\ddot{a}_x$.

The assurance functions produced by the program are:

A{x}	=	A_x		
{x}A{n}	=	$A^{\ 1}_{x:\overline{n}\rceil}$	=	${}_{n}E_{x}$
{n}A{x}	=	$A^{1}_{x:\overline{n}\rceil}$	=	${}_{n}A_{x}$
A{x&n}	=	$A_{x:\overline{n}\rceil}$		

A{x&y}	=	A_{xy}
A{x|y}	=	$A_{\overline{xy}}$
{y}A{x}	=	A^{1}_{xy}
A{x&y&n}	=	$A_{xy:\overline{n}\rceil}$
A{(x|y)&n}	=	$A_{\overline{xy}:\overline{n}\rceil}$
{n}A{x&y}	=	${}_{n}A_{xy}$
{n}A{x|y}	=	${}_{n}A_{\overline{xy}}$
{n&y}A{x}	=	${}_{n}A^{1}_{xy}$

Premiums

The program calculates a limited number of premium functions. These are:

P{x}	=	P_x	=	$\frac{A_x}{\ddot{a}_x}$
{n}P{x}	=	${}_{n}P_x$	=	$\frac{{}_{n}A_x}{\ddot{a}_{x:\overline{n}\rceil}}$
P{x&n}	=	$P_{x:\overline{n}\rceil}$	=	$\frac{A_{x:\overline{n}\rceil}}{\ddot{a}_{x:\overline{n}\rceil}}$

Mortality and commutation functions

Although the notation described above does not have an identical significance when applied to mortality and commutation functions it has been carried through to provide a measure of consistency; since only single life functions are involved there is no ambiguity. Thus,

l{x} = l_x, q{x} = q_x and μ{x} = μ_x

Similarly for commutation functions:

D{x} = D_x, N{x} = N_x, S{x} = S_x

C{x} = C_x, M{x} = M_x, R{x} = R_x

PHI functions

A limited range of functions is available for PHI. A description of these functions and the notation used is given in Chapter Seven - PHI Forms. The linear notation used in the program translates to the notation of Chapter Seven as follows:

aSS{[x]+t,N}	=	$a^{\overline{ss}(f)}_{[x]+t,t+d:\overline{N}\rceil}$
"aSS{[x]+t,N}	=	$\ddot{a}^{\overline{ss}(f)}_{[x]+t,t+d:\overline{N}\rceil}$

l{[x]}	=	$l_{[x]}$
L{[x]+t}	=	$L_{[x]+t} = \frac{l_{[x]+t} + l_{[x]+t+1}}{2}$
ia{[x]+t}	=	$ia^{d}_{[x]+t}$
ib{[x]+t}	=	$ib^{d}_{[x]+t}$
a2(x,N)	=	$a^{2}_{x,N}$
a12(x,N)	=	$a^{1,2}_{x,N}$
a21(x,N)	=	$a^{2,1}_{x,N}$
aHS(x,N)	=	$a^{HS(d/all)}_{x,d:\overline{n}\rceil}$

Appendix D

Sample PHI Output

This Appendix shows the four pages of printed output from **STP** referred to in *Chapter Seven – PHI Forms*.

1. Sample Current Claim Annuity output
2. Sample Current Claim Annuity output with a duration adjustment
3. Sample Pricing Function output with type (a) inception rates
4. Sample Pricing Function output with type (b) inception rates

Current Claim Annuities

Morbidity basis : CMIR12
Deferred period : 13 weeks
Non-reported claims : Excluded
Adjustments : 1.0000*rho+1.0000*nu
Interest : 6.0000%

Payments : 52 pa in arr
Initial Multiple : 1
Proportion : Yes - Default

$$a^{SS(52)}_{[x]+t,t:N=65-[x]}$$

Age [x]	Term	t=0	t=1/52	t=4/52	t=13/52	t=26/52	t=52/52	t=2	t=3	t=4	t>=5	[x]+t
16	49	.49429	.49994	.59906	1.14426	1.93299	3.02943	4.77395	5.91095	6.47488	6.63779	21
17	48	.51411	.52042	.62372	1.18514	1.99005	3.10055	4.85175	5.98500	6.54531	6.70756	22
18	47	.53504	.54205	.64969	1.22779	2.04906	3.17349	4.93071	6.05968	6.61607	6.77747	23
19	46	.55715	.56489	.67704	1.27228	2.11008	3.24825	5.01078	6.13489	6.68701	6.84739	24
20	45	.58051	.58900	.70583	1.31866	2.17314	3.32483	5.09188	6.21051	6.75800	6.91714	25
21	44	.60519	.61447	.73615	1.36701	2.23829	3.40322	5.17393	6.28642	6.82885	6.98652	26
22	43	.63125	.64135	.76807	1.41739	2.30556	3.48340	5.25682	6.36244	6.89939	7.05530	27
23	42	.65878	.66973	.80166	1.46987	2.37497	3.56534	5.34044	6.43841	6.96938	7.12323	28
24	41	.68784	.69968	.83700	1.52451	2.44655	3.64898	5.42463	6.51410	7.03857	7.19003	29
25	40	.71851	.73128	.87416	1.58136	2.52029	3.73426	5.50923	6.58929	7.10668	7.25537	30
26	39	.75088	.76461	.91324	1.64047	2.59619	3.82110	5.59404	6.66371	7.17338	7.31887	31
27	38	.78501	.79974	.95429	1.70188	2.67423	3.90938	5.67883	6.73704	7.23831	7.38014	32
28	37	.82099	.83675	.99740	1.76563	2.75437	3.99898	5.76333	6.80894	7.30106	7.43870	33
29	36	.85889	.87571	1.04263	1.83173	2.83656	4.08972	5.84725	6.87902	7.36118	7.49406	34
30	35	.89879	.91671	1.09004	1.90019	2.92071	4.18143	5.93024	6.94684	7.41815	7.54563	35
31	34	.94074	.95980	1.13970	1.97100	3.00671	4.27386	6.01190	7.01190	7.47141	7.59277	36
32	33	.98481	1.00504	1.19164	2.04412	3.09441	4.36673	6.09179	7.07365	7.52032	7.63480	37
33	32	1.03105	1.05248	1.24591	2.11950	3.18365	4.45973	6.16942	7.13149	7.56418	7.67092	38
34	31	1.07950	1.10215	1.30250	2.19704	3.27420	4.55249	6.24420	7.18471	7.60221	7.70027	39
35	30	1.13018	1.15408	1.36142	2.27662	3.36578	4.64455	6.31551	7.23256	7.63356	7.72189	40
36	29	1.18309	1.20826	1.42264	2.35807	3.45807	4.73543	6.38263	7.27419	7.65727	7.73475	41
37	28	1.23822	1.26468	1.48610	2.44119	3.55069	4.82453	6.44475	7.30867	7.67229	7.73769	42
38	27	1.29550	1.32326	1.55170	2.52569	3.64318	4.91121	6.50099	7.33495	7.67747	7.72943	43
39	26	1.35487	1.38393	1.61930	2.61125	3.73498	4.99469	6.55035	7.35190	7.67155	7.70861	44
40	25	1.41617	1.44654	1.68871	2.69745	3.82548	5.07413	6.59171	7.35826	7.65315	7.67369	45
41	24	1.47924	1.51089	1.75967	2.78380	3.91393	5.14855	6.62385	7.35264	7.62073	7.62302	46
42	23	1.54383	1.57674	1.83186	2.86970	3.99947	5.21683	6.64541	7.33352	7.57266	7.55479	47
43	22	1.60962	1.64375	1.90486	2.95444	4.08113	5.27775	6.65488	7.29924	7.50710	7.46703	48
44	21	1.67620	1.71150	1.97816	3.03718	4.15776	5.32989	6.65060	7.24798	7.42209	7.35758	49
45	20	1.74307	1.77947	2.05113	3.11694	4.22808	5.37168	6.63072	7.17773	7.31547	7.22413	50
46	19	1.80959	1.84700	2.12301	3.19255	4.29059	5.40137	6.59323	7.08632	7.18490	7.06413	51
47	18	1.87500	1.91331	2.19286	3.26267	4.34361	5.41696	6.53591	6.97138	7.02785	6.87483	52
48	17	1.93836	1.97742	2.25958	3.32574	4.38523	5.41627	6.45631	6.83031	6.84155	6.65326	53
49	16	1.99854	2.03820	2.32186	3.37994	4.41325	5.39683	6.35177	6.66032	6.62302	6.39619	54
50	15	2.05420	2.09424	2.37813	3.42318	4.42522	5.35591	6.21935	6.45833	6.36901	6.10014	55
51	14	2.10372	2.14392	2.42655	3.45308	4.41836	5.29046	6.05584	6.22104	6.07602	5.76134	56
52	13	2.14520	2.18528	2.46496	3.46686	4.38953	5.19712	5.85776	5.94483	5.74027	5.37572	57
53	12	2.17640	2.21602	2.49083	3.46138	4.33522	5.07215	5.62127	5.62580	5.35765	4.93890	58
54	11	2.19466	2.23346	2.50120	3.43304	4.25146	4.91141	5.34220	5.25974	4.92377	4.44614	59
55	10	2.19689	2.23444	2.49266	3.37774	4.13382	4.71031	5.01602	4.84206	4.43385	3.89233	60
56	9	2.17947	2.21526	2.46121	3.29082	3.97733	4.46382	4.63777	4.36782	3.88275	3.27199	61
57	8	2.13817	2.17164	2.40224	3.16698	3.77643	4.16635	4.20207	3.83168	3.26494	2.57921	62
58	7	2.06808	2.09860	2.31045	3.00023	3.52491	3.81176	3.70308	3.22786	2.57445	1.80760	63
59	6	1.96352	1.99036	2.17970	2.78377	3.21586	3.39328	3.13443	2.55013	1.80488	.95032	64
60	5	1.81789	1.84023	2.00293	2.50993	2.84156	2.90346	2.48923	1.79176	.94929		
61	4	1.62351	1.64043	1.77198	2.16994	2.39328	2.33395	1.75977	.94527			
62	3	1.37064	1.38110	1.47648	1.75259	1.85975	1.67369	.93544				
63	2	1.04608	1.04886	1.10232	1.24241	1.22498	.90655					
64	1	.62704	.62056	.62482	.61109	.45843						

Hashcode : FC5DDE18
Form name : aSS{x+t,n} D13 (52 pa) 6.% x+n=65

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Current Claim Annuities

Morbidity basis : CMIR12
Deferred period : 13 weeks
Non-reported claims : Excluded
Adjustments : 1.0000*rho+1.0000*nu
Interest : 6.0000%

Payments : 52 pa in arr
Initial Multiple : 1
Proportion : Yes - Default
Duration Adjustment : w=.5000/52

$$a^{SS(52)}_{[x]+t,t:N=65-[x]}$$

Age [x]	Term	t=0	t=1/52	t=4/52	t=13/52	t=26/52	t=52/52	t=2	t=3	t=4	t>=5	[x]+t -w
16	49	.49429	.50499	.58314	1.12209	1.91499	3.02027	4.76948	5.91260	6.48128	6.64674	21
17	48	.51411	.52510	.60688	1.16216	1.97159	3.09122	4.84729	5.98670	6.55174	6.71650	22
18	47	.53504	.54633	.63189	1.20399	2.03014	3.16399	4.92626	6.06142	6.62251	6.78641	23
19	46	.55715	.56876	.65825	1.24763	2.09069	3.23858	5.00635	6.13668	6.69348	6.85633	24
20	45	.58051	.59244	.68602	1.29315	2.15330	3.31501	5.08749	6.21237	6.76450	6.92608	25
21	44	.60519	.61746	.71528	1.34063	2.21799	3.39325	5.16958	6.28833	6.83539	6.99546	26
22	43	.63125	.64388	.74610	1.39013	2.28480	3.47330	5.25252	6.36443	6.90596	7.06425	27
23	42	.65878	.67177	.77855	1.44172	2.35376	3.55510	5.33619	6.44046	6.97599	7.13220	28
24	41	.68784	.70122	.81272	1.49544	2.42488	3.63862	5.42045	6.51624	7.04522	7.19901	29
25	40	.71851	.73229	.84869	1.55138	2.49819	3.72380	5.50513	6.59152	7.11337	7.26436	30
26	39	.75088	.76507	.88652	1.60956	2.57366	3.81054	5.59003	6.66603	7.18013	7.32788	31
27	38	.78501	.79964	.92630	1.67005	2.65128	3.89874	5.67491	6.73946	7.24511	7.38917	32
28	37	.82099	.83606	.96810	1.73286	2.73103	3.98827	5.75953	6.81148	7.30793	7.44777	33
29	36	.85889	.87443	1.01199	1.79804	2.81283	4.07897	5.84358	6.88168	7.36812	7.50315	34
30	35	.89879	.91480	1.05804	1.86557	2.89661	4.17065	5.92671	6.94962	7.42516	7.55476	35
31	34	.94074	.95725	1.10631	1.93547	2.98227	4.26307	6.00854	7.01483	7.47851	7.60196	36
32	33	.98481	1.00183	1.15683	2.00769	3.06966	4.35597	6.08861	7.07674	7.52751	7.64403	37
33	32	1.03105	1.04859	1.20966	2.08218	3.15862	4.44901	6.16643	7.13474	7.57147	7.68021	38
34	31	1.07950	1.09758	1.26481	2.15886	3.24891	4.54183	6.24144	7.18815	7.60962	7.70963	39
35	30	1.13018	1.14880	1.32227	2.23762	3.34029	4.63400	6.31299	7.23619	7.64109	7.73134	40
36	29	1.18309	1.20227	1.38203	2.31828	3.43242	4.72501	6.38037	7.27804	7.66493	7.74429	41
37	28	1.23822	1.25796	1.44404	2.40066	3.52492	4.81429	6.44279	7.31274	7.68010	7.74732	42
38	27	1.29550	1.31582	1.50821	2.48447	3.61735	4.90117	6.49935	7.33928	7.68544	7.73918	43
39	26	1.35487	1.37576	1.57440	2.56941	3.70916	4.98491	6.54905	7.35649	7.67970	7.71849	44
40	25	1.41617	1.43764	1.64244	2.65507	3.79973	5.06465	6.59079	7.36314	7.66149	7.68371	45
41	24	1.47924	1.50128	1.71208	2.74097	3.88832	5.13941	6.62334	7.35783	7.62928	7.63320	46
42	23	1.54383	1.56643	1.78302	2.82651	3.97410	5.20809	6.64535	7.33905	7.58144	7.56515	47
43	22	1.60962	1.63277	1.85486	2.91102	4.05608	5.26947	6.65530	7.30512	7.51613	7.47758	48
44	21	1.67620	1.69988	1.92711	2.99365	4.13313	5.32212	6.65153	7.25424	7.43139	7.36836	49
45	20	1.74307	1.76724	1.99915	3.07345	4.20398	5.36450	6.63221	7.18440	7.32507	7.23515	50
46	19	1.80959	1.83422	2.07025	3.14927	4.26714	5.39483	6.59532	7.09343	7.19482	7.07541	51
47	18	1.87500	1.90005	2.13951	3.21978	4.32093	5.41114	6.53863	6.97896	7.03812	6.88641	52
48	17	1.93836	1.96376	2.20586	3.28344	4.36345	5.41124	6.45972	6.83841	6.85220	6.66517	53
49	16	1.99854	2.02423	2.26801	3.33845	4.39252	5.39267	6.35591	6.66895	6.63407	6.40846	54
50	15	2.05420	2.08008	2.32443	3.38276	4.40570	5.35271	6.22427	6.46754	6.38050	6.11280	55
51	14	2.10372	2.12970	2.37332	3.41399	4.40021	5.28830	6.06159	6.23085	6.08799	5.77443	56
52	13	2.14520	2.17116	2.41257	3.42939	4.37292	5.19609	5.86438	5.95529	5.75275	5.38928	57
53	12	2.17640	2.20219	2.43970	3.42586	4.32033	5.07233	5.62881	5.63695	5.37069	4.95297	58
54	11	2.19466	2.22013	2.45180	3.39980	4.23848	4.91289	5.35072	5.27161	4.93740	4.46077	59
55	10	2.19689	2.22184	2.44550	3.34715	4.12294	4.71320	5.02555	4.85470	4.44812	3.90758	60
56	9	2.17947	2.20369	2.41686	3.26326	3.96875	4.46819	4.64837	4.38127	3.89771	3.28791	61
57	8	2.13817	2.16141	2.36135	3.14287	3.77035	4.17230	4.21379	3.84598	3.28064	2.59584	62
58	7	2.06808	2.09005	2.27371	2.97999	3.52155	3.81938	3.71596	3.24305	2.59095	1.82503	63
59	6	1.96352	1.98390	2.14786	2.76785	3.21541	3.40264	3.14851	2.56626	1.82222	.96861	64
60	5	1.81789	1.83632	1.97684	2.49879	2.84421	2.91465	2.50454	1.80888	.96754		
61	4	1.62351	1.63958	1.75252	2.16405	2.39924	2.34704	1.77635	.96341			
62	3	1.37064	1.38387	1.46464	1.75245	1.86919	1.68874	.95332				
63	2	1.04608	1.05592	1.09921	1.24855	1.23811	.92363					
64	1	.62704	.63277	.63185	.62417	.47549						

PHI Pricing Functions

Morbidity basis : CMIR12
Deferred period : 26 weeks
Non-reported claims : Excluded
Adjustments : 1.0000*rho+1.0000*nu

Payments : 12 pa in arr
Initial Multiple : 1
Proportion : No

Mortality table : CMIR12 q[x] 26wk deferred E34
Inception table : CMIR12 ia D26 NonRpd Excluded
Adjustments : 1.0000*ia+0.0000

Interest : 6.0000%

Interest prior to vesting : 4.0000% $v^{1/2}$=.98058068 v^{d}=.98058068

Age [x]+t	v^x	$l_{[x]+t}$ t=0	$L_{[x]+t}$ t=0	$L_{[x]+t}$ t=1	$L_{[x]+t}$ t=2	$L_{[x]+t}$ t=3	$L_{[x]+t}$ t=4	$L_{[x]+t}$ t>=5	$ia_{[x]+t}$ t=0	$ia_{[x]+t}$ t=1	$ia_{[x]+t}$ t=2	$ia_{[x]+t}$ t=3	$ia_{[x]+t}$ t=4	$ia_{[x]+t}$ t>=5	$a^{2}_{(x,N)}$ N=65-[x]	$a^{1,2}_{(x,N)}$ N=65-[x]	$a^{HS}_{(x,N)}$ N=65-[x]	Age [x]+t
25	.37511680	1155026.	1154663.						.000130						1.70971	1.69448	.0879	25
26	.36068923	1154267.	1153914.	1153933.					.000140	.000275					1.77233	1.75653	.0910	26
27	.34681657	1153526.	1153180.	1153201.	1153208.				.000150	.000294	.000294				1.83725	1.82087	.0942	27
28	.33347747	1152800.	1152457.	1152479.	1152486.	1152491.			.000161	.000316	.000316	.000316			1.90450	1.88754	.0975	28
29	.32065141	1152075.	1151733.	1151759.	1151766.	1151771.	1151775.		.000174	.000341	.000341	.000340	.000340		1.97407	1.95653	.1008	29
30	.30831867	1151348.	1151003.	1151032.	1151041.	1151047.	1151051.	1151052.	.000187	.000367	.000367	.000367	.000367	.000367	2.04596	2.02784	.1042	30
31	.29646026	1150610.	1150258.	1150290.	1150302.	1150309.	1150313.	1150315.	.000202	.000396	.000396	.000396	.000396	.000396	2.12012	2.10144	.1077	31
32	.28505794	1149856.	1149493.	1149527.	1149540.	1149548.	1149555.	1149556.	.000219	.000429	.000429	.000429	.000429	.000429	2.19650	2.17727	.1112	32
33	.27409417	1149072.	1148694.	1148733.	1148747.	1148758.	1148764.	1148767.	.000237	.000465	.000465	.000465	.000465	.000465	2.27500	2.25525	.1147	33
34	.26355209	1148254.	1147855.	1147897.	1147915.	1147925.	1147933.	1147936.	.000258	.000505	.000505	.000505	.000505	.000505	2.35551	2.33526	.1183	34
35	.25341547	1147387.	1146963.	1147011.	1147030.	1147043.	1147052.	1147055.	.000281	.000549	.000549	.000549	.000549	.000549	2.43785	2.41716	.1218	35
36	.24366872	1146463.	1146009.	1146062.	1146084.	1146098.	1146108.	1146112.	.000306	.000599	.000599	.000599	.000599	.000599	2.52182	2.50073	.1254	36
37	.23429685	1145468.	1144978.	1145038.	1145063.	1145080.	1145091.	1145096.	.000334	.000654	.000654	.000654	.000654	.000654	2.60716	2.58575	.1289	37
38	.22528543	1144390.	1143858.	1143927.	1143956.	1143975.	1143988.	1143993.	.000366	.000716	.000716	.000716	.000715	.000715	2.69353	2.67188	.1324	38
39	.21662061	1143217.	1142636.	1142713.	1142748.	1142770.	1142785.	1142791.	.000402	.000785	.000785	.000785	.000785	.000784	2.78054	2.75876	.1358	39
40	.20828904	1141932.	1141296.	1141384.	1141423.	1141450.	1141467.	1141474.	.000441	.000862	.000861	.000861	.000861	.000861	2.86770	2.84591	.1391	40
41	.20027793	1140519.	1139821.	1139922.	1139968.	1139998.	1140019.	1140027.	.000486	.000949	.000949	.000949	.000948	.000948	2.95444	2.93280	.1423	41
42	.19257493	1138965.	1138196.	1138309.	1138364.	1138400.	1138423.	1138433.	.000536	.001046	.001046	.001046	.001045	.001045	3.04009	3.01877	.1452	42
43	.18516820	1137247.	1136399.	1136531.	1136592.	1136634.	1136663.	1136674.	.000593	.001155	.001155	.001154	.001154	.001154	3.12382	3.10303	.1479	43
44	.17804635	1135348.	1134413.	1134562.	1134635.	1134682.	1134717.	1134730.	.000656	.001278	.001278	.001277	.001277	.001276	3.20469	3.18468	.1502	44
45	.17119841	1133246.	1132214.	1132385.	1132469.	1132525.	1132564.	1132579.	.000727	.001417	.001417	.001416	.001416	.001415	3.28159	3.26265	.1522	45
46	.16461386	1130917.	1129778.	1129976.	1130072.	1130137.	1130184.	1130201.	.000808	.001574	.001573	.001572	.001572	.001571	3.35324	3.33569	.1537	46
47	.15828256	1128333.	1127077.	1127307.	1127420.	1127495.	1127549.	1127570.	.000900	.001752	.001750	.001750	.001749	.001748	3.41814	3.40238	.1546	47
48	.15219476	1125473.	1124089.	1124350.	1124484.	1124572.	1124634.	1124658.	.001004	.001953	.001951	.001950	.001949	.001948	3.47457	3.46104	.1549	48
49	.14634112	1122302.	1120776.	1121080.	1121234.	1121339.	1121411.	1121439.	.001122	.002181	.002179	.002178	.002176	.002176	3.52054	3.50976	.1544	49
50	.14071262	1118788.	1117110.	1117460.	1117642.	1117763.	1117849.	1117881.	.001256	.002441	.002438	.002436	.002435	.002433	3.55377	3.54633	.1529	50
51	.13530059	1114897.	1113051.	1113459.	1113670.	1113812.	1113912.	1113951.	.001409	.002736	.002733	.002731	.002729	.002727	3.57167	3.56824	.1505	51
52	.13009672	1110590.	1108563.	1109035.	1109283.	1109449.	1109565.	1109610.	.001584	.003073	.003068	.003065	.003063	.003062	3.57124	3.57259	.1468	52
53	.12509300	1105825.	1103601.	1104149.	1104439.	1104633.	1104770.	1104822.	.001782	.003457	.003452	.003447	.003445	.003443	3.54909	3.55609	.1417	53
54	.12028173	1100554.	1098117.	1098754.	1099094.	1099322.	1099480.	1099542.	.002011	.003897	.003890	.003885	.003881	.003878	3.50137	3.51502	.1352	54
55	.11565551	1094729.	1092063.	1092802.	1093199.	1093466.	1093652.	1093724.	.002273	.004402	.004392	.004384	.004379	.004376	3.42367	3.44511	.1271	55
56	.11120722	1088291.	1085379.	1086240.	1086704.	1087015.	1087233.	1087317.	.002572	.004979	.004967	.004958	.004950	.004945	3.31105	3.34154	.1171	56
57	.10693002	1081184.	1078005.	1079006.	1079550.	1079914.	1080168.	1080267.	.002918	.005643	.005626	.005615	.005605	.005598	3.15786	3.19887	.1054	57
58	.10281733	1073341.	1069876.	1071039.	1071674.	1072099.	1072396.	1072511.	.003316	.006407	.006385	.006370	.006357	.006348	2.95776	3.01092	.0919	58
59	.09886282	1064689.	1060918.	1062268.	1063008.	1063505.	1063852.	1063986.	.003775	.007287	.007259	.007238	.007222	.007208	2.70359	2.77073	.0767	59

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Form name : L{x} ia{x,t} aSS{x,t} D26 (12 pa) 6.% x+n=65

Form library : STP Manual
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PHI Pricing Functions

Morbidity basis : CMIR12
Deferred period : 26 weeks
Non-reported claims : Excluded
Adjustments : 1.0000*rho+1.0000*nu

Payments : 12 pa in arr
Initial Multiple : 1
Proportion : No

Mortality table : CMIR12 q[x] 26wk deferred E34
Inception table : CMIR12 ia D26 NonRpd Excluded
Adjustments : 1.0000*ia+0.0000

Interest : 6.0000%

Interest prior to vesting : 4.0000% $v^{1/2}$=.98058068 v^{d}=.98058068

Age [x]+t	v^x	$l_{[x]+t}$ t=0	$L_{[x]+t}$ t=0	$L_{[x]+t}$ t=1	$L_{[x]+t}$ t=2	$L_{[x]+t}$ t=3	$L_{[x]+t}$ t=4	$L_{[x]+t}$ t>=5	$ia_{[x]+t}$ t=0	$ia_{[x]+t}$ t=1	$ia_{[x]+t}$ t=2	$ia_{[x]+t}$ t=3	$ia_{[x]+t}$ t=4	$ia_{[x]+t}$ t>=5	$a^{2}_{(x,N)}$ N=65-[x]	$a^{1,2}_{(x,N)}$ N=65-[x]	$a^{HS}_{(x,N)}$ N=65-[x]	**Age [x]+t**
60	.09506040	1055155.	1051057.	1052620.	1053480.	1054059.	1054463.	1054619.	.004306	.008303	.008265	.008238	.008215	.008198	2.38726	2.47048	.0602	60
61	.09140423	1045325.	1040874.	1042015.	1043011.	1043682.	1044152.	1044334.	.004919	.009477	.009427	.009389	.009360	.009336	1.99915	2.10099	.0430	61
62	.08788868	1034702.	1029873.	1031026.	1031517.	1032292.	1032835.	1033046.	.005631	.010834	.010769	.010718	.010679	.010646	1.52648	1.65042	.0262	62
63	.08450835	1023307.	1018073.	1019156.	1019558.	1019796.	1020422.	1020666.	.006457	.012408	.012319	.012252	.012199	.012156	.94986	1.10139	.0114	63
64	.08125803	1011334.	1005667.	1006420.	1006634.	1006743.	1006815.	1007095.	.007418	.014233	.014114	.014023	.013951	.013893	.22187	.41637	.0016	64

Hashcode : 3D291781
Form name : L{x} ia{x,t} aSS{x,t} D26 (12 pa) 6.% x+n=65

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PHI Pricing Functions

Morbidity basis : CMIR12
Deferred period : 4 weeks
Non-reported claims : Excluded
Adjustments : 1.0000*rho+1.0000*nu

Payments : 12 pa in arr
Initial Multiple : 1
Proportion : No

Mortality table : CMIR12 q[x] 4wk deferred E26
Inception table : CMIR12 ib D 4 NonRpd Excluded
Adjustments : 1.0000*ib+0.0000

Interest : 6.0000%

Interest prior to vesting : 4.0000% $v^{1/2}$=.98058068 v^{d}=.99698757

Age [x]+t	v^x	$l_{[x]+t}$ t=0	$L_{[x]+t}$ t=0	$L_{[x]+t}$ t=1	$L_{[x]+t}$ t=2	$L_{[x]+t}$ t=3	$L_{[x]+t}$ t=4	$L_{[x]+t}$ t>=5	$ib_{[x]+t}$ t=0	$ib_{[x]+t}$ t=1	$ib_{[x]+t}$ t=2	$ib_{[x]+t}$ t=3	$ib_{[x]+t}$ t=4	$ib_{[x]+t}$ t>=5	$a^{2}_{(x,N)}$ N=60-[x]	$a^{2,1}_{(x,N)}$ N=60-[x]	$a^{HS}_{(x,N)}$ N=60-[x]	Age [x]+t
20	.45638695	1200521.	1200028.						.004701						.14765	.14792	.1110	20
21	.43883360	1199505.	1199026.	1199044.					.005184	.005167					.15474	.15502	.1149	21
22	.42195539	1198517.	1198051.	1198067.	1198072.				.005683	.005665	.005665				.16232	.16262	.1187	22
23	.40572633	1197545.	1197089.	1197112.	1197115.	1197118.			.006195	.006177	.006176	.006176			.17043	.17076	.1226	23
24	.39012147	1196590.	1196141.	1196167.	1196173.	1196175.	1196177.		.006719	.006699	.006698	.006698	.006698		.17912	.17947	.1266	24
25	.37511680	1195646.	1195202.	1195230.	1195238.	1195242.	1195243.	1195244.	.007249	.007229	.007229	.007228	.007228	.007227	.18842	.18879	.1305	25
26	.36068923	1194704.	1194263.	1194297.	1194305.	1194310.	1194313.	1194314.	.007786	.007765	.007764	.007764	.007764	.007763	.19837	.19877	.1345	26
27	.34681657	1193761.	1193320.	1193358.	1193369.	1193374.	1193378.	1193380.	.008327	.008305	.008304	.008304	.008303	.008303	.20901	.20944	.1384	27
28	.33347747	1192812.	1192368.	1192409.	1192422.	1192430.	1192434.	1192436.	.008870	.008847	.008846	.008845	.008845	.008845	.22039	.22084	.1423	28
29	.32065141	1191847.	1191396.	1191445.	1191458.	1191468.	1191473.	1191475.	.009413	.009390	.009388	.009388	.009387	.009387	.23255	.23304	.1461	29
30	.30831867	1190861.	1190401.	1190455.	1190472.	1190481.	1190489.	1190491.	.009957	.009934	.009932	.009930	.009930	.009929	.24553	.24605	.1498	30
31	.29646026	1189843.	1189369.	1189433.	1189453.	1189465.	1189472.	1189475.	.010501	.010476	.010475	.010473	.010472	.010471	.25938	.25994	.1535	31
32	.28505794	1188790.	1188299.	1188368.	1188394.	1188408.	1188417.	1188420.	.011045	.011020	.011017	.011016	.011015	.011014	.27414	.27473	.1570	32
33	.27409417	1187687.	1187174.	1187255.	1187282.	1187302.	1187312.	1187316.	.011590	.011564	.011561	.011559	.011558	.011557	.28984	.29047	.1603	33
34	.26355209	1186530.	1185991.	1186079.	1186114.	1186134.	1186149.	1186153.	.012138	.012111	.012107	.012105	.012104	.012102	.30651	.30718	.1635	34
35	.25341547	1185305.	1184735.	1184835.	1184872.	1184898.	1184914.	1184920.	.012691	.012661	.012658	.012655	.012653	.012652	.32418	.32489	.1664	35
36	.24366872	1183997.	1183391.	1183507.	1183551.	1183579.	1183599.	1183606.	.013250	.013219	.013215	.013211	.013209	.013208	.34286	.34360	.1691	36
37	.23429685	1182600.	1181952.	1182080.	1182135.	1182168.	1182190.	1182199.	.013820	.013788	.013782	.013779	.013775	.013774	.36253	.36332	.1715	37
38	.22528543	1181099.	1180403.	1180545.	1180607.	1180648.	1180675.	1180685.	.014405	.014370	.014364	.014359	.014356	.014354	.38320	.38402	.1735	38
39	.21662061	1179476.	1178725.	1178888.	1178957.	1179004.	1179037.	1179049.	.015008	.014971	.014963	.014958	.014954	.014952	.40480	.40566	.1750	39
40	.20828904	1177716.	1176904.	1177088.	1177170.	1177223.	1177261.	1177276.	.015637	.015596	.015587	.015581	.015576	.015573	.42728	.42817	.1762	40
41	.20027793	1175806.	1174925.	1175130.	1175225.	1175288.	1175331.	1175348.	.016296	.016252	.016241	.016234	.016228	.016225	.45052	.45143	.1767	41
42	.19257493	1173721.	1172763.	1172996.	1173104.	1173177.	1173228.	1173248.	.016993	.016944	.016932	.016924	.016917	.016912	.47436	.47529	.1767	42
43	.18516820	1171442.	1170398.	1170662.	1170789.	1170872.	1170932.	1170955.	.017736	.017683	.017668	.017659	.017651	.017645	.49861	.49954	.1759	43
44	.17804635	1168950.	1167811.	1168107.	1168253.	1168351.	1168420.	1168447.	.018536	.018476	.018459	.018448	.018439	.018432	.52297	.52391	.1744	44
45	.17119841	1166216.	1164973.	1165309.	1165475.	1165589.	1165669.	1165700.	.019402	.019334	.019316	.019302	.019291	.019283	.54710	.54802	.1720	45
46	.16461386	1163215.	1161856.	1162238.	1162429.	1162559.	1162652.	1162688.	.020348	.020271	.020249	.020233	.020220	.020211	.57053	.57141	.1686	46
47	.15828256	1159918.	1158431.	1158864.	1159085.	1159235.	1159342.	1159384.	.021386	.021300	.021274	.021255	.021240	.021229	.59269	.59349	.1641	47
48	.15219476	1156292.	1154665.	1155157.	1155411.	1155584.	1155707.	1155756.	.022535	.022438	.022407	.022384	.022366	.022353	.61283	.61353	.1583	48
49	.14634112	1152301.	1150521.	1151080.	1151372.	1151572.	1151714.	1151770.	.023816	.023704	.023667	.023640	.023618	.023602	.63006	.63063	.1513	49
50	.14071262	1147906.	1145959.	1146595.	1146930.	1147160.	1147325.	1147389.	.025248	.025119	.025075	.025042	.025017	.024997	.64327	.64364	.1428	50
51	.13530059	1143061.	1140931.	1141658.	1142042.	1142308.	1142497.	1142572.	.026862	.026712	.026659	.026619	.026588	.026564	.65108	.65121	.1328	51
52	.13009672	1137719.	1135390.	1136220.	1136664.	1136968.	1137187.	1137273.	.028688	.028513	.028448	.028400	.028362	.028334	.65184	.65165	.1211	52
53	.12509300	1131828.	1129281.	1130230.	1130740.	1131091.	1131342.	1131441.	.030766	.030559	.030480	.030422	.030375	.030339	.64352	.64292	.1078	53
54	.12028173	1125322.	1122538.	1123628.	1124215.	1124617.	1124907.	1125020.	.033142	.032896	.032799	.032726	.032668	.032625	.62368	.62256	.0929	54

Hashcode : A364B7C1
Form name : L{x} ib{x,t} aSS{x,t} D4 (12 pa) 6.% x+n=60

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PHI Pricing Functions

Morbidity basis : CMIR12
Deferred period : 4 weeks
Non-reported claims : Excluded
Adjustments : 1.0000*rho+1.0000*nu

Payments : 12 pa in arr
Initial Multiple : 1
Proportion : No

Mortality table : CMIR12 q[x] 4wk deferred E26
Inception table : CMIR12 ib D 4 NonRpd Excluded
Adjustments : 1.0000*ib+0.0000

Interest : 6.0000%

Interest prior to vesting : 4.0000% $v^{½}$=.98058068 v^{d}=.99698757

Age [x]+t	v^x	$l_{[x]+t}$ t=0	$L_{[x]+t}$ t=0	$L_{[x]+t}$ t=1	$L_{[x]+t}$ t=2	$L_{[x]+t}$ t=3	$L_{[x]+t}$ t=4	$L_{[x]+t}$ t>=5	$ib_{[x]+t}$ t=0	$ib_{[x]+t}$ t=1	$ib_{[x]+t}$ t=2	$ib_{[x]+t}$ t=3	$ib_{[x]+t}$ t=4	$ib_{[x]+t}$ t>=5	$a^{2}_{(x,N)}$ N=60-[x]	$a^{2,1}_{(x,N)}$ N=60-[x]	$a^{HS}_{(x,N)}$ N=60-[x]	**Age [x]+t**
55	.11565551	1118137.	1115094.	1116345.	1117022.	1117485.	1117817.	1117948.	.035872	.035577	.035457	.035366	.035294	.035240	.58936	.58759	.0765	55
56	.11120722	1110195.	1106871.	1108309.	1109089.	1109621.	1110002.	1110152.	.039025	.038668	.038517	.038403	.038312	.038244	.53663	.53401	.0589	56
57	.10693002	1101414.	1097782.	1099435.	1100333.	1100944.	1101381.	1101553.	.042683	.042247	.042056	.041911	.041796	.041710	.45959	.45582	.0407	57
58	.10281733	1091696.	1087729.	1089630.	1090660.	1091362.	1091861.	1092059.	.046949	.046411	.046165	.045980	.045833	.045723	.34809	.34253	.0230	58
59	.09886282	1080937.	1076604.	1078788.	1079968.	1080769.	1081341.	1081566.	.043974	.047000	.046708	.046487	.046312	.046170	.16808	.15519	.0072	59

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