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# LifeCalc™

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## User Guide

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# LifeCalc™ User Guide

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## BCRI'S LifeCalc™ PROGRAM

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BCRI's LifeCalc™ program provides analysts the ability to quickly perform life analysis, commonly referred to as a Historical Mortality Analysis. With LifeCalc, the analysts will spend far less time generating the statistical results, leaving more time to spend evaluating the results. LifeCalc supports both Actuarial Analysis (a.k.a.: retirement rate analysis) and Simulated Plant-Record (SPR) analysis. LifeCalc includes all Iowa Curves, including the ½ year curves, the negative curves, and the square curve.

The analyst can use LifeCalc's analytical tools to quickly find the best-fit Iowa curves and life to the observed mortality data. LifeCalc includes various tools and functions to readily compute the Percent Surviving, Vintage Average Remaining Lives, and Remaining Value Factors for any curve and specified life.

LifeCalc supports both Experience and Placement banding; and complex inclusion and exclusion of activity years and/or vintages. LifeCalc automates the specification of Placement & Experience bands and automatically computes the resulting banded mortality data. Additionally, LifeCalc can automatically generate Rolling and Shrinking bands allowing the user to specify the start year, stop year, years in band, and the increment between bands.

LifeCalc is a completely self-contained Excel® Add-In; and makes no changes to the user's computer. LifeCalc includes built-in spreadsheet templates for input and output, which can be customized to suit the analyst's specific needs.

LifeCalc also includes useful built-in functions that can be placed in any cell in any open workbook; menu commands that will generate any Iowa Curve for any specified life or generate all generic Iowa Curves normalize to a 100.00 year average life (or 100.00%); along with the depreciation/valuation table for any Iowa curve and life.

LifeCalc includes many features to assist the life analyst, including, but not limited to easy selection of individual Iowa curves or entire Iowa curve families to be evaluated; automatically create comparison graphs depicting the computed versus observed results; and automatically generate Worm Charts from fitted results.

LifeCalc's data input feature can read virtually any mortality (or accounting) data that is organized in column/tabular format. In the case of aged-mortality data, LifeCalc will automatically generate the Mortality Record of Experience (MROE) and Observed Life Table (OLT). Historically, this was a very time consuming process. From the MROE, LifeCalc can generate the typical MROE Matrix providing a visual of the MROE dataset.

### QuickStart Guide

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LifeCalc includes numerous features and capabilities; hence, this lengthy user guide. LifeCalc, however, is quite easy to use. To quickly experience LifeCalc's basic features, we recommend that the analyst first utilize LifeCalc's **QuickStart Guide**. This guide will walk the analyst through several simple exercises. Upon completion, the analyst will be able to use LifeCalc to perform life analysis utilizing local mortality data. The analyst should still read this user guide to become better acquainted with LifeCalc's array of features and conventions. LifeCalc must be installed before undertaking the exercises. See the next section for installation instructions.

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## Proprietary & Liability Notice

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The LifeCalc™ program, documentation, and related documents constitute intellectual property of BCRI Inc., with all rights reserved. If you were provided a complimentary copy by BCRI Inc., your copy carries with it a single user license to use the program and accompanying instructional material. Information regarding multi-user licenses can be obtained by contacting BCRI using the contact information found in the page footer. LifeCalc is provided as-is with no warranty or liability to BCRI Inc. The extent of any, and all, liability to BCRI Inc. associated with LifeCalc or its use and results is limited to the cost paid for the LifeCalc license/program.

## Installing and Un-Installing the LifeCalc™ Add-In into Excel®

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LifeCalc is an Excel© Add-In program and **cannot** be opened like you would open a normal Excel file – It must be installed as an Excel Add-in program. Once installed, it is available for use anytime Excel is open. LifeCalc can be easily removed from Excel at any time. The steps below will guide you through the installation process.

BCRI's LifeCalc program is designed to run with Microsoft Excel 2007 or later.

1. Copy the LifeCalc Add-in file to a permanent folder on your hard drive. The filename is:

“BCRI LifeCalc AddIn.xlam”

2. Note: Microsoft has a special folder for Add-in programs. While you do not have to use this folder, it is strongly recommended. The Microsoft Add-in folder is:

- a. For Win2007:

“C:\Documents and Settings\*your login ID*\Application Data\Microsoft\AddIns\”

- b. Win-10 and later:

“C:\Users\*your login ID*\AppData\Roaming\Microsoft\Addins\”

3. Follow the add Add-in procedures for your version of Excel and Windows. On a Win-10 PC, as of this writing, the following procedure should apply.

- a. From the **Developer** menu, select **Excel Add-ins**

1. *If you don't see the Developer menu, consult Excel Help to add it to the Excel ribbon menu.*

- b. In the list of available Add-ins, check **BCIR LifeCalc Addin**.

1. If you don't see the LifeCalc add-in, click **Browse** to browse to the folder where you saved LifeCalc. Select the LifeCalc file and click **OK** twice to return to Excel.

Once installed, you can access the functionality of LifeCalc from any Excel file. The LifeCalc menu ribbon can be found under the “LifeCalc” menu item, which is at the top right of the Excel window. All functions and features of LifeCalc are accessed from this menu ribbon. You are now ready to use LifeCalc.

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LifeCalc (or any add-in) can be uninstalled by unchecking it on the **Excel Add-ins** window and clicking **OK**; or re-added by checking it on the Excel Add-ins window.

## *Known Potential Installation Problem*

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On some PC's you may experience the situation where the LifeCalc add-in menu item will sometimes disappear when you close and reopen Excel. This is a long-standing Microsoft issue. If you experience this problem, temporarily uninstall the LifeCalc add-in and also uninstall Excel's "Analysis ToolPak" and "Analysis ToolPak – VBA" add-ins. First add back the LifeCalc add-in and click OK on the Add-in menu; and then add back the Analysis ToolPaks if you use them. This should resolve the problem.

## LifeCalc Features & Conventions

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### Iowa Curves Supported

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LifeCalc supports all standard Iowa Curves, plus the ½ year curves, the negative curves, and the Square (SQ) curve. The following list contains all the curve types supported. Note: the curve identification labels indicated below must be used when specifying Iowa curves to LifeCalc.

Left Modal:	L-0.5, L0, L0.5, L1, L1.5, L2, L2.5, L3, L3.5, L4, L4.5, L5
Right Modal:	R0.5, R1, R1.5, R2, R2.5, R3, R3.5, R4, R4.5, R5
Symmetric:	S-0.5, S0, S0.5, S1, S1.5, S2, S2.5, S3, S3.5, S4, S4.5, S5, S5.5, S6
Origin:	O1, O2, O3, O4
Square Curve	SQ

### LifeCalc's Standard Worksheets

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Before we begin, a general word regarding LifeCalc's standard worksheets. LifeCalc uses various standard input and output results worksheets. These sheets are automatically generated and, where applicable, automatically populated by LifeCalc. Required inputs are underlined.

Other than entering needed input data in the locations provided, the user should not modify these sheets. Doing so may cause LifeCalc to not function properly. For instance, you will note that several of LifeCalc's standard worksheets contain one or more hidden columns or rows. While these hidden columns and rows are empty, their existence greatly reduces processing time and are required for LifeCalc to run properly. Do not delete hidden columns or rows and do not add values into these hidden cells.

Avoid adding values into cells directly below any tabulated data. LifeCalc may misinterpret these values as valid input or output data. Always leave a completely blank row after tabulated data to mark the end of valid data. The user is free to use the cells to the right of the last used column on any standard worksheet, however, on input sheets you must skip a column between the last column used by LifeCalc and any additional data.

### Worksheet Naming Conventions

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To help the analyst keep track their worksheets, LifeCalc uses a standard worksheet naming convention. For life analysis purposes, LifeCalc has only two standard input worksheets, one each for SPR and Actuarial analysis. LifeCalc will automatically generate these input sheets once the analyst has identified the mortality data to LifeCalc.

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Throughout this guide the term “OLT Input Sheet” is used to denote LifeCalc’s standard input worksheet for Actuarial Analysis. The acronym “OLT” is used to refer to this sheet because the Observed Life Table is the primary data table on the worksheet. Similarly, the input sheet for SPR analysis is referred to as the “SPR Input Sheet”.

**Scope of Workbook (Excel file)** – While not required, we recommend that separate Excel files be used for each class of plant analyzed. Your life analysis Excel workbook can easily become cluttered with numerous input and results worksheets; as well as charts, graphs, and views; especially when banding is also used.

**Sheet Naming** – New SPR or OLT input worksheets created by LifeCalc, are given the default name “SPR” or “OLT” respectively. If the sheet name already exists, a sequential number is added. Feel free to rename such sheets as desired.

Worksheets containing curve-fitting results are given the sheet name containing the root source data with the suffix “>Rslt” appended to the sheet name. Worksheets containing curve comparison graphs are given the name of the sheet containing the curve-fitting results appended with the suffix “>Crvs”. For instance, if the Observed Life Table is on sheet “OLT Widgets”, then LifeCalc will write the fitted curve results to a sheet named “OLT Widgets >Rslt”. Similarly, for any comparison graphs generated from the result sheet, LifeCalc will write the results to a sheet named “OLT Widgets >Rslt>Crvs”. If the derived name of a sheet already exists, a sequential number is appended to the name.

**Tab Color** – The tab color of any results sheet generated by LifeCalc is set to the tab color of the worksheet containing the root data source, e.g., the sheet containing the OLT. In the previous example, the worksheet containing the root data source is “OLT Widgets”; the tab color of all result sheets tracing back to this root source will be set to the same color of the root worksheet.

**Sheet Ordering** – When a new LifeCalc SPR or OLT input sheet is generated, LifeCalc will place the new sheet in the last (rightmost) position on the tab bar. Dependent LifeCalc results sheets will be placed to the right of the data source underlying the results. The position of LifeCalc’s standard worksheets is not critical; however, the analyst can better locate and manage the sheets if this ordering convention is maintained.

While BCRI strongly recommends the above naming, ordering and color conventions, LifeCalc’s processing is not dependent on these worksheet attributes. LifeCalc keeps track of your input and results worksheets independent of the sheet names and tab colors assigned, therefore, the user is free to set the sheet names and tab colors to any desired value.

The life analysis workbook can easily become cluttered with numerous input and results worksheets. Following the above conventions will mitigate confusion. LifeCalc includes three ribbon commands to aid in tracking your analysis: **Show Data Source**, **Set Tab Color to Source**, and **Re-Color Source Tabs**. These commands are described in the General Tools section of this guide.

## LifeCalc’s Results Worksheet

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LifeCalc writes the curve-fitting results to a standard results worksheet. The result sheets are very similar for SPR and Actuarial analysis. Both will contain the typical header information, i.e., company, description, class of plant, etc.; and both will contain a row for each fitted curve. The first three columns of each row will list the Band Description, the Iowa Curve, and the best fit Projection Life (PLife). The remaining

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columns contain curve-fitting metrics and other information, some of which is different for SPR and Actuarial.

For SPR, the next three columns contain parameters that measure the quality of fit between the observed and computed mortality data. Bauhan's Conformance Index (CI) and its reciprocal, the Index of Variation (IV)<sup>1</sup> provide a measure of the closeness of the match between the observed and computed balances. The maturity of the mortality data is measured by Bauhan's Retirement Experience Index (REI). The CI, IV and REI are color coded according to the relative quality of fit as depicted in the table below.

Measure of Fit	CI	IV (%) / 100	REI (%)
Excellent	Over 75	Under 13.3	Over 75
Good	50 to 75	13.3 to 20	50 to 75
Fair	25 to 50	20 to 40	33 to 50
Poor	Under 25	Over 40	Under 33

For Actuarial, the results sheet will contain the Root Mean Squared Error (RMSE) and the Exposure Weighted Root Mean Squared Error (WRMSE). These fit-criteria are also color coded using a graduated scale, with dark green indicating the best-fit and dark red indicating the worst-fit.

The last two columns on both the SPR and Actuarial results sheet contains the detailed band criteria used and the TCut, if any. More on this latter. Finally, when the results are written or updated, they are sorted by best to worst statistical fit.

## Excel Filtering

Excel's filtering feature is turned on for the curve-fit results. Filtering allows the user to easily sort and hide/unhide individual curves, which can be useful to easily limit plotted results. Filtering can be turned on/off by selecting **Data > Filter** from the Excel ribbon. When turning filtering on, first select a cell within the range of curve-fit results.

## Worksheet Tracking

As noted earlier, LifeCalc keeps track of input and result worksheets and tries to locate the needed worksheet when commands are invoked from a sheet other than the one needed to support the selected command. For instance, consider the following situations:

### Life Analysis is run from an SPR or OLT input worksheet:

- The active sheet<sup>2</sup> is assumed to be the input sheet that the analyst wishes to use.
- LifeCalc will attempt to locate the most recent existing results sheet that was derived from the active input sheet.
  - LifeCalc will search from the input sheet on the tab bar going to the right for valid dependent results sheets. If one is found, the analyst will be asked to 1) overwrite the results, 2) append to the results, or 3) create a new results sheet.

<sup>1</sup> The IV performance metric is formally defined as  $1000/CI$ . In LifeCalc, however, we choose to reformat this metric as  $IV/100$  and display it as a percentage. While this reformatting has absolutely no impact on the quality of the metric, in this form it facilitates graphic comparison of curve-fitting results.

<sup>2</sup> In Excel, the active sheet is the worksheet displayed. If multiple sheets are visible, the active sheet is the one that the user has selected.

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- If no valid result sheet is found, LifeCalc will automatically create a new results sheet.

## Life Analysis is run from a results worksheet.

- LifeCalc will locate the root source for the active results sheet and use it.
- In this case, the active sheet is assumed to be the results sheet the analyst wishes the new results to be written. The analyst will be asked to 1) overwrite the results, 2) append to the results, or 3) create a new result sheet.

LifeCalc applies similar search logic for all commands that need or create input or results sheets.

## Duplicating LifeCalc Standard Worksheets

While you can cut, copy, and paste any data on any worksheet, we strongly recommend that you do not use these commands to duplicate standard LifeCalc worksheets – LifeCalc may not be able to process worksheets generated in this manner. Use the following technique to duplicate a LifeCalc standard worksheet.

- While depressing the control key drag the desired tab to a new location on the tab bar. Alternately, you can use Excel's "Move or Copy..." command, which can be accessed by right clicking the sheet's name on the tab bar.
- To copy mortality data into an OLT or SPR input sheet, use Excel's **Paste Values** command.
- **Do not** use Excel's **Cut** command to cut or delete data from either the OLT or SPR input sheets. The **Cut** command will delete internal references needed by LifeCalc.
  - Use the **Copy** command to copy data, and
  - Use the **Delete** command to delete data.

## The LifeCalc Ribbon Menu

All features and functions are accessible through LifeCalc's ribbon commands. The LifeCalc ribbon consist of five (5) groupings of commands. These are listed and described below.

- Miscellaneous
- Data Input
- Actuarial and Simulated Plant Life Analysis
- Data Source Tools
- Legacy Features

In this section, only a brief description of the Ribbon command groups and the commands within each group are provided. A fuller description is provided in the body of this guide.

### Ribbon Command Group: Miscellaneous

This group contains a few commonly used Excel commands familiar to the most users. They include Cut, Copy, Paste, and Freeze Panes. Their use is identical to Excel's comparable commands.

### Ribbon Command Group: Data Input

This group contains commands dealing with user input data. These commands are briefly described below and fully addressed later in the user guide.



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**Blank SPR Sheet** – This command inserts a new SPR standard input worksheet into your workbook. This sheet is intended to support direct user input of non-aged mortality data necessary for SPR life analysis.

**Blank Actuarial Sheet** – This command inserts a new Actuarial Analysis standard input worksheet into your workbook. This sheet is intended to support direct user input of the Observed Life Table data necessary for Actuarial life analysis.

**Load Mortality Data** – This command is designed to read raw accounting-type mortality data, either aged or non-aged, and create and populate the appropriate standard Input sheets discussed above. This command greatly reduces user effort associated with developing the needed mortality data from raw accounting data.

## **Ribbon Command Group: Actuarial and Simulated Plant Life Analysis**

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This grouping contains the commands needed to facilitate to the curve-fitting and life analysis process.

In previous versions, there were separate commands and command groups for SPR and Actuarial analysis. With the 2021 release, we simplified the life analysis process into one set of common commands applicable to both SPR and Actuarial analysis. LifeCalc now automatically recognizes the appropriate life analysis to be performed. These commands are briefly described below and fully addressed later in the user guide.

**Bands Builder** – This command aids the user in specifying Placement and Experience bands limiting the mortality data to be processed. Additionally, it can automatically generate Rolling and Shrinking bands.

**Select Curves** – This command aids the user in specifying the curves to be considered in the life-analysis process.

**Run Options** – This command allows the analyst to preselect the run options to be used when the command **Run Life Analysis** is invoked.

**Run Life Analysis** – This command performs the life analysis. It finds the best-fit average life to the mortality data for each survivor curves and band specified.

**Comparison Chart** – This command creates a plot that compares simulated results to the observed data for selected curves. This plot provides a visual of how well the simulated results match the observed results. A full description of Comparison Charts is provided later in this guide.

**Worm Chart** – This command creates a plot of the average life (PLife) and curve-fit metrics for each curve on the results sheet. This allows the use to quickly compare the quality of the curve-fits for all curve results. A full description of Worm Charts is provided later in this guide.

**MROE Matrix** – This command will create a matrix view of the MROE data from each Band included on the Input sheet. If no Bands are specified, the command will create the MROE Matrix for the full MROE. An example of an MROE Matrix is provided in the Band section later in this guide.

## **Ribbon Command Group: Data Source Tools**

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**Show Data Sources** – This command will display the data sources of the active worksheet. Because processing results can be developed from other results sheets rather than directly from an SPR or OLT input sheet, this command displays both the immediate data source as well as the “Root” data source.

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The Root data source traces back to the underlying SPR or OLT input sheet<sup>3</sup>; whereas the immediate data source is the result sheet from which the results on the active sheet were directly derived – which could be the same as the Root data source.

**Set Tab Color to Source** – This command sets the tab color of the active sheet(s) to match the tab color of its root data source. If the analyst has selected multiple worksheets, the tab color of each selected worksheet will be set to that of its respective root data source.

**ReColor Source Tabs** – This command will assign unique Tab colors to each root source worksheet, and then set the Tab color of each dependent worksheet accordingly.

## Ribbon Command Group: Legacy Features

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These commands are primarily legacy commands of the original LifeCalc plus LifeCalc's built-in functions. These commands are briefly described below. The QuickStart guide also contains examples of these features.

**Iowa Curve** – This command will insert a new sheet containing the Iowa Curve desired the Iowa curve and PLife. When selected, the analyst will be prompted for the curve and life desired. The user must separate the curve from the life using a backslash “\”. For example, to generate the Iowa R3.5 curve with a 16.36 year projection life, enter “R3.5\16.36” when prompted.

The generated Iowa curve will contain all ages up to and including the age where the computed remaining life is less than 0.5 years. At this point and beyond, the remaining life remains constant at 0.5 years and the Percent Surviving is 0.00%.

Note: To generate the full Iowa Curve, enter a PLife of 100 years. The survivor curve generated may be slightly different than commonly published Iowa Curves because many published Iowa curves have an average life approximately equal to 100 years, but not exactly equal to 100 years. The LifeCalc generated Percent Surviving will be accurate to 3 or 4 decimal places. Also, please see the Note below.

**Depreciation Table** – This command will insert a new sheet containing Depreciation/Valuation table for the desired Iowa curve and PLife. When selected, the analyst will be prompted for the curve and life desired. Separate the curve from the life using a backslash “\”. For example, to generate the Depreciation Table for an Iowa R3.5 curve with a 16.36 year projection life, enter “R3.5\16.36” when prompted.

The generated Depreciation Table will contain the Effective Age, the Remaining Life and Percent Remaining Value (a.k.a., Percent Good) for each age. The Percent Remaining Value is computed using the classic age-life concept, and more specifically,  $Pct.Rem.Value = Rem.Life / (Age + Rem.Life)$ .

Additionally, the table contains an “Age Index” for reference and compatibility to some published tables by others. The table extends several ages past the minimum Remaining Life, which by convention is ½ year. The table may be continued, if needed, using the formula given above. Also, please see the Note below.

**Note:** The **Iowa Curve** and **Depreciation Table** commands will also create three Named Ranges on the generated worksheet: Curve, PLife and Age. This simplifies the use of the Iowa built-in functions. For

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<sup>3</sup> While this command works 99% of the time, we have encountered rare instances where the data sources get corrupted. We are hoping to resolve this issue going forward.

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example, the cell formula “=pflowaARL(Curve,PLife,@Age)” will equal the Average Remaining Life for the given Iowa curve, projection life and the age specified in the Age column, typically the first column, for the row on which the formula resides. The “@” symbol before ‘Age’ in the formula is required and tells Excel to use the age given for that row.

**Show All Iowa Curves** – This command will insert a new worksheet that contains all the generic Iowa Curves, including the whole, half-year, and negative curves.

**Parameter Input Sheet** – This command inserts a general-purpose parameter input worksheet into the workbook. The parameter sheet facilitates the practical use of Iowa curves. This worksheet contains three primary input fields Iowa Curve, Projection Life and Effective Age. And, several output fields, including Remaining Life, Percent Surviving, and Percent Remaining Value (Percent Good). The sheet is designed such that each field resides in a given column. LifeCalc can then compute the output fields (columns) for all rows in the parameter sheet. Examples of using and customizing this sheet is provided in the QuickStart guide.

**Compute Parameters** – This command performs two functions.

1. Computes the identified output fields (columns) on a Parameter Sheet.
2. If LifeCalc doesn't recognize the current worksheet as a Parameter Input Sheet, LifeCalc will prompt the user for the locations of allowed input/output fields. LifeCalc remembers these locations for this worksheet; and then computes the output fields (columns). This feature allows the user to create their own custom Parameter Input Sheet.

An example of building a custom parameter sheet is provided in the QuickStart guide.

**About LifeCalc** – This command displays the version number and other general information about LifeCalc. If your copy is a test version, it will have an expiration date displayed in the title area of the display.

## The LifeCalc Process

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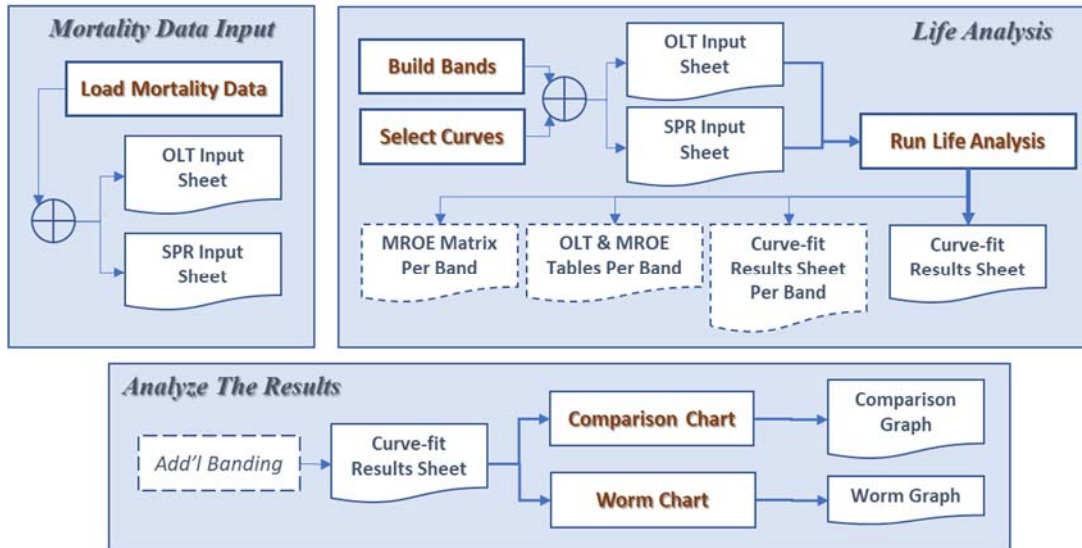
The LifeCalc life analysis process has three primary phases.

- Mortality Data Input
  - Here the accounting transactions are imported, aggregated, and reformatted into the mortality information needed to support the Life Analysis: The Observed Life Table & Mortality Record of Experience for Actuarial Analysis, and Gross Additions and EOY Survivors for SPR analysis.
- Life Analysis
  - This phase performs the curve-fitting and life analysis. For each band and dispersion curve selected by the analysis, LifeCalc determines the best-fit average life to the mortality data. The curve-fit results along with appropriate statistical fit-criteria are written to a standard results sheet(s).
- Analyze the Results.
  - LifeCalc provides several features to help analyze the results. Commonly accepted statistical metrics are provided for each curve-fit and life analysis result. Automated generation of commonly used graphs, Worm Charts, result comparison plots, and visual representation of the MROE, are supported.

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The LifeCalc commands available for each phase of the analysis, along with their inputs and outputs are depicted in Figure 1. LifeCalc commands are shown in bold red text, input and output sheets depicted with blue text and blue outline; and dashed output sheets denote optional outputs.

Figure 1 – LifeCalc Processing Overview



A detailed discussion of each life analysis phase is providing in the following sections. Separate discussions are provided for:

- Mortality Data Input
- Life Analysis
  - Banding
    - MROE Matrix
  - Curve Selection
  - Life Analysis
    - Actuarial Analysis
    - SPR Analysis
- Analyzing the Results
  - Banding
  - Comparison Charts
  - Worm Charts

## Mortality Data Input

The first step in any life analysis is to transform the accounting transactions, mortality, into useable mortality data. This can be a very time consuming effort; however, LifeCalc helps facilitate this process and minimize user effort.

For Actuarial Analysis, the analyst must establish the *full* Mortality Record of Experience, and from the MROE, develop the *full* Observed Life Table. The term “*full*” is used to denote non-banded data, i.e., all mortality data supported by the accounting data are included.

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For Simulated Plant-Record Analysis, the analyst must establish the total End-of-Year (EOY) Survivors by Activity Year, and the original Gross Additions for each Vintage. The Gross Additions should reflect all plant subject to the retirements that factored into the EOY Survivors.

## General Formatting Conventions

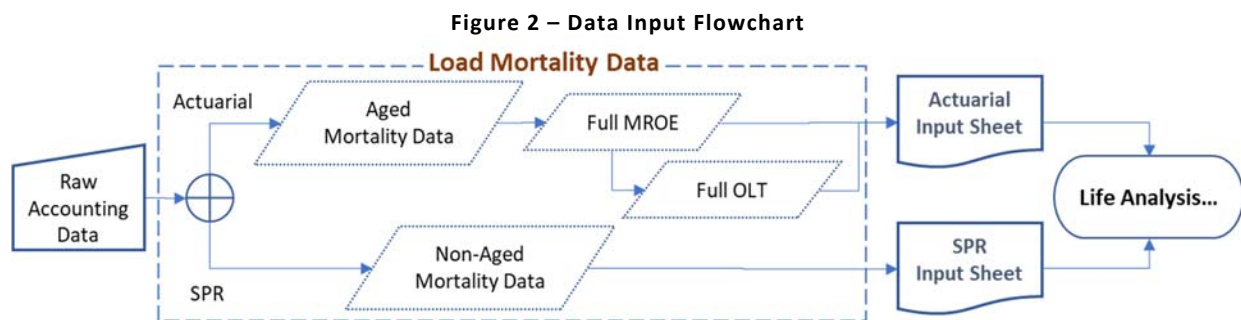
Generally, the analyst will load the mortality into LifeCalc by putting the data into an Excel spreadsheet. Often the data will be sourced from a database that was either retrieved directly into Excel or cut and pasted from the data source, or simply keyed by the user. Regardless of how the data was sourced, LifeCalc is designed to read the data with minimum, if any, intervention from the analyst.

The mortality data should follow the following conventions:

- The mortality data to be read by LifeCalc, must be in tabular format. For example, the Year Placed, Additions, Retirements, and Year Retired must be in separate columns.
- Each column of mortality data must have a column heading, e.g. “Year Placed” or simply “Vintage”. There are no restrictions regarding column labels.
- Other data may be present on the worksheet, including descriptive heading information and additional data columns. Non needed data will be ignored.
- The mortality data columns can be in any order. The needed data columns do not need to be contiguous, however, a blank column denotes the end of the tabular data.
- At this time, year-values should be entered as whole numbers, not dates, e.g.: use “2007” not “1/1/2007”.

## Loading Mortality Data

LifeCalc’s **Load Mortality Data** command automates the process of loading the mortality data into LifeCalc. As noted earlier, LifeCalc is designed to load your mortality data directly with minimum, if any, manual changes. This command reads the analyst’s mortality data, processes it, and generates the appropriate Actuarial or SPR input sheet. Figure 2 outlines the data loading process that LifeCalc performs. The processing within the dashed lines indicates the processing LifeCalc performs internally.



When **Load Mortality Data** is run the Load Mortality Data form shown in Figure 3 will be displayed. This form is where the analyst identifies the data to be used by LifeCalc. The Load Mortality Data form has three sections:

- Type of Analysis,
- Header Information, and
- Data Locations.

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**Type of Analysis:** The analyst must identify the type of mortality data to be loaded. For Actuarial analysis, select Continuing Property Record (CPR). For SPR analysis select Simulated Plant Record (SPR).

Figure 3 – Mortality Data Input Form

The screenshot shows a window titled "Load Mortality Data" with a close button (X) in the top right corner. The form is divided into several sections:

- Continuing Property Record (CPR) Locations:** A section with a green header containing two radio buttons: "Continuing Property Record (CPR) Data" (selected) and "Simulated Plant Record (SPR) Mortality Data".
- Project Description:** A section with a green header containing four text input fields: "Company Name:" (with "Company" entered), "Description:" (with "Description" entered), "Class of Plant:" (with "ClassOfPlant" entered), and "Scenario ID:" (with "Scn-0" entered).
- Double-Click to set CPR data:** A section with a blue header containing four text input fields: "Year Placed (Vintage):" (with "1" entered), "Year Retired (ActYr):", "Retirements:", and "Additions/Adjustments:". Each field has "Not Set" to its right.
- Buttons:** Three buttons at the bottom: "Continue", "Save & Close", and "Cancel".

Three callout boxes on the right side of the form provide additional information:

- Type of Analysis:** Select either Actuarial (CPR) or SPR.
- Header Information:** Enter or select descriptive information.
- Data Locations:** Double-click to select the cell containing the column label of the desired data.

**Header Information:** includes the Company Name, Description, Class of Plant, and Scenario ID. Once entered, LifeCalc remembers the header information and will put the header on all worksheets that LifeCalc creates. The header information is common for the entire workbook. Note that changing the header information a particular worksheet will not change the header information maintained internally by LifeCalc. To change the header information, re-run **Load Mortality Data** command again and type or select the new information.

The header information may be entered directly on the Load Mortality Data form; or alternately, if the information exists on the spreadsheet, double-click the form field, and then select the spreadsheet cell that contains the desired information.

**Data Locations:** This portion of the Load Mortality Data form is where the analyst identifies the spreadsheet locations of the mortality data. **Double-click** the desired field and then select the cell containing the label of the column containing the corresponding data. Click **OK**. LifeCalc will put the selected cell address in the form field and display the column label to its right.

At this point the analyst should click on one of the three command buttons on the form. These commands are described as below.

**Continue:** LifeCalc will compute, aggregate, and transform the raw accounting data into the needed mortality data and save the data to the appropriate SPR or Actuarial Input worksheet.

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For Actuarial data, LifeCalc will compute the full MROE, develop the OLT table, and save the table in an Actuarial (OLT) Input sheet. This MROE will be flagged as the **Full MROE**; and any subsequent Banding will be based on this MROE. The Full MROE need only exists once in the entire Excel workbook.

For SPR data, LifeCalc will compute a table of Original Cost by Vintage and a table of EOY Survivors by Activity Year and save the tables to an SPR Input sheet.

**Cancel:** will discard all changes and exit. All subsequent processing is halted.

**Save & Close:** will save any entered information and exit. All subsequent processing is halted.

The analyst's accounting data may take many forms and formats. LifeCalc should be able process most accounting data as is, however, there could be situations where the analyst may have to manually reformat the data. Hopefully, such situations will be rare; and when encountered, the reformatting effort will be minor.

## *Manually Entering the Mortality Data*

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The recommended way to manually enter mortality data is to put the data on a blank worksheet. It can be keyed, pasted, or imported from a data source. Then run **Load Mortality Data** as described above.

## *Year Versus Date Fields*

---

At this time, LifeCalc requires that year-type data be entered as numbers not dates. While dates can be formatted to display only the year-part of the date, Excel still stores the date as a date. For example, 1/1/2000 is stored internally as 36526, regardless of the displayed format. If your data contains dates for either the Activity Year or Placement Year, use the Excel formula “=YEAR(*date*)” to extract the year part of the date as a number into an adjacent column; and then identify this column as the corresponding location of the Activity or Placement year.

## Life Analysis

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Once the Data Input phase is complete and the appropriate Input sheet generated (either by LifeCalc or manually), the life analyst is ready to begin the Life Analysis phase. Before the actual analysis can begin, the analyst must specify:

1. **Run Options:** Identify the functions they want LifeCalc to perform.
2. **Curve Selection:** Identify the curves to be evaluated.
3. **Banding (Optional):** Specify any bands to be applied to the mortality data.

## *Run Options*

---

When Life Analysis is run, LifeCalc will display the Run Options popup form, shown in Figure 4.

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Figure 4 – Life Analysis Run Options

The screenshot shows a dialog box titled "Output Options" with a close button (X) in the top right corner. Inside the dialog, there are five checkboxes, each with a label:   
1.  Perform Curve Fitting   
2.  Generate Separate Results Sheet for Each Band   
3.  Generate OLT Sheet for Each Band   
4.  Generate MROE Matrix for Each Band   
5.  Use Exposure Weighted MSE for Curve-Fitting Criteria   
At the bottom of the dialog, there are three buttons: "Continue", "Save & Abort", and "Cancel".

Run Options are unique to, and saved with, each Input sheet. When the Run Options form is invoked, the previously used or saved options for the Input sheet will be the defaults.

## **Perform Curve Fitting**

When checked, LifeCalc will perform the life and curve-fitting analysis for each curve and band specified.

## **Generate Separate Results Sheet for Each Band**

If checked, LifeCalc will write the curve-fitting results for each band to a separate results sheet. Note, when selected, the Perform Curve Fitting option will automatically be selected. This may be useful when Comparison Curves are anticipated. If left unchecked, all results will be written to the same results sheet.

## **Generate OLT Sheet for Each Band (Actuarial Only)**

If checked, LifeCalc will compute the banded MROE and OLT tables and write them to a new OLT/Actuarial input sheet for each band. Actuarial Analysis will not be performed unless the Perform Curve Fitting box is also checked.

## **Generate MROE Matrix for Each Band (Actuarial Only)**

If checked, LifeCalc will generate an MROE Matrix for each band. Actuarial Analysis will not be performed unless the Perform Curve Fitting box is also checked. The option is only allowed for Actuarial analysis.

## **Use Exposure Weighted MSE for Curve-Fitting Criteria (Actuarial Only)**

By default, LifeCalc performs the curve-fitting process based on minimizing the Sum of Squared Errors (SSE) between the observed and computed data. The Root Mean Square Error (RMSE), which provides a measure of the goodness of fit for each curve type evaluated, will be displayed on the results sheet. If this option is selected, LifeCalc will perform the curve-fitting based on the Exposure weighted SSE and compute and display the Weighted Root Mean Squared Error (WRMSE) for each curve in lieu of the RMSE. An exposure weighted curve-fit gives more weight to those ages with the greater exposures.

The Run Options form is displayed each time the **Run Life Analysis** command is invoked. Click the **Continue** button to save the options and perform the Life Analysis. Click the **Save & Abort** button to save the options and abort the Life Analysis. Click the **Cancel** button to discard any changes and abort all processing. Alternately, the analyst can invoke the run options form by clicking **Run Options** on the LifeCalc ribbon menu.



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## **Banding – Limiting the Mortality Data**

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**Banding** is the term commonly used when the analyst chooses to limit the scope of the observed mortality data in the life analysis. **Placement Bands** refer to years of placement (vintages); and **Experience Bands** refer to activity (retirement) years.

There are numerous reasons an analysis may desire to limit the scope of the observed mortality data. For instance, a particular activity year(s) may have been overly influenced by a onetime event, e.g., a hurricane. Another example may be a particular vintage or range of vintages may involve the placement of defective products and the analyst may want to exclude those vintages from the life analysis. A full discussion of Banding is beyond the scope of this user guide. LifeCalc, however, allows unrestricted Placement and Experience banding; and includes a feature to assist the analyst in building the desired bands.

LifeCalc's banding features allow complex filtering of your mortality data. It supports any combination of Experience Bands and/or Placement Bands. A band can include or exclude Activity Years or Vintages. There are, however, limits to applying banding depending on the type of analysis and the mortality data available.

**Banding With SPR Analysis** – only Experience Bands are allowed in SPR Analysis. Placement Bands are not valid because the retirements are not aged. In other words, the vintage of the retirements which affected the EOY survivors is unknown.

**Banding with Actuarial Analysis** – both Experience Bands and Placement Bands are allowed with Actuarial Analysis. To perform banding, however, the Full Mortality Record of Experience (MROE) must exist somewhere in the workbook. The Full Mortality MROE is automatically created when LifeCalc's **Load Mortality Data** command is used to load the mortality data.

As a minimum, Actuarial Analysis requires an Observed Life Table, which is calculated from the MROE (either banded or non-branded). When banding is indicated, LifeCalc applies each band to the Full MROE and creates a banded MROE and a banded OLT internally for each specified band. LifeCalc then uses the new OLT to perform the life analysis.

The banded MROE & OLT are not saved unless this option is selected on the Run Options form. When an OLT is provided without the underlying MROE, LifeCalc will simply use the provided OLT in the life analysis; and any specified bands, will be ignored.

While LifeCalc can treat a banded MROE as a Full MROE, it is not recommended. Applying bands to a banded MROE may produce erroneous results. Caution and verification are advised if you choose to do so. Additionally, with very rare exception, it is not possible to recreate the MROE from an OLT. LifeCalc does not support such a feature.

## **Band Specification**

---

LifeCalc's SPR and Actuarial (OLT) Input sheets contain a section that list the user specified bands. These columns are initially hidden and automatically un-hidden when one or more bands are specified. LifeCalc supports the simultaneous use of multiple Experience and Placement Bands. The table below depicts a hypothetical example. Here, the analyst specified a rolling band of 5 years, with a 2 year step between bands for activity years 2000 – 2014. Additionally, the analyst excluded vintage years 1980-1986.

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Bands to Process	
Band	Band Criteria
RB:2014-2010...	2014-2010;;;1980-1986
RB:2012-2008...	2012-2008;;;1980-1986
RB:2010-2006...	2010-2006;;;1980-1986
RB:2008-2004...	2008-2004;;;1980-1986
RB:2006-2002...	2006-2002;;;1980-1986
RB:2004-2000...	2004-2000;;;1980-1986

The above table was created by LifeCalc's **Build Bands** command. Each row of the list constitutes one *compound*<sup>4</sup> band. The left column is a name assigned to each band by LifeCalc. The analyst is free to give each band any desired name, however, unique names are recommended. The right column contains the band's defining criteria. The Band Criteria has four sections separate by semicolons.

The four sections are:

1. The activity years to include in the band (leave blank to include all activity years),
2. The activity years to exclude from the band,
3. The Vintages to include in the band (leave blank to include all vintages),
4. The vintages to exclude from the band.

Each section may consist of one or more ranges of years and/or individual years. Years and year-ranges must be separated by commas within each section; and ranges are denoted by a dash "-" between the years. LifeCalc's **Build Bands** command does this automatically. The analyst, however, may key in their desired band directly into the Band Criteria column.

When manually keying Band Criteria, follow the following conventions:

- Give all bands a name.
- Do not skip lines between bands. LifeCalc will stop processing when it encounters a blank row.
- If the 1<sup>st</sup> band row is blank, LifeCalc will perform the life analysis with no banding. Additional bands will be ignored.

## LifeCalc's Band Building Feature

**Build Bands** – This command displays a popup form to assist the analyst in building the list of compound bands to be processed. It is generally more expedient to use the **Build Bands** commands to quickly generate the desired bands. If desired, the analyst may edit the LifeCalc-generated bands manually. The popup form is shown in Figure 5, along with a description of the major features of the form.

<sup>4</sup> "Compound" refers to the fact that each band can consist of both experience and placement years to include and/or exclude.

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Figure 5 – Bands Builder Pop-up

**Standard Bands**  
Either Fixed, Rolling or Shrinking Band.

**Standard Band Criteria**  
The data & text shown will vary depending on the selected Standard Band.

**Minimum & Maximum Activity Years; based on the mortality data.**

**Activity Years in Fixed Band to include/Exclude.**

**Vintages in Fixed Band to Include/Exclude.**

**The selected curves from the input sheet.**

**Number of Curve-fits needed, = #Bands \* #Curves**

Build Placement & Experience Bands

**Standard Bands**

Fixed Band  
 Rolling Bands  
 Shrinking Bands

Number of Years to Shift Each Band: 2

Number of Years in Each Band: 5

Oldest Activity Year: 2000 (Minimum: 1978)

Most Recent Activity Year: 2014 (Maximum: 2014)

**Customize Banding**

**Experience Bands**      **Placement Bands**

Include These Years:  Activity Years       Vintage Years

Exclude These Years:      

Clear Bands Criteria      Add Band To List

List of Bands:

Band Desc	Band Criteria
RB:2014-2010...	2014-2010;;;
RB:2012-2008...	2012-2008;;;
RB:2010-2006...	2010-2006;;;
RB:2008-2004...	2008-2004;;;
RB:2006-2002...	2006-2002;;;
RB:2004-2000...	2004-2000;;;

Clear All Bands      Clear Selected Bands

Number of Bands: 6

Number of Curves Selected: 18 (L,S,R)

Total Number Curve Fits: 108

Save & Close      Cancel

To use this form, first select one of the three Standard Bands (upper left). LifeCalc will display the applicable input fields for the selected band option and type of life analysis. Provide the information necessary to define the desired band(s) then click the **Add Band To List** command. The band criteria for the selected band option will be computed and added to the bands List shown in the middle of the form; but not added to the Input spreadsheet at this time. Continue this process to add additional bands.

The form's bands list cannot be edited directly; however, you can double-click any band in the list. The clicked band's filtering criteria will then be displayed in the appropriate fields, which can then be edited. To add the edited band to the list, click **Add Band To List**. To replace the selected band, first click **Clear Selected Band**, then click **Add Band to List**.

LifeCalc's banding supports automatic generation of the commonly used band types. The three band types supported are as follows:

**Fixed Band** – A range of activity years and/or vintages to be included or excluded. For example:

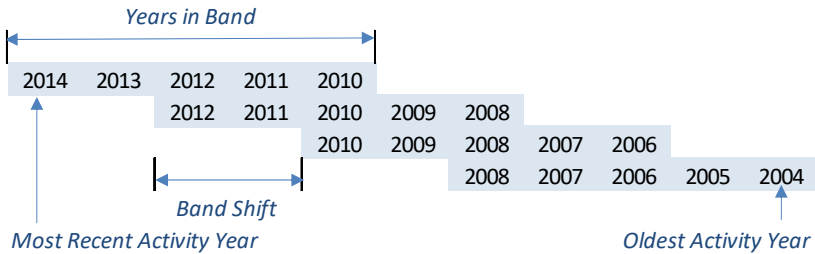
- "2014-2004;;2000-2014;2010" will include activity years 2004 through 2014, and vintages 2000 through 2014, but excluding vintage 2010.

Fixed Bands help identify impacts of events, or to limit the life analysis to specific periods of time. For instance, the analyst may believe that more recent data is more reflective of the future.

**Rolling Bands** – Multiple overlapping experience bands, each with a fixed number of activity years in each band. For example, consider the following rolling bands. Here, the analyst specified 5-year bands, for Activity Years 2014 through 2004, with a 2-year shift

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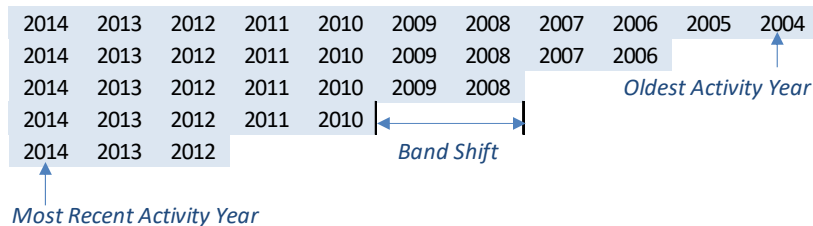
between bands; additionally, no vintage limits were specified. LifeCalc then computed the following 4 rolling bands.



Rolling Bands are helpful to identify trends, the impact of events or other changes over time that may have impacted the life. Additionally, the analyst can use the Rolling Bands option to automatically generate a single year band for each activity year by setting the number of years in each band to 1. This is often used with a single Iowa curve to analyze and/or plot Life changes over time (a.k.a.: a Worm Chart).

Additionally, it should be noted that if the total number of activity years is not evenly divisible by the band width, then the last band width will have one or less years. LifeCalc adjusts the last band by forcing the number of included years to equal the specified band width.

**Shrinking Bands** – Shrinking Bands help identify the effects of more recent data on the change in average life over time. They consist of multiple overlapping experience bands, whereby the number of activity years in successive bands shrinks a fixed number of years, e.g., consider the following 2 year shrinking bands. Here, the analyst included activity years 2004 – 2014, and specified a 2-year shift between bands. LifeCalc then generated the following 5 bands.



*Note, to invert the Shrinking Bands such that each band starts with the oldest activity year and reduces the most recent activity year, enter a negative number for the Band Shift.*

While LifeCalc can process highly complex band specifications, it’s a good idea to keep the band criteria as simple as possible. If you encounter a bands-related error using complex band criteria, try simplifying the criteria and rerun the life analysis.

## Other Banding Features & Commands

LifeCalc’s Banding form also includes:

- The number of bands in the bands list,
- The Iowa Curves specified on the input sheet, and the total number of curves to be evaluated.
- The resulting number of curve-fits that are needed (= # Curves \* # Bands).

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- In the sample form above, the total number of curve-fits is 90. This number can grow very rapidly especially when Rolling or Shrinking bands are used. Depending on the volume of mortality data, the time it takes for each curve-fit to complete can range from less than a second to 30+ seconds.

**Save & Close** – Saves the bands in the list to the Input sheet. If you exit the form without first saving the bands, the bands in the form’s band list will be lost.

**Cancel** – Cancels all processing; the forms bands list is not saved.

**Clear All Bands** – Clears all bands in the form’s bands list. Does not impact the bands on the Input worksheet until the **Save & Close** command is clicked.

**Clear Selected Bands** – Clears the selected bands from the bands list. Use the shift or control key to select multiple bands on the bands list.

**Add Band To List** – Reads the entered band criteria and writes the resulting band to the bands list.

**Clear Bands Criteria** – You can use this command to delete the band criteria input fields. Does not impact the bands list.

## MROE Matrix

The MROE Matrix provides a visual representation of the MROE data. LifeCalc develops this graphic by first applying the band criteria to the Full MROE. The activity years are shown across the top row and vintages are shown down the left column. Exposures are listed in the upper left corner of each square and Retirements are shown in red in the lower right corner of each square. The top two rows display the Total Exposures and Total Retirements for each Activity Year.

When arranged in this fashion, age-groups are along the diagonal. A hypothetical MROE Matrix for Activity Years 2004-2014 and Vintages 2004-2014 is shown in Figure 6.

**Figure 6 – Typical MROE Matrix**

Tot.Expo:	1,305,257	8,899,566	16,536,362	17,329,292	143,878,184	155,990,328	178,239,843	178,809,837	173,638,516	175,750,586	176,228,716
Tot.Rets:	0	0	158,441	0	0	0	24,146	6,239,405	1,057,119	5,778,506	1,921,364
FB.2004-2014...	2004-2014;;2004-2014;										
MROE Matrix	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
2004	1,305,257 0	1,305,257 0	1,305,257 158,441	1,146,816 0	1,146,816 0	1,146,816 0	1,146,816 0	1,146,816 931,243	215,573 17,593	197,980 21,240	176,740 0
2005		7,594,309 0	7,594,309 0	7,594,309 0	7,594,309 0	7,594,309 0	7,594,309 0	7,594,309 2,258,089	5,336,220 1,039,526	4,296,694 516,121	3,780,573 170,327
2006			7,636,795 0	7,636,795 0	7,636,795 0	7,636,795 0	7,636,795 0	7,636,795 1,631,694	6,005,101 0	6,005,101 3,043,196	2,961,905 0
2007				951,371 0	951,371 0	951,371 0	951,371 0	951,371 309,564	641,807 0	641,807 626,576	15,231 9,259
2008					126,548,891 0	126,548,891 0	126,548,891 24,146	126,524,745 1,108,813	125,415,932 0	125,415,932 896,707	124,519,225 147,464
2009						12,112,144 0	12,112,144 0	12,112,144 0	12,112,144 0	12,112,144 0	12,112,144 69,650
2010							22,249,515 0	22,249,515 0	22,249,515 0	22,249,515 674,542	21,574,973 130,822
2011								594,140 0	594,140 0	594,140 0	594,016 124
2012									1,068,084 0	1,068,084 0	1,068,084 0
2013										3,169,189 0	3,169,189 1,393,842
2014											6,256,636 0

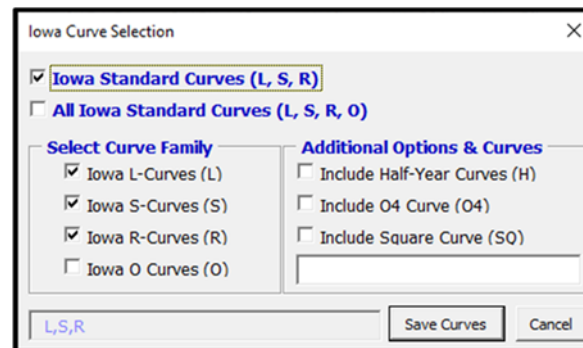
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To generate a MROE Matrix, select an OLT Input sheet, or one of its dependent result sheets, and click the **MROE Matrix** command. A matrix view will be generated for each band on the OLT sheet, or if no band is specified a matrix for the Full MROE will be developed.

## Curve Selection

Specifying the desired Iowa Curves is easy. LifeCalc provides a selection form that allows the analyst to simply check the desired Iowa curve families. The selected curves are written to the Iowa Curves field on the Input sheet. Alternately, the analyst can skip the form and type the specific curves or curve families directly in the Iowa Curves field on the Input sheet. The curve selection pop-up form is shown in Figure 7.

Figure 7 – Iowa Curve Selection Pop-Up



The selection form allows the analyst to simply check the desired curve families or groups. The form includes check boxes for all standard Iowa Curve families or individual curve families.<sup>5</sup> The analyst may also include the Iowa ½-year curves and the square curve. Use the text box just above the Save command to specify specific curves in addition to those selected via the check boxes.

The syntax for manually keying desired curves on the Input sheet is:

- first list the family of curves desired, use a comma to separate families (e.g.: “L,S,R”).
- Follow this with a semicolon, and then list any desired individual curves separate by commas. To include the half-year curves, include an “H” with the family of curves – the half-year curves for any included curve family will also be processed.

Individual curves are identified by their mode letter followed by their mode number (e.g., L1, R2.5, etc). For example, to include all L & S curves along with the ½ year curves and curves R2 & R3, the syntax would be “L,S,H;R2,R3”. To include all curves, the syntax is “L,S,R,O,O4,SQ,H” or “L,S,R,O,H;O4,SQ” LifeCalc allows the O4 and SQ curves to be included as either a curve family or individual curve. See the introduction section for a list of curves supported by LifeCalc. You can use either lower case or upper case, and spaces between curves are ignored.

The final curve string text is shown in the display only text box in the lower left of the pop-up form. To see a list of the individual curves resulting from your selection, in a blank cell on the Input sheet type the following function “=ParseIowaCurvesStr(Curves)”. Alternately, you can replace “Curves” with a list of curve families to see the individual curves included, e.g., “=ParseIowaCurvesStr(“R,H”)” will display

<sup>5</sup>LifeCalc does not automatically include the O4 curve with the O-curve family. The reason is that the O4 is not a valid curve for tangible property. The analyst, however, can select the O4 curve if desired.

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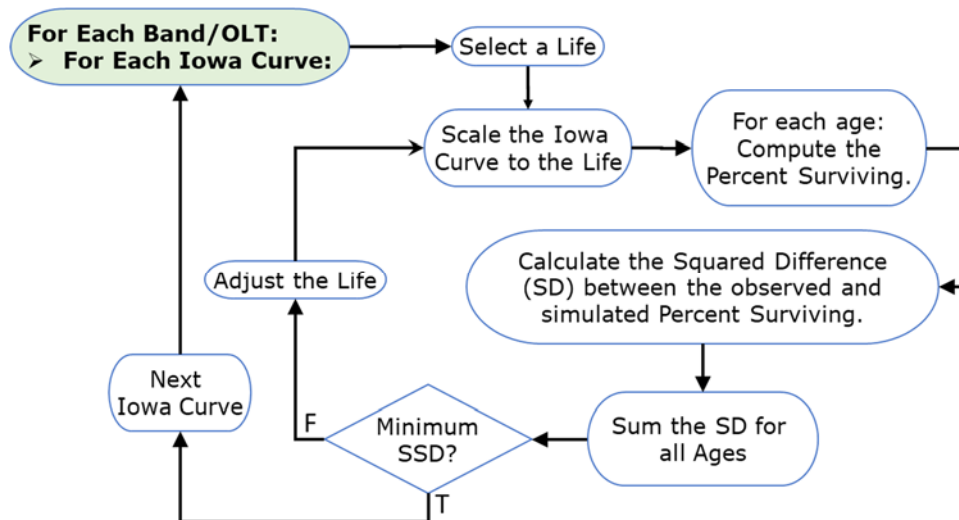
the following list of curves: “R1,R2,R3,R4,R5,R0.5,R1.5,R2.5,R3.5,R4.5”. Note, LifeCalc will skip any duplicate curves specified.

## Actuarial Analysis

Actuarial Analysis, also known as Retirement Rate Analysis, is used when aged mortality data is available. As a minimum this would include the beginning of year (BOY) Survivors (Exposures) and Retirements occurring during the year for each Vintage and Activity Year. This mortality data is commonly referred to as the Mortality Record of Experience (MROE). Once the MROE is established, the analyst may elect to limit the MROE via the Banding process discussed earlier.

Once Actuarial Analysis is invoked, LifeCalc develops a banded MROE Table and a banded Observed Life Table for each specified band. If no band is specified, LifeCalc simply uses the OLT on the OLT Input sheet. The OLT constitutes the minimum mortality data needed the life analysis process (a.k.a., curve-fitting process). The Actuarial life analysis technique used by LifeCalc is illustrated in Figure 8.

Figure 8 – Actuarial Life Analysis Process



The curve-fitting process is accomplished by finding the average life which produces the minimum Sum of Squared Difference (SSD), or optionally the Exposure weighted SSD, between the observed percent surviving (via the OLT) and the simulated or computed percent surviving for each survivor curve and life. The process involves an iteration technique which varies the Projection Life (PLife) until the minimum SSD is found. This process is performed for each band and each Iowa curve.

While LifeCalc internally computes a banded MROE and OLT, by default they are discarded once the results have been computed and saved. Optionally, the analyst can save the OLT and MROE tables via the Run Options discussed earlier in this guide.

## Running Actuarial Analysis

Actuarial Analysis is run from an OLT Input sheet, or any of its dependent result sheets: select the appropriate sheet and click **Run Life Analysis**.

For each specified band and survivor curve, LifeCalc will find the average life that best-fits the mortality data and compute the Root Mean Squared Error (RMSE) and Exposure weighted Root Mean Squared Error

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(WRMSE) curve-fit metrics. LifeCalc writes the results to a standard results worksheet. The Actuarial results include

- Band Description,
- Curve
- PLife
- RMSE (underlined if used for curve-fitting)
- WRMSE (underlined if used for curve-fitting)
- Band Criteria
- TCut

If the results sheet already exists, the analyst will be given to opportunity to overwrite it, append to it, or create a new results sheet. LifeCalc also sorts the curve-fit results from statistical best to worst fit. Use Excel's Filter button to quickly change the sort criteria and/or sort order. For more complex sorting use Excel's **Data > Sort** feature.

## Run Options

The Run Options form is displayed each time **Run Life Analysis** is invoked. See the Life Analysis chapter for details regarding the various run options supported.

## Actuarial Analysis – Standard Input Worksheet

LifeCalc includes an Actuarial Input worksheet (aka, OLT Sheet) that identifies the needed inputs. The Actuarial Input worksheet is typically populated via LifeCalc; however, a blank OLT sheet may be generated by selecting **Blank Actuarial Sheet** from the LifeCalc ribbon. The Actuarial input worksheet is depicted in Figure 9 and described in the following text.

Figure 9 – Actuarial Analysis Input Worksheet

Project Header information		Observed Life Table					Bands List		MROE Table					
Company:	ACME Inc.	Observed Life Table					Bands to Process		MROE Tabular Data					
Description:	Actuarial (OLT) Input sheet.	Age	Exposures	Retirements	Retirement Ratio	Survivor Ratio	Percent Surviving	Band	Band Criteria	Vintage	ActYr	Rets	Exposure \$	Age
Class of Plant:	Widgets...													
OLT Band:	Full Mortality													
OLT Band Criteria:														
PLife Seed Value:	0.0													
TCut (age):	0.0													
lowa Curves:	L,S,R													
Scenario ID:	Scn-1													
Maximum Age:	0.0													
Sum(Exposures):	0													
Sum(Retirements):	0													
Obs. Life Indication:	0.00													
Number of Bands:	1													
Number of Curves:	18													
Required CurveFits:	18													

## Project Header Information

This section of the input worksheet contains descriptive information regarding the project and class of plant being studied; along with analyst options that govern the analysis. The pertinent input fields are described below.

### Company, Description, Class of Plant, OLT Band, OLT Band Criteria, & Scenario ID



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These optional and self-explanatory fields can be used by the analyst to describe the nature of the Actuarial analysis and a particular Actuarial run. This information will be automatically carried forward to all results worksheets generated from these data. Each band yields a unique OLT. The OLT Band and OLT Band Criteria fields describe the band that underlies the OLT, irrespective of the Bands in the Bands List. The Scenario ID can be used by the analyst to assign a unique code to each Actuarial run.

## **PLife Seed Value**

Providing a seed value for the projection life may decrease the run time of the life analysis when the entered life is roughly accurate. For input sheets created by LifeCalc an estimated seed value is provided.

## **TCut**

The TCut is the maximum age of plant to be analyzed in the curve-fitting process. The analyst may use the TCut to exclude older mortality data that may be erratic or insignificant. A carefully selected TCut can improve the accuracy of the curve-fit. If omitted or set to zero (the default), all ages will be included in the analysis. In lieu of a TCut, the analyst may wish to use the run option WRMSE fit-criterion when the exposures are decreasing with age.

## **Iowa Curves**

This required field indicates which Iowa curves are evaluated in the life analysis. See the Curve Selection section, page 20, for details. If no curves have been specified, the Curve Selection form will be displayed.

## **OLT Statistics**

This section provides general statistics regarding the OLT. These are self-explanatory.

## **Run Counts**

The section contains the number of bands to be processed, the number of curves to be evaluated, and the total number of required curve-fits to be performed (= #Bands \* #Curves). Note, if the number of Bands is -1, hit the F9 key to recalculate the worksheet. If no bands are specified, the band count will be 1 because LifeCalc will perform the life analysis with no banding.

## **Observed Life Table (OLT)**

---

The OLT represents a statistical summary of the mortality data being analyzed. An OLT may be banded or non-banded. LifeCalc fits each selected Iowa curve to the observed Percent Surviving by varying the life to yield the minimum difference between the observed and computed (or simulated) data. A hypothetical OLT is depicted in Figure 10, followed by a description of the data columns.

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Figure 10 – Typical Observed Life Table

Observed Life Table					
*Age	Esposures	Retirements	Retirement Ratio	Survivor Ratio	*Percent Surviving
0.0	14,200	13	0.09%	99.91%	100.00%
0.5	12,804	291	2.27%	97.73%	99.91%
1.5	11,200	864	7.71%	92.29%	97.64%
2.5	9,159	1,682	18.36%	81.64%	90.11%
3.5	6,545	1,787	27.30%	72.70%	73.56%
4.5	4,100	1,324	32.29%	67.71%	53.47%
5.5	2,343	836	35.68%	64.32%	36.21%
6.5	1,236	500	40.45%	59.55%	23.29%
7.5	580	272	46.90%	53.10%	13.87%
8.5	228	126	55.26%	44.74%	7.36%
9.5	67	43	64.18%	35.82%	3.29%
10.5	13	9	69.23%	30.77%	1.18%
11.5					0.36%

**Age – Required.** The Age of the Exposures at the beginning of the age interval (usually an activity year).

**Exposures – Optional.** The Original Cost of the surviving plant **exposed** to retirement during the age interval.

**Retirements – Optional.** The plant retired during the age interval.

**Retirement Ratio – Optional.** For any given age interval, the Retirements divided by the Exposures.

**Survivor Ratio – Optional.** The ratio of the end-of-year (EOY) Exposures to the beginning-of-year (EOY) Exposures, which also equals 1 less the Retirement Ratio.

**Percent Surviving – Required.** The percentage of the original plant surviving (PS) at the BOE Age. By definition, the PS at age zero is 100%. The PS for subsequent ages equals the previous period PS times the previous period's Survival Rate.

## Bands List

The Bands List displays the bands that the analyst has specified to be applied to the Full MROE. See the section on Banding, page 15, for details on specifying bands. For clarity, the Bands List columns are hidden on the Input sheet until bands are specified.

## MROE Table

The MROE Table columns are initially hidden. To display these columns, use Excel's Unhide command. By default, LifeCalc only creates an MROE table for the Full MROE. See the Mortality Data Input chapter presented earlier. When Life Analysis is run with banding, a banded MROE and OLT is created internally for each band. The analyst can optionally save the banded OLT and MROE, however, by default they are discarded once the results have been written.

The fields in the MROE table are as follows:

**Vintage – Required.** The year of placement or the Retirements and Exposures.

**Activity Year – Required.** The activity year in which the Retirements occurred.

**Retirements – Required.** The retirements that occurred during the activity year from the vintage specified.

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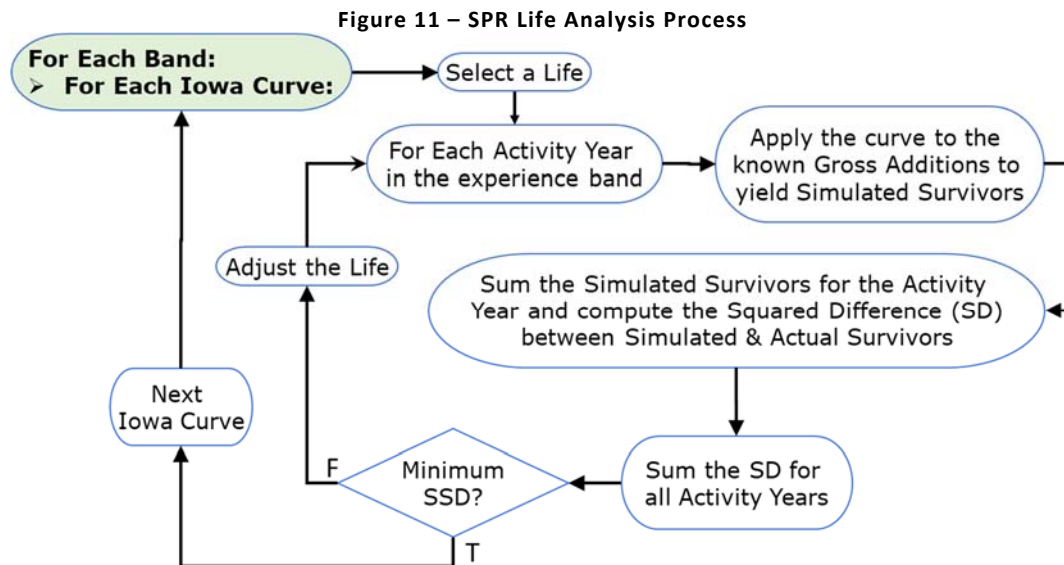
**Exposures – Required.** The BOY exposures.

**Age – Optional.** The age of the plant at the beginning of the activity year. Equals the Activity Year – Vintage + 0.5 (equals 0 when the vintage = activity year). The BOY age is provided in this table only for convenience, it is recomputed internally as needed.

## Simulated Plant-Record Analysis

LifeCalc uses the SPR Balances technique. SPR analysis is used when the age of the retirements is not known. Briefly stated, the SPR objective is to minimize the Sum of Squared Difference (SSD) between the sum of the observed end-of-year (EOY) plant balances and the sum of the simulated EOY plant balances for each activity year in the mortality data sample. The analyst may wish to limit the mortality data sample using the Banding process discussed earlier – only Experience Bands are valid with SPR.

This SPR Balances curve-fitting technique is accomplished using an iteration process of varying the projection life until the minimum SSD is found. This process is performed for each Band and each Iowa curve; and is illustrated in Figure 11.



## Running SPR Analysis

SPR Analysis is run from an SPR Input sheet, or any of its dependent result sheet: select the appropriate sheet and click **Run Life Analysis**. For each Iowa Curve and for each Experience Band, LifeCalc will find the average life that best-fits the mortality data and compute several curve-fit metrics. These include:

- Bauhan's Conformance Index (CI),
- Dr. Ron White's Index of Variation (IV)<sup>6</sup>,
- Bauhan's Retirement Experience Index (REI), and
- Root Mean Squared Error (RMSE).

<sup>6</sup> See footnote 1 on page 5.

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These metrics were described earlier in the section “LifeCalc’s Results Worksheet” on page 4; however, a full description is beyond the scope of this guide. LifeCalc writes the SPR results and descriptive information to an SPR standard results sheet. If the results worksheet already exists, the analyst will be given the opportunity to overwrite it, append to it, or create a new results sheet.

## SPR – Standard Input Worksheet

LifeCalc provides a single SPR input worksheet that holds the observed mortality data and SPR processing instructions. A blank SPR input worksheet is generated by selecting **Blank SPR Sheet** from the LifeCalc ribbon. Additionally, as discussed earlier in the Data Input section, the **Load Mortality Data** command can be used to load raw mortality data into an SPR input sheet.

The SPR input worksheet is depicted in Figure 12 and described in the following text.

Figure 12 – SPR Standard Input Worksheet

The screenshot shows a spreadsheet interface for the SPR Standard Input Worksheet. It is divided into three main sections: 'User provided descriptive information', 'Observed Mortality Data', and 'Bands List'. The 'User provided descriptive information' section includes fields for Company (ACME Inc.), SPR Description (Test Load Mort Data), Class of Plant (Widgets), PLife Seed Value, TCut (age) (0.0), Iowa Curve (L,R,S), and Scenario ID (Scn-12). Below these are 'Mortality Data Statistics' fields (ActYr Count, Minimum ActYr, Maximum ActYr, Vintage Count, Minimum Vintage, Maximum Vintage) and 'Run Counts' (Number of Bands: 1, Number of Curves: 18, Required CurveFits: 18). The 'Observed Mortality Data' section is titled 'Simulated Plant-Record Analysis' and contains a table with columns for Original Cost (Vintage, Original Installed Cost), EOY Survivors (Activity Year, Observed EOY Balance), and Bands to Process (Band, Band Criteria). The 'Bands List' section is currently empty.

### Descriptive Information

This section of the input worksheet, upper left, contains descriptive information regarding the project and class of plant being studied. The pertinent input fields are described below.

#### Company, SPR Description, Class of Plant, & Scenario ID

These optional and self-explanatory fields can be used by the analyst to describe the nature of the SPR analysis and a particular SPR run. This information will be automatically carried forward to all results worksheets generated from these data. The Scenario ID can be used to assign a unique code to each SPR run.

#### PLife Seed Value

Providing a seed value for the projection life may decrease the run time of the life analysis when the entered life is roughly accurate.

#### TCut

The TCut is the maximum age of plant to be analyzed in the curve-fitting process. The analyst may use the TCut to exclude older mortality data that may be erratic or insignificant. A carefully selected TCut

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can improve the accuracy of the curve-fit. If omitted or set to zero (the default), all ages will be included in the analysis.

## **Iowa Curves**

This required field indicates which Iowa curves are evaluated in the life analysis. See the Curve Selection section, page 20, for details. If no curves have been specified, the Curve Selection form will be displayed.

## **Observed Mortality Data**

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This section of the input worksheet is where the analyst enters the observed mortality data; namely, Original Cost by Vintage and EOY Balance for each Activity Year. These fields are required and described as follows:

**Vintage** – The year in which property is placed in service.

**Original Costs** – The installed first costs (Original Cost) of plant placed in service during the vintage year.

**Activity Year** – The year in which surviving plant balances (EOY Balance) are observed.

**EOY Balance** – The Original Cost of plant that is still in service (i.e., surviving) at the end of each Activity Year.

## **Bands List**

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The Bands List section of the sheet lists the bands that will be used in the life analysis. The first column contains the name or ID of the band, and the second column provides the criteria that defines the band. For SPR analysis, only Experience Bands are valid. See the section on Banding, page 15, for details on specifying bands.

## **Life Analysis Results**

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A full description on how to interpret or analyze the results of SPR and Actuarial life analysis is beyond the scope of this guide. Experience with life analysis techniques; familiarity with the subject property; its placement and maintenance practices; and other factors along with informed judgement factor into the analyst's selection of the curve and life that best reflects the ongoing mortality of the subject property. LifeCalc is specifically designed to assist the life analyst in this effort. LifeCalc's ease of use and fast processing affords the analyst the ability to rapidly perform sophisticated life analysis that was often infeasible or time consuming for independent analysts.

LifeCalc's sophisticated banding capabilities allow the analyst to quickly investigate trends in the mortality characteristics over time, screen-out or zero-in on specific events or technologies. LifeCalc's MROE Matrix gives the analyst a clear visual of the banded MROE. In addition, LifeCalc provides charting capabilities to assist in identifying trends and comparing results. These analytical features are described below.

## **Banding**

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In addition to using banding to omit suspect or erratic data from the analysis, banding can also be useful in identifying trends in both the dispersion pattern and average life. LifeCalc's automatic generation of Rolling and Shrinking bands are specifically useful in this regard. See the section on Banding, page 15, for details regarding LifeCalc's banding features.

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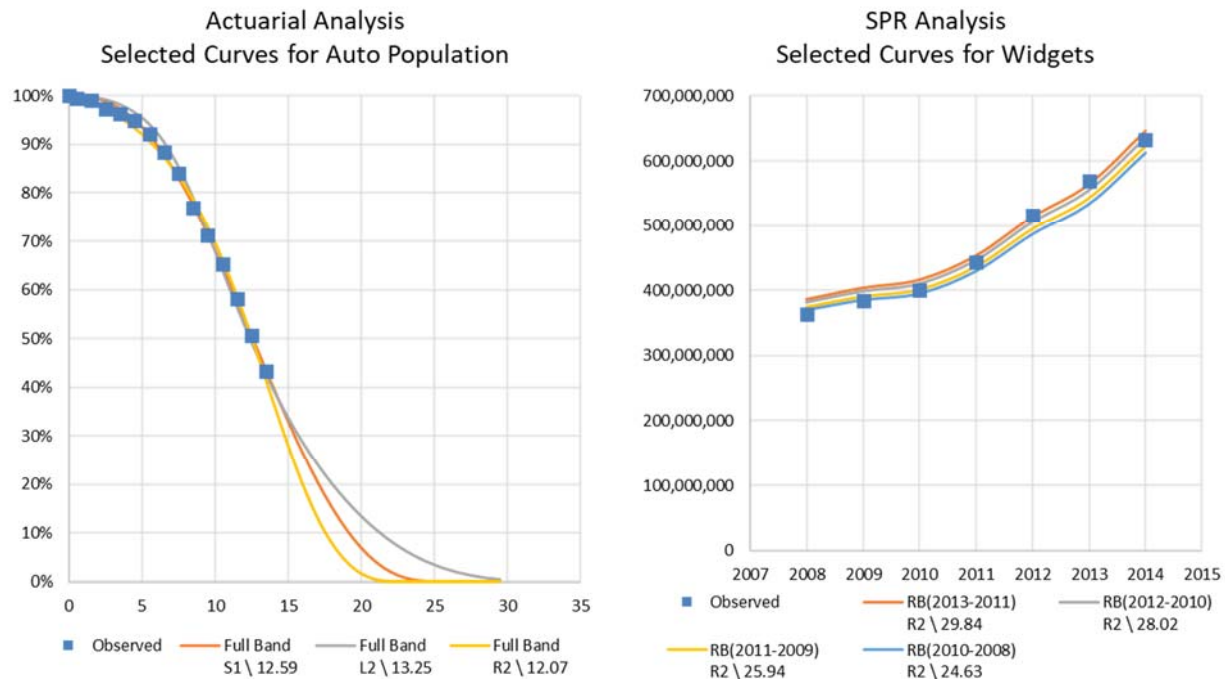
## Comparison Charts

The Comparison Chart compares selected simulated results to the observed mortality data. This plot provides a visual of how well the simulated results for one or more curves match the observed mortality data. The comparison graph is different for Actuarial and SPR results. Examples of the Comparison Chart is show in Figure 13.

For Actuarial Analysis, the chart plots the percent surviving (PS) of the selected results to the observed PS from the OLT. Because the PS is dependent on the banding, to avoid the situation where the plotted observed and computed PS, are not based on the same underlying OLT, use the Run Option: **“Generate OLT Sheet for Each Band”** when running Actuarial life analysis. A banded OLT will be created on a new Actuarial Input sheet; and the banded results will be linked back to the banded OLT on this input sheet.<sup>7</sup>

For SPR Analysis, the chart plots the observed versus simulated EOY Plant Balances. The above described situation, applicable to Actuarial results, does not exists for SPR results because the EOY Survivors by activity year do not change with banding.

Figure 13 – Typical Actuarial and SPR Comparison Charts



When the **Comparison Chart** command is invoked, LifeCalc will first display the results sheet associated with the active worksheet; LifeCalc will then prompt the analyst to select one or more fitted curves to plot. To select a fitted curve, click on a single cell in the row containing the desired curve. The selected cell can be in any column within the results. A range of fitted curves may be selected by selecting a range of cells within a single column. Additionally, non-contiguous curves can be individually selected by clicking on a cell, or range of cells, while holding down the control key. Alternately, the desired curves can be selected prior to running the **Comparison Chart** command.

<sup>7</sup> This mismatch situation only occurs when banding is used in Actuarial Analysis and the analyst didn't generate an OLT sheet for each band; resulting in the plotted Observed PS from the non-banded OLT on the Input sheet versus the computed PS, which was developed from the internally computed banded OLT.

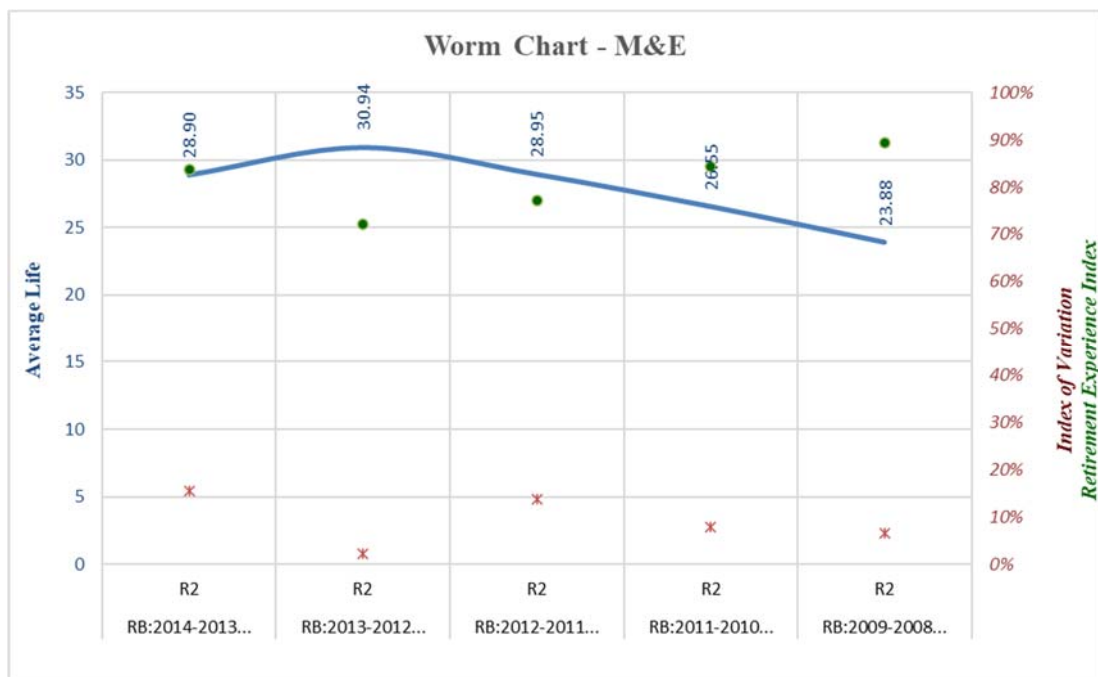
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## Worm Charts

The **Worm Chart** command plots the best-fit average life, a.k.a., Projection Life (PLife), for each curve-fit result on the Results sheet. In addition to the average life, the appropriate fit criteria is also plotted (RMSE or WRMSE for Actuarial Analysis; and the Index of Variation<sup>1</sup> (IV) and Retirement Experience Index (REI) for SPR Analysis). The average life is plotted against the Primary Axis (on left) and the fit metrics are plotted against the Secondary Axis (on right).

Worm Charts are often used to track the change in the life over time for a given survivor curve. Typically, either single years or a rolling or shrinking band of years is used. To produce the SPR worm chart shown in Figure 14, Life Analysis was run using the R2 survivor curve with a 2-year rolling band. **Worm Chart** was then run against these results.

Figure 14 - Typical Worm Chart



The Worm Chart is placed directly on the active Results sheet. By default, LifeCalc plots all the fitted curves on the Results sheet. The analyst can use Excel's Hide command to hide rows to limit the fitted curves plotted. The analyst can use Excel's graphing features to easily modify the graph to plot a different selection of results or alter its appearance.

Excel's filtering feature can also be used to hide curve-fit results from both the Results sheet and the Worm Plot. Alternately, to limit the curves plotted on a Worm Chart, sort the RMSE column lowest to highest. Then click an open area on the Worm Chart. The plotted data will be boxed; select the lower left corner of the box surrounding the Band data and drag it upward until only the desired curve-fits are selected.

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## Using LifeCalc's Built-in Excel Functions

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LifeCalc contains several built-in functions that the analyst can use anywhere in the spreadsheet. These functions can be used like any other Excel function. Like Excel's functions, you specify the formula's argument values either directly in the formula or via a cell references that contains the desired values.

Three depreciation related built-in functions include:

- **pflowaPS** – Returns the Percent Surviving,
- **pflowaARL** – Returns the vintage Average Remaining Life,
- **pflowaRV** – Returns the Remaining Value Factor.

These public functions have the same required arguments:

**Curve** The desired dispersion (survivor) curve selected for the subject property. The curve can be any of the supported curves listed earlier in this document.

**PLife** The desired Projection Life, or average life. The specified curve is scaled to the desired projection life.

**Age** The age or effective age.

### **pflowaPS(Curve, PLife, Age)**

Returns the Percent Surviving for the specified curve, life and age specified.

Use the *pflowaPS* function to compute the Percent Surviving for the curve, life, and age you specify. For example, if you wanted the percent surviving for a property or asset that is 3.5 years old; expected to be in service 10.25-years and has mortality characteristics consistent with an Iowa L1 curve. You could use the following formula:

=pflowaPS("L1", 10.25, 3.5) Returns: 91.47%

### **pflowaARL(Curve, PLife, Age)**

Returns the vintage Average Remaining Life for the curve, life and age specified.

Use the *pflowaARL* function to compute the vintage average remaining life for the curve, life, and age you specify. For example, if you wanted the most probable remaining life for a property or asset that is 3.5 years old, expected to be in service 10.25-years and has mortality characteristics consistent with an Iowa L1 curve. You could use the following formula:

=pflowaARL("L1", 10.25, 3.5) Returns: 7.49

### **pflowaRV(Curve, PLife, Age)**

Returns the Remaining Value factor for the curve, life and age specified.

Use the *pflowaRV* function to compute the Remaining Value factor for the curve, life, and age you specify. For example, if you wanted the Remaining Value for a property or asset that is 3.5 years old, expected to be in service 10.25-years and has mortality characteristics consistent with an Iowa L1 curve. You could use the following formula:



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=pflowaRV("L1", 10.25, 3.5) Returns: 68.16%

The Remaining Value factor is computed based on the Age-Life concept as the ratio of the Remaining Life to the Probable Life, i.e., (Age + Remaining Life).

## ParselowaCurvesStr(Curves)

Returns the individual curves identified in the *curve string*. The term "Curves" in the formula is a cell that contains the *curve string*, e.g., "L,S,R". On an Input sheet "Curves" is a Range Name that points to the Iowa Curves cell that contains the *curve string*.

If the Iowa Curves field (cell) on the Input sheet contains "L,S" then

=ParselowaCurvesStr(Curves) Returns: 'L0,L1,L2,L3,L4,L5,S0,S1,S2,S3,S4,S5,S6'

Similarly:

=ParselowaCurvesStr("L,S") Also Returns: 'L0,L1,L2,L3,L4,L5,S0,S1,S2,S3,S4,S5,S6'

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End of Report