AKUR8
RESERVING

Arius
Getting Started

Table of Contents

1. Installation

- Complete installation requirements and procedures are here: https://www.actuarialsoftware.com/en/support or https://arius.milliman.com/en/support
- Note: Administrator privileges are required to install Arius.

OPEN ARIUS

After installation you will be prompted to open the application, or you can find it listed as Arius in your START | ALL PROGRAMS listing if you want to open it later.

Authenticate

When opening Arius the first time, you will be prompted to enter your email address to authenticate as a licensed (trial or production) user. You must be connected to the Internet to authenticate Arius.

After the Welcome screen, the File screen displays. From here you can confirm what version of Arius you have installed, and you can open an existing Arius project or create a new one.

SAMPLE FILES

Arius installs with six sample project files, a sample external factor file and several sample API files.

The project and factor files can be found in C:\…Documents\Milliman\Arius\DemoFiles.

- **Arius_Sample.apj**

  This is sample data with five segments (a mix of short, medium, and longer tailed). It is intended to give you a sense of the capabilities of Arius and a sampling of how the various deterministic methods and models can be set up with different assumptions for different lines.

- **Arius_Sample_Canadian.apj**

  This is sample data showing gross, net, and ceded layers of reinsurance and includes data that populates the collections under the DETERMINISTIC | SPECIAL REGULATORY | CANADIAN (PFAD) folder. You can use this file to follow along with the "Canadian Provision for Adverse Deviations" document available from HELP | USER DOCUMENTATION.

- **Arius_Stochastic_Sample.apj**

  This is sample data across four segments, showing a detailed implementation of all four families of stochastic models (ODP Bootstrap, GLM, Mack Bootstrap and Hayne MLE) fully parameterized.

- **Arius_GLM_Case_Studies.apj**

  This is sample data that includes various case studies that serve as an introduction to potential applications of the Generalized Linear Model framework. You can use this file to follow along with Section 2 of the "Generalized Linear Models" document available from HELP | USER DOCUMENTATION.

- **Hayne_Paper.apj**

  This file contains the data used in Dr. Roger Hayne's paper on maximum likelihood estimator approaches, "A Flexible Framework for Stochastic Reserving Models" available from HELP | TECHNICAL REFERENCES.

- **SampleIndustry_FactorLibrary.xlsx**

  This contains sample paid and incurred development factors for 10 lines of business, some of which are mapped and displayed in the corresponding exhibits in Arius_Sample.apj.

- The **API files** can be found in C:\...Documents\Milliman\Arius\API\ExcelVBA Samples.

  Note that all API examples are described in the "API User Guide," available from HELP | USER DOCUMENTATION.

2. Creating a new project

WHAT IS A PROJECT?

An Arius project contains a set of input arrays, diagnostic and development exhibits, actuarial methods and reports, and selections for one or more reserving segments.

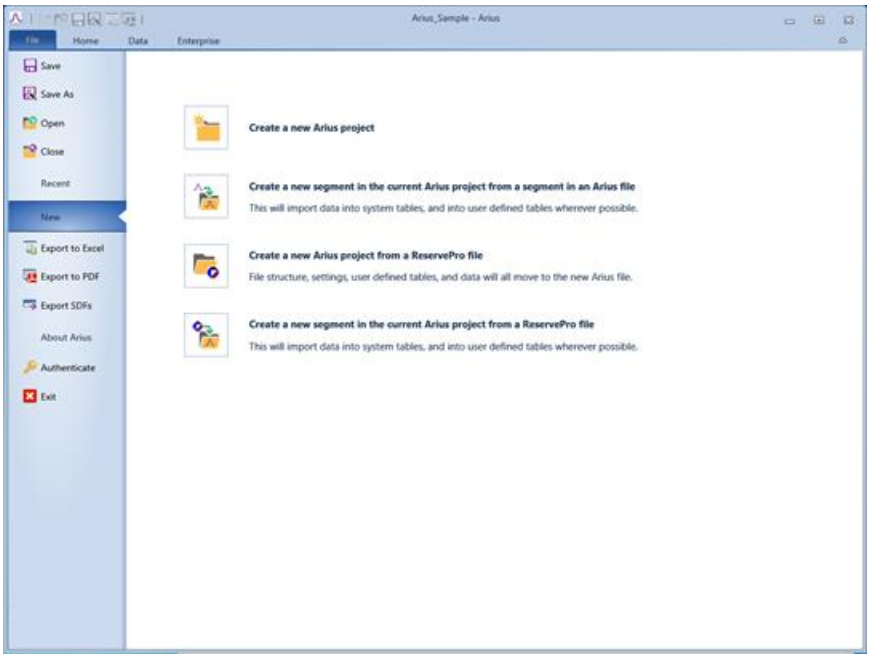
WHAT IS A SEGMENT?

A segment in an Arius project contains a complete set of tables for performing an analysis, whether that is a line of business, a specific coverage, or any other grouping on which a reserve review is performed. A project can contain one or more segments. All segments in a project file will have the same structure, views, and available tables.

CREATE A NEW PROJECT

To create a new Arius project, click FILE | NEW and select one of the options.

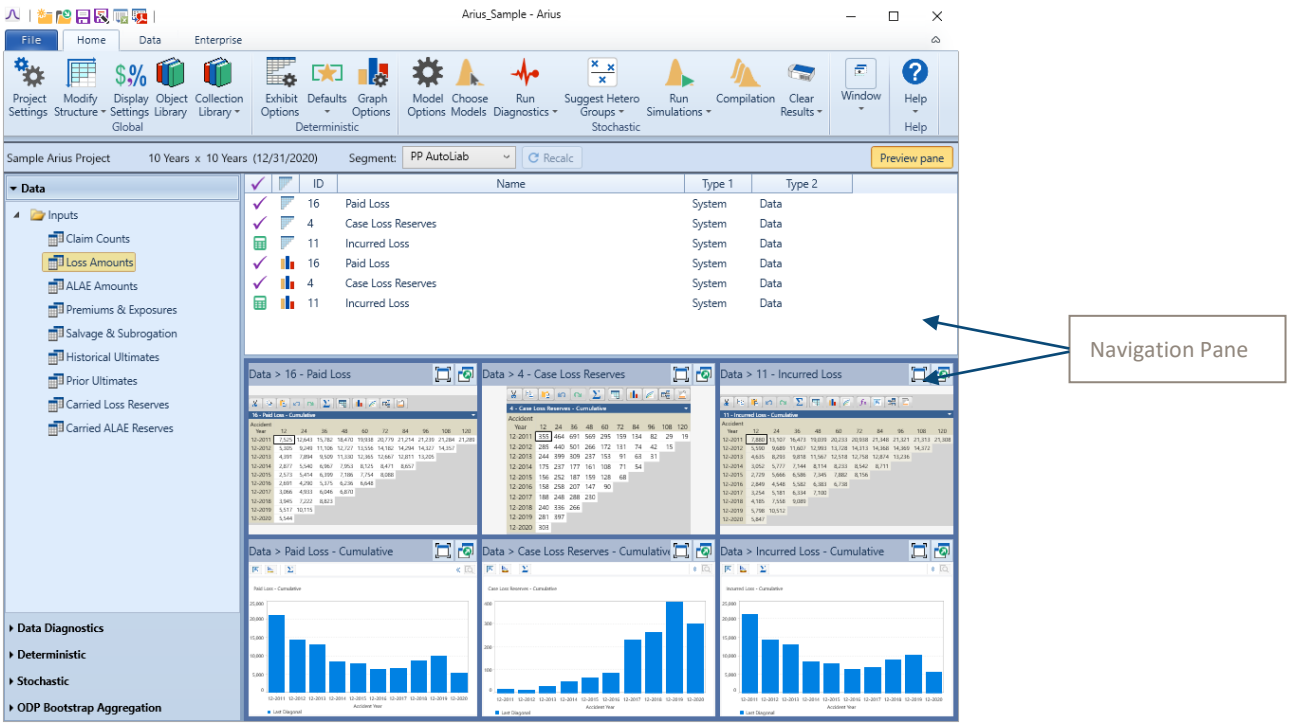
- **Create a new Arius project** by manually defining the structure and segment(s).
- **Create a new segment in the current Arius project from a segment** in a different Arius file, importing data into the new segment.
- **Create a new Arius project from a ReservePro file**, reproducing the structure and user defined tables of the original ReservePro file and importing all data, settings, and selections from one of the layers of the ReservePro file.
- **Create a new segment in the current Arius project from a ReservePro file**, importing data and selections from one layer of the ReservePro file into the new segment.



3. Navigation

A project opens to the **Home** screen. The **Home** window displays the project file name at the top and the title, structure, and active segment directly below the **Home** ribbon. The **Home** screen includes the **Home** ribbon, general project information and views populated with data of the currently active segment.

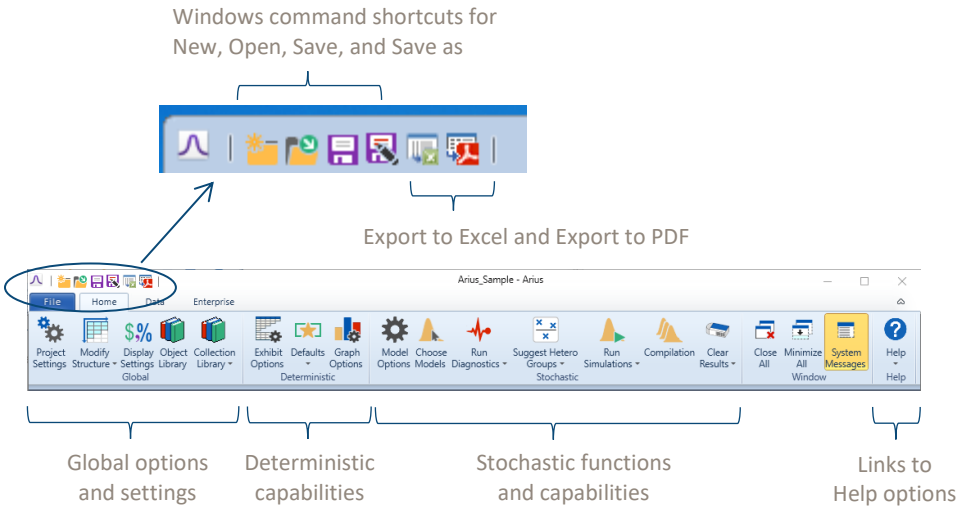
THE HOME SCREEN



Segments

Segments of a project are defined in Project Settings. Select a segment of a project from the **Segment** drop-down under the **Home** ribbon.

HOME RIBBON



Global options and settings

Selections in the **Global** ribbon will affect all segments and all tables in both the Deterministic and Stochastic modules.

Project Settings

- **Data Structure** – View the size and structure of the tables in the file, and view/modify row and column labels.
- **General** – Enter the project title and other informational text. Note that text in these fields can be referenced in table footnotes and print labels.
- **Segments** – Create one segment for each set of data you will be analyzing (e.g., line of business, coverage, etc.). Each segment will have its own data, assumptions, results, and selections.

Modify Structure

- **Append/Remove Evaluation Periods** – Add or remove development periods (i.e., diagonals on triangles).
- **Append/Remove Exposure Periods** – Add or remove exposure periods (i.e., rows in a triangle) including combining old exposure periods into a Prior row.
- **Append/Remove All Prior Row** – The Prior row can be used to combine several periods of data into one period; for example, this is helpful when there is no further development, or when the company wishes to maintain a consistent structure when appending new evaluation periods.
- **Compress Columns/Rows** – If the original structure contains exposure and/or development periods shorter than years, these commands will compress data and selections appropriately (for example, converting quarterly triangles to annual ones). Note that you must save the original file and the compressed file under two different names to retain both structures.

Display Settings

- **Number** and **Date** format options

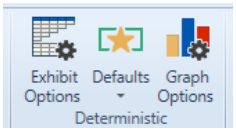
Object Library

- Access the **Object Library** to see a list of all the tables available in the current file. The **Object Library** also contains options to **Create**, **Edit**, **Delete**, and **Export/Import** user defined tables.

Collection Library

- Access the **Collection Library** to see a list of all the collections/views provided by Arius, some of which will automatically be displayed on the **Home Navigation Pane**. You can also save a new or modified collection or load a previously saved collection.

Deterministic capabilities

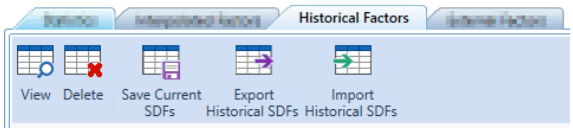


Selections in the Deterministic options will affect Exhibits and Graphs in all segments in the Deterministic module.

Exhibit Options

- **Statistics** – Select which statistics you want to display on various exhibit types for all data elements and segments in the current file. The **Choose Exhibits** icon on this tab allows you to choose the tables where statistics are displayed. Refer to "Exhibit Statistics" under HELP | USER DOCUMENTATION for more information.
- **Interpolated Factors** – Select which curves you want to fit to calculate interpolated factors, using Age-to-Ultimate or Ratio-to-Ultimate values from the selected factors. The interpolated factors are only displayed and used when appropriate, based on **Project Settings**. Refer to "Interpolation and Extrapolation" under HELP | USER DOCUMENTATION for more information.

  The Set Default icon on this tab allows you to set which curve and source to use when interpolating historical or external factors to fit the current file structure (if they do not match).
- **Historical Factors** – Select which historical selected factors display on exhibits. Whenever a new evaluation period is added to a project, the current period's selected factors are saved as historical factors available for future use. Over time, substantial history will build up in an Arius data file. Refer to "Historical Factors on Exhibits" under HELP | USER DOCUMENTATION for more information.



- **Save Current SDFs** – Manually save selected development factors when performing interim analyses using data structure modifications other than **Append New Evaluation Period**. Refer to "Arius Actual vs. Expected Analysis" under HELP | USER DOCUMENTATION for examples of when this might be necessary.
- **Export Historical SDFs** – Export all development factors in the Historical Factor Library (HFL) to a CSV file. This is valuable, for example, for sharing factors among similar Arius projects.
- **Import Historical SDFs** – Import Historical Factors from a CSV file of your choice. An easy way to create an Import Historical Factor Library (HFL) CSV file in the correct format is to export the existing HFL within the project and modify as necessary.
- **External Factors** – **New, Edit, View, Delete** and **Map Segments** – Add external development factors, stored in an Excel file, to the current Arius project. Examples include industry factors (for example, from A.M. Best Aggregates and Averages, RAA, or NCCI) or selected countrywide factors from another analysis being displayed on regional/state analyses. Refer to "External Factors on Exhibits" under HELP | USER DOCUMENTATION for more information.

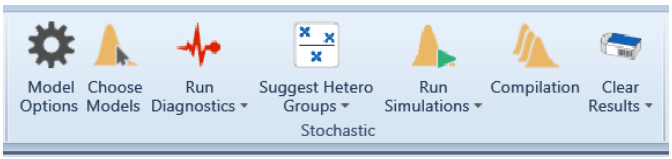
Defaults

- **Data** – Have the system automatically enter values into some or all cells of an entered table (one with white cells). Options are to set a value for all blank cells or for all cells and Fill Blank Value.
- **Exhibits** – Specify default selections for specific exhibits and segments. Can be set for either selected development factors (SDFs) or interpolated SDFs.
- **Clear Manual Selections** – Choose SDFs, Interpolated SDFs and/or Ultimates for the specified segments.

Graph Options

- Select the default number of periods to include in each type of graph. The default can be overridden individually for each table.

Stochastic functions and capabilities



Selections in the Stochastic options can affect one or all segments in the data file. Refer to the "Arius Stochastic User Guide" for more detailed information.

Model Options

- **Options** – Selections here will apply to all segments. Arius gives you control over the number of iterations to run in a simulation, which percentiles to return in your results, and whether

your results should be discounted. You should confirm or edit the information on this tab as a starting point for running stochastic models.

- **Term Discount** – This allows for the use of a yield curve in discounting model results. Entries here will apply to all segments, and are only activated if you selected **Enable Discount Rate?** on the **Options** tab.
- **Default Model Selection** – Select a default set of models for typical use with most segments. You can then manually select different models to run for individual segments, if you prefer, in the **Choose Models** screen.
- **Table Mapper** – Select which Arius objects should be used in the stochastic models. For example, you can change the input table into your bootstrap models from Paid Loss to Paid Loss + ALAE (a user-defined table).

Choose Models

- Select which models to include for the active segment. You can modify these selections for each segment for which you want to run stochastic models.

Run Diagnostics

- Run for an individual segment or for all segments and correlation. Note that this step is separate from running the model itself. This provides several elements of key diagnostic information to help you further parameterize your model.

Suggest Hetero Groups

- Used for ODP Bootstrap and applies to an individual segment or all segments. This provides recommended groupings of your residuals by similar distributions and helps to adjust your model to account for potential heteroscedasticity in your data.

Run Simulations

- Run for an individual segment or for all segments and aggregation.

Compilation

- Combines stochastic results from multiple projects and model types into one stochastic distribution.

Clear Results

- Clear for an individual segment or for all segments and aggregation.

Windows and other options

Close All

- Closes all tables, graphs and collection windows that have been launched from the interface.

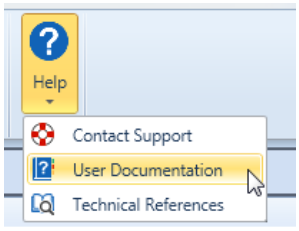
Minimize All

- Minimizes all tables, graphs and collection windows that have been launched from the interface.

System Messages

- Toggle button that turns on/off the system messages that appear as a separate window in the bottom right corner of the Arius application. System defaults to ON.

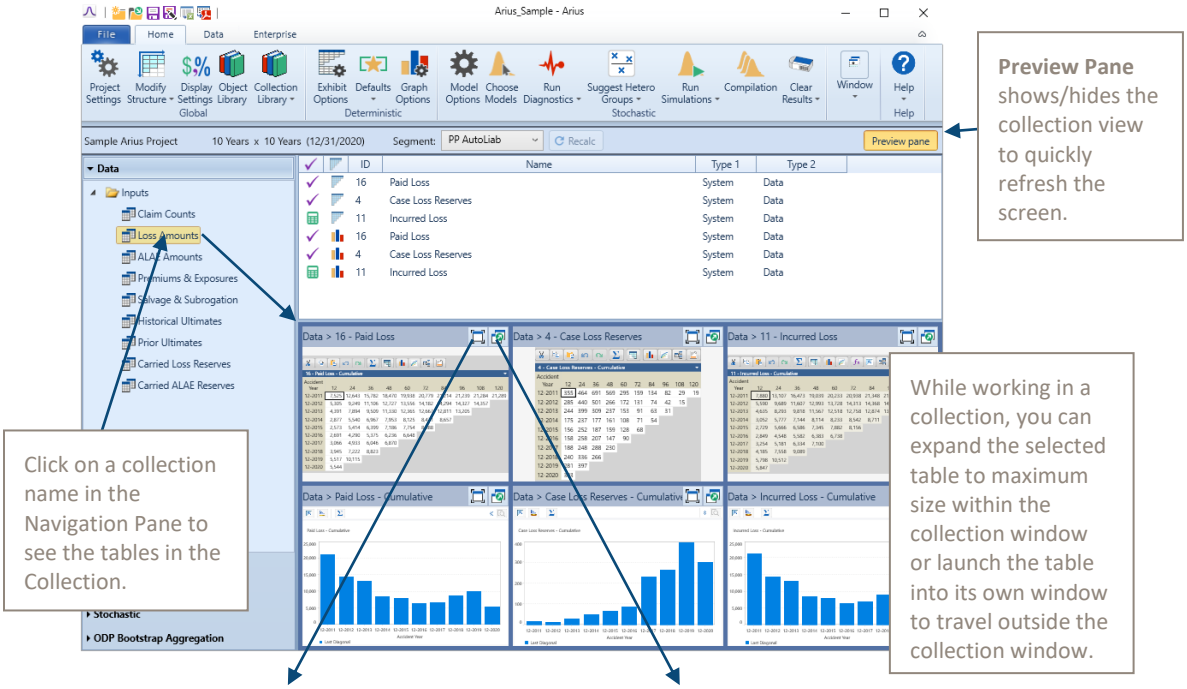
Where to get help



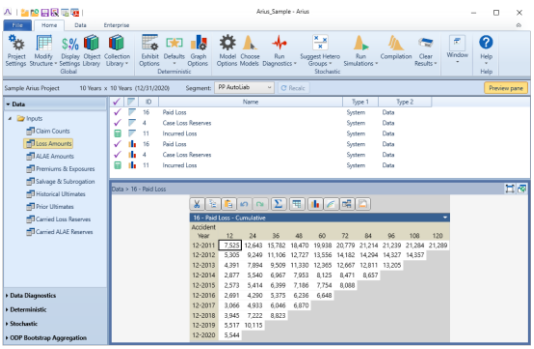
- **Contact Support** – View the FAQs page for helpful tips, and email or call the Arius software support team.
- **User Documentation** – Includes help documents and video tutorials for both the deterministic and stochastic modules of Arius, as well as Arius Enterprise and Triangles on Demand.
- **Technical References** – Quick access to some of the white papers referenced in the stochastic models and calculations.

COLLECTIONS

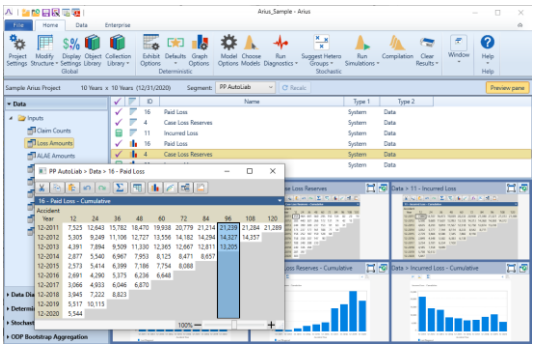
Collections are views of one or more tables on the **Home** screen, organizing the objects you use in your analysis into a customizable and efficient workflow. For example, the Loss Amounts collection below displays three data tables and corresponding bar graphs.



Expand/Collapse Window



Launch Window



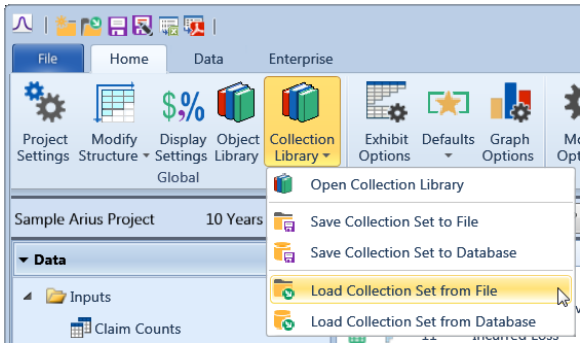
Collections are global in that they are shared across all segments in an Arius project, but they can vary from file to file. Many collections are included with the software and automatically display in the **Navigation Pane** when creating a new file. Many more are available for your use in the **Collection Library**. You can create your own collections by copying an existing collection or creating one from scratch. Collections are also handy for building export and print lists rather than selecting one object at a time.

COLLECTION SETS

All the collections that group and manage your workflow throughout a project are shown in the project's **Navigation Pane**. All these collections taken together for the entire project (the .APJ file) are called a **Collection Set**. This set supports the workflow for all segments in the project.

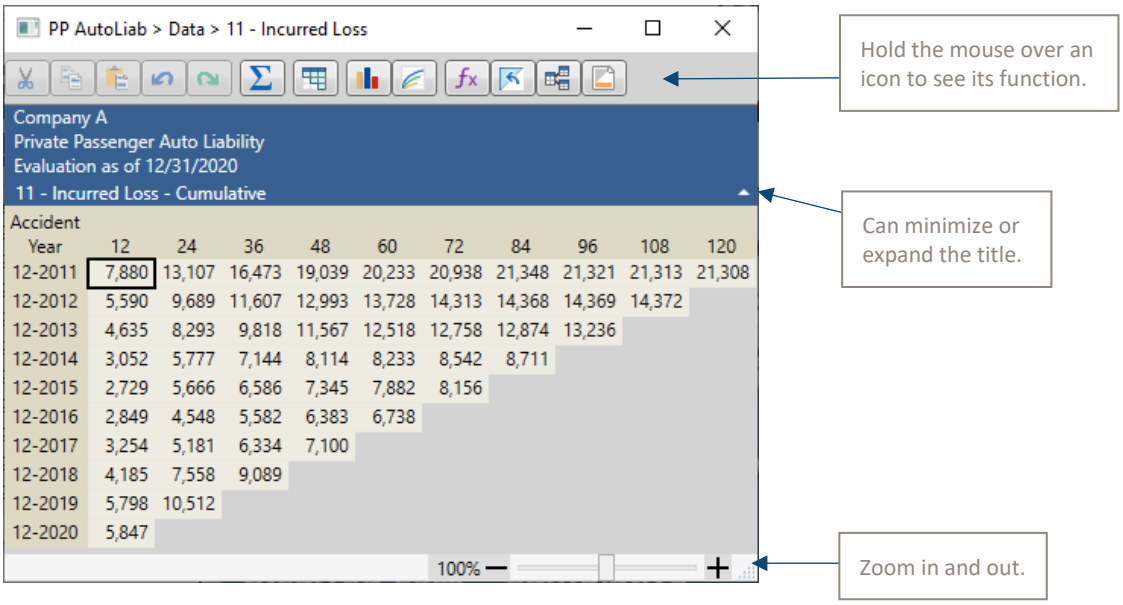
Collection Sets are a part of and specific to a particular project. Once you get the collections like you want them in one Arius project/file, you can save the **Collection Set** for reuse with other projects. The **Save Collection Set to File** function saves all the information necessary to open these same collections in another Arius project or to revert back to these collections in the current project at some later date if necessary.

You can import another **Collection Set** into your current Arius project using the **Load Collection Set from File** function.



DETERMINISTIC TABLE RIBBONS

In addition to the ribbon on the **Home** screen, each deterministic table has a ribbon of its own.



Cumulative/Incremental

- Toggles between displaying data triangles in cumulative or incremental amounts.

Development/Calendar

- Toggles between displaying data in development triangles or calendar period format.

Edit UDO (available on user defined tables)

- Allows you to edit the formula or layout of a user defined object (UDO) by taking you directly to the UDO editor dialog, also accessible via the Object Library.

Graph: Bar (latest diagonal), Series as Rows, Ratio to Ultimate, and Series as Columns

Each type of Deterministic table can be graphed in multiple ways. Once a graph is displayed, click on the **Graph Settings** icon to select which exposure periods, series, or columns are included (not available on bar graphs) and click on the **Graph Styles** icon to modify the axis, legend, and title fonts and positions.

- Input tables – Bar graph of incremental or cumulative amounts in the last diagonal or line graph of cumulative amounts for each exposure period.
- Exhibit tables – Line graphs of selected **Ratio to Ultimate**, **Series as Rows**, and **Series as Columns**.
- Method and Report tables – Combination bar and line graph of one or several columns in the table.

Show Formula

- Displays the formula for the table or for cells linking to or calculated from other columns or tables.

Source Data

- If there is only one source, the source table opens automatically. If there is more than one source, a list of sources displays with an option to select and open one of those source tables.

Trace Dependents

- Shows you the list of tables dependent on (or affected by) the table in view.

Calculated Segment

- Allows you to see and potentially override the related segment calculation for each object in a calculated segment.

Edit Footnote

- Allows the entry of footnotes for each table, and optionally to share that footnote with the same table in all other segments in the file. Footnotes can be entered as hardcoded text or can refer to text from various fields in the file. Footnotes print below the related tables when exporting to PDF.

Tail Factor Analysis (available for development exhibits with a Selected row)

- In tables calculating development factors, you can select any row of data on the exhibit, fit a curve to the series, and extend the curve into the future to help estimate a tail. Right-click on the row label text in the left pane and initiate or edit existing tail factor calculations. A second window will open, displaying the results of three different curves fit to the selected data. After making any revisions, you can select which results to display on your development exhibit.

Heat Map (available for any Exhibit as defined in the Object Library)

- Provides conditional format-type coloring for each column in an exhibit triangle. The highest number down each column is shaded red, the lowest number is shaded green, and all numbers between those two values are shaded accordingly. Heat maps can be especially helpful in visually identifying trends or outlier diagonals or periods in your data.

Box-Whisker Plot (available for any Exhibit as defined in the Object Library)

- Provides a graphical depiction of the values in each column of an exhibit triangle, with the box indicating those factors in the 25^{th} - 75^{th} percentile, the median depicted by the line in the box, and the whiskers depicting the highest and lowest values in the column that don't exceed the criteria for being outliers. Outliers are those values exceeding 150% above or below the interquartile range, and they are displayed as an orange dot on the box-whisker plot. When displayed for an exhibit that has selections, the selected value will be displayed as a green dot on the box-whisker plot. These plots can be helpful in identifying such situations as bias in your selections (for example, all your selections are above or below the median).

Settings (gear) icon

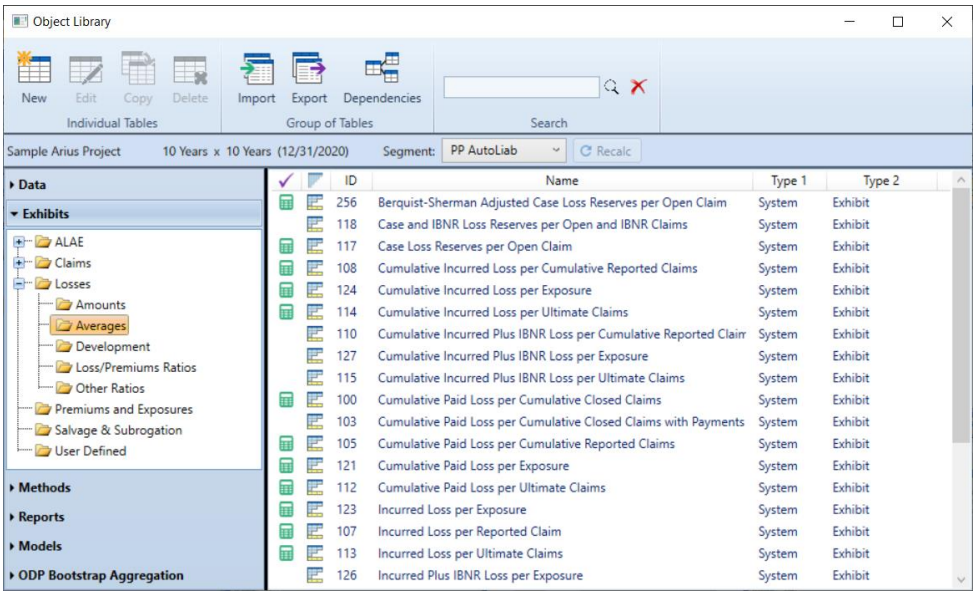
- A **Settings** icon is available on tables with additional structure options. For example, the **Report Settings** icon on the **Comparison of Ultimates** reports is used to select which methods to display. The **Default Settings** icon on exhibits provides options for defaulting blank cells to a value or setting a minimum and maximum default value for selected development factors (SDFs). On resizable row arrays like the **Loss Payment Pattern**, it allows selection of the length and age increment of the payment pattern. On graphs, it allows selection of which exposure periods to include.

4. Object library

The **Object Library** lists every table available in an Arius file. It is the source for building collections and export and print lists, and is where you create, modify, or delete your own tables.

A typical analysis will only use a select subset of all the Arius tables. Many of these tables are displayed on the left **Navigation Pane**; however, many more are available to help in your analysis. They are stored here in the **Object Library,** and you can pull them into your **Navigation Pane** as part of your workflow.

The Arius-provided tables in the **Object Library** cannot be modified or deleted, though they can be copied and then the copies can be edited. Tables created by the user, whether from scratch or by copying an existing table, will be stored in the **User Defined** folder under the appropriate node on the tree.



Note

Be sure to browse through the list of Exhibits at least once. They will automatically populate when source data is available, providing a variety of diagnostic information with no additional user intervention.

NAVIGATION PANE

Data

Generally, tables in the **Data** section include raw data, assumptions for methods, and selected ultimates. A data table can be a triangle, row, column, single cell scalar, triangle index, or formula driven assumption. They can be entered or calculated values and referenced directly in formulas. Examples include **Paid Loss**, **Loss Ratios** for BF methods, and **Ultimate Claims**.

Exhibits

Exhibit-type tables are always triangles and are always calculated values with a consistent calculation across the entire triangle. The only entry field in an Exhibit is a row for selecting factors. Exhibits are typically some type of ratio, and they are defined as one of four types in Arius (development, average, ratio, and other). Each type of exhibit can display a different set of statistics. Examples of exhibits include **Paid Loss Development**, **Cumulative Incurred Loss to Ultimate Loss**, and **Ultimate Claims per Exposure**.

Methods

Method-type tables typically calculate an ultimate that will be referenced in another method or report. These table types are columnar, with each column having its own formula. One column in every Method is designated as the **Calculated Ultimate**, which can be referenced in a formula in another table. Examples include the **Paid Loss Development** and the **Bornhuetter-Ferguson Using Ultimate Premiums and Incurred Loss** methods.

Reports

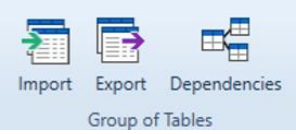
Report tables are similar in structure to Method tables - columnar with each column having its own formula - but they are more summary in nature, and calculated values in a report cannot be referenced in a formula in another table. One example is the **Comparison of Ultimates** report, which allows you to compare method results, calculate a weighted average if desired, and select (using defaults or manually entered) ultimates. Other examples include a **Summary of Reserve Estimates** and various cash flow reports.

Models & ODP Bootstrap Aggregation

The **Models** and **ODP Bootstrap Aggregation** nodes on the tree in the **Object Library** list all the tables and graphs in each stochastic model and for the ODP aggregate calculations. These tables are specific to the stochastic module and are described in detail in the "Arius Stochastic User Guide" available from HELP | USER DOCUMENTATION.

OBJECT LIBRARY RIBBON

Additional features available in the Object Library include the ability to import and export groups of tables and the ability to produce a list of table dependencies on all user defined tables.



Export

When using Arius Desktop, the user defined tables that exist within a project are independent from other files. The **Export** button provides the ability to share user defined tables across projects. Once all user defined tables have been created and reviewed, you can export to a *.udodef file via the **Export** icon. This file will include all the user defined tables that exist in the project file (Table IDs 501 – 999).

For Arius Enterprise users, user defined tables are saved within the Arius Analysis database and shared across all projects, so the export/import process is not needed.

Import

Once a *.udodef file exists via the **Export** process above, the user defined objects can then be imported into other project files via the **Import** icon. Note that the import process attempts to merge the user defined tables from the import file with the user defined tables from the current file.

- If new table IDs are identified, these tables will be imported to co-exist with the existing tables from the current file.

- If a table ID conflicts with an existing table ID, Arius will alert you, as the import could potentially lead to loss of data (e.g., if the array type has changed causing a mismatched shape, or if the table name has changed). If you choose to continue, any modifications to the table's name, description, formulas, or formats will be imported, overlaying the existing table from the current file.

Dependencies

The dependencies feature will trace the dependents across all user defined tables in your Arius project and output the results to a CSV file for a consolidated view. This feature is helpful for those managing and reviewing the user defined library.

5. Creating/editing collections

Collections are views of one or more tables on the **Home** Navigation screen, organizing the objects used in an analysis into a customizable and efficient workflow. For example, a collection might include a set of raw data tables and corresponding graphs or several diagnostic tables reflecting frequency and/or severity. Collections are global in that they are shared across all segments in an Arius project, but they can vary from project to project. Many collections are included with the software and several automatically display in a new project. A complete list of system-provided collections is available in the **Collection Library** accessible from the **Home** ribbon.

A collection from the **Collection Library** can easily be added to or deleted from the **Navigation Pane**.

- To add a system collection to the **Navigation Pane**, click the name of the collection in the **Collection Library** and drag it into the desired position in the **Navigation Pane**.
- To remove a system collection from the **Navigation Pane**, right-click and select **Delete**.
- Note that system-provided collections can be removed from the **Home Navigation Pane**, but they are not deleted from the file. They can easily be restored by dragging them from the **Collection Library** back into the **Navigation Pane**.

You can also create your own collections, either from scratch or by copying an existing collection.

- **Create**, **Copy**, **Edit**, and **Delete** functionality for collections is performed by a right-click in the preferred node, folder, and collection (if appropriate) in the **Navigation Pane**.
- Once a collection has been created, right-click and select **Edit** to modify the structure, rearrange existing objects, add new objects, or remove existing objects.
- To add objects to a collection (the collection must be in edit mode), open the **Object Library** and click-and-drag each object from the library to the appropriate position in the collection window.
- Click **Save & Close** to see the new collection in the **Navigation Pane**.

6. User defined tables

Arius has hundreds of system tables built in to store data, calculate diagnostics and actuarial methods, and store selections. In addition, you can create your own tables, referred to as **User Defined** tables. **User Defined** tables can be built from scratch or by copying another table and editing it as necessary. You can also copy an entire set of **User Defined** tables from one project to another.

All **User Defined** table activity occurs from the **Object Library**.

It might first help to understand table types:

- A **Data table** can be a triangle, row, column, single cell (scalar), triangle index, or formula-driven assumption. These can be entry tables or calculated tables. Data tables can be referenced directly in formulas.
- An **Exhibit** is always a calculated triangle and is typically for development factors or other diagnostics. Exhibits are the only table type providing for a row of selected factors that can then be referenced in other formulas.
- **Methods and Reports** are columnar tables, where each column has a different calculation, and all columns are calculated fields. Methods typically calculate an ultimate, while Reports typically summarize information from Data, Exhibits, and Methods.

  The major difference between a Method and a Report is that Methods have one column designated as “ultimate” which can be referenced in other formulas. Columns in a report cannot be referenced directly from another table.

The easiest way to create a **User Defined** table is to find an existing Arius table that is close to the type of table you need, copy it, and edit it as appropriate.

1. In the **Object Library**, navigate to the table you wish to copy. Either right-click on the table name and select **Copy** or click once on the table name to select it and click the **Copy** icon in the ribbon. Enter a new name and click **OK**.
2. You will automatically be taken to the **User Defined** folder in the appropriate node on the tree where your new table is saved. To edit the table, either right-click on the table name and select **Edit** or click once on the table name to select it and click the **Edit UDO** icon in the ribbon.

To create a table from scratch:

1. Select **New** from the ribbon in the **Object Library** and select the table type.
   - For Input and Exhibit tables a window displays to name the table, set formats, and enter formulas for the table’s calculations.
   - For Method and Report tables the same window displays but you can click in each column to select column specific formats and formulas.
2. Refer to “Arius Deterministic Formula Functions” for details about each function available for building formulas. It is accessed from HELP | USER DOCUMENTATION on the **Home** ribbon.

7. Sample Deterministic analysis

1. Create a new Arius project using FILE | NEW.
   - Select either **Create a New Arius project** or **Create a New Arius Project from a ReservePro file**.
   - Note that much of the information below in step 2 will be automatically set upon importing a ReservePro file. Click **Project Settings** on the **Home** ribbon to review or modify these fields.
2. Provide basic information about the data you will be entering and working with in the **Project Settings** screens:
   - Use the **Data Structure** tab to define the size and structure of the triangles in the project.
   - Use the **General** tab to enter project information and notes.
   - Use the **Segments** tab to add all the lines of business or coverages you will work with in this project. Each reserving segment will have its own data, models, and assumptions. (Note that you can also come back and add additional segments to this file later.)
   - Click **OK** on the bottom of the **Project Settings** window to finish creating a new file.
3. Enter or import the data necessary for your analysis:
   Copy and paste or use the API to import from Excel, then review the data in
   NAVIGATION PANE | DATA or OBJECT LIBRARY | DATA | INPUTS.
4. Define preferences for exhibits:
   DETERMINISTIC RIBBON | EXHIBIT OPTIONS
   - Specify which statistics to display on development and other exhibit types.
   - Define which curves to display for interpolation (if required). Interpolation will only be displayed on development exhibits if the file structure identifies a partial period in the last diagonal, as shown in **Project Settings**.
   - Select external development factor sources (e.g., NCCI factors, etc.) and map them to appropriate segments. These can then be displayed on your exhibits. A file named SampleIndustry_FactorLibrary.xlsx shows an example of using an external source and is provided in C:\...Documents\Milliman\Arius\DemoFiles.
5. Review diagnostics to better understand what's going on in your data with
   NAVIGATION PANE | DATA DIAGNOSTICS.
   - A complete list of available diagnostics tables is in OBJECT LIBRARY | EXHIBITS.
6. Review and select development factors:
   NAVIGATION PANE | DETERMINISTIC or GLOBAL RIBBON | OBJECT LIBRARY | EXHIBITS
   - Click the **Heat Map** icon on the table ribbon to activate the heat map.
   - Exclude factors in the calculated triangle by selecting one or more cells, then right-click and select **Exclude Factor(s) from Statistics?**.
   - Set default development factor selections by right-clicking in the appropriate cells and/or statistics row labels and selecting **Set as Default**.
   - Make any manual adjustments or overrides to the default factors by entering them in the **Manual Selected** row.

- Run tail factor analysis by clicking on the row label text for the row of factors you want to fit the curves to (for example, this is often the **Selected** row), then right-click or click the **Tail Factor Analysis** icon in the ribbon.
- View box-whisker plots by clicking on the **Box-Whisker Plot** icon on the table ribbon to identify unusual outliers or any potential bias in your selections.

7. Review/update reserving methods:
   NAVIGATION PANE | DETERMINISTIC or GLOBAL RIBBON | OBJECT LIBRARY | METHODS
8. Compare methods and select ultimates:
   NAVIGATION PANE | DETERMINISTIC | LOSS SUMMARY or GLOBAL RIBBON | OBJECT LIBRARY | REPORTS | COMPARISON OF ULTIMATE XXX ESTIMATES.
   - Click the **Report Settings** icon to select which methods to display and optionally display an average or weighted average of those methods.
   - Once the appropriate methods are displayed, set default selected ultimates by right-clicking in the desired cells and selecting **Set as Default**.
   - Make any manual adjustments by entering the adjustments in the **Manual Selected** column.
9. Review the reasonableness of results:
   From the **Navigation Pane**, review **Data Diagnostics** and **Deterministic**, or from the **Object Library** review **Exhibits** and **Reports**.
   - Review the **Summary of Reserve Estimates** report.
   - Review the **Post-analysis Diagnostics** collection exhibits.

8. Sample Stochastic analysis

If you already completed the deterministic analysis in Arius, skip to step 4.

1. Create a new Arius project using FILE | NEW.
   - Select either **Create a New Arius project** or **Create a New Arius Project from a ReservePro file**.
   - Note that much of the information below in step 2 will be automatically set upon importing a ReservePro file. Click **Project Settings** on the **Home** ribbon to review or modify these fields.
2. Provide basic information about the data you will be entering and working within the **Project Settings** dialogue:
   - Use the **Data Structure** tab to define the size and structure of the triangles in the project.
   - Use the **General** tab to enter project information and notes.
   - Use the **Segments** tab to add all the lines of business or segments you will work with in this model; each reserving segment will have its own data, models, and assumptions.
   - Click **OK** on the bottom of the **Project Settings** window to finish creating a new file.
3. Enter or import data:

   Copy and paste or use the API to import from Excel, then review the data in NAVIGATION PANE | DATA or OBJECT LIBRARY | DATA | INPUTS.
   - Paid Loss and/or Incurred Loss data
   - Earned Premiums, Ultimate Premiums and/or Exposure data
   - Closed Claims and/or Reported Claims data
4. Set model options:

   Click on **Model Options** on the **Stochastic** ribbon.
   - Use the **Options** tab to change any of the **Global Options** used with all stochastic models or either of the **ODP Bootstrap Options,** which are only used with the ODP Bootstrap models for all segments.
   - If you selected the **Yes, Term** option in the **Enable Discount Rate?** field, then use the **Term Discount** tab to either manually enter or select from a lookup table a discount rate yield curve.
   - Use the **Default Model Selection** tab to select the models you expect to typically use for every segment.
   - Click **OK** on the bottom of the **Model Options** window to save your changes.
5. Below the **Home** ribbon, use the **Segment** drop-down list to select one of the reserving segments to work with.
6. In the STOCHASTIC | ODP BOOTSTRAP | MODEL ASSUMPTIONS area of the **Navigation Pane**:
   - Select **General** model options for this segment.
   - Enter **Bornhuetter-Ferguson** and/or **Cape Cod** assumptions if applicable.

7. From the **Home** ribbon, click on **Run Diagnostics** and select **Run Diagnostics for {segment}** to fill the exhibits and graphs with diagnostic information.
8. In the STOCHASTIC | ODP BOOTSTRAP | PAID LOSS | DIAGNOSTICS areas (and/or Incurred Loss) of the **Navigation Pane**, respectively:
    - Review the patterns in the Residual Graphs. Adjust for heteroscedasticity as necessary using the **Select Hetero Groups Graphically** window and/or using the **Suggest Hetero Groups** icon and select the **Suggest Hetero Groups for {segment}** option from the **Home** ribbon if desired.
    - If using the icon to **Suggest Hetero Groups**, you will need to enter values in, or copy and paste into, the **Group Number** row in the **Heteroscedasticity** table.
    - Review the **Normality (Q-Q) Plo**t and **Box-Whisker Plot** in the **Normality** window to determine if you need to exclude any outliers.
    - To remove an outlier, you can either click on the appropriate dot in the **Residual Graphs** window (the dot will turn red once selected as an outlier) or you can identify the correct cell with a one (1) in the **Outliers** table.
    - After selecting (or changing) hetero groups and/or outliers, you will need to use the **Run Diagnostics** icon again to recalculate all the diagnostic statistics with the effects of the heteroscedasticity adjustments.
    - Use the **Tail Factor** window to enter tail factor assumptions, such as whether to simulate a new tail for each iteration, etc.
9. Run the simulations for this segment using **Run Simulations** and selecting the **Run Simulations for {segment}** option from the **Home** ribbon.
10. In the STOCHASTIC | ODP BOOTSTRAP | PAID LOSS (and or INCURRED LOSS) | MODEL NAME areas of the **Navigation Pane**, respectively:
    - Review the simulation results in all the tables and graphs for each model; and
    - Interactively adjust model options and re-run the diagnostics and/or simulations until you are satisfied with the model fit and simulation results for each model.
11. Repeat steps 6 to 10 above for the **Mack Bootstrap, Generalized Linear Model,** and **Hayne MLE** models, as desired. These models provide less options for parameterization than the **ODP** ones but have similar output. To activate these models for each segment, you must have selected them as part of your **Default Model Selection** options in step 2 above, or you can use the **Choose Models** icon from the **Home** ribbon to customize which models you use for each segment.
12. In the STOCHASTIC | ODP BOOTSTRAP | ODP SUMMARY | ASSUMPTIONS area of the **Navigation Pane**, enter weights by accident period for each model in the **Model Weights** table and simulate again to get the initial best estimate.
13. In the STOCHASTIC | ODP BOOTSTRAP | ODP SUMMARY | SUMMARY RESULTS area of the **Navigation Pane**:
    - Review the simulation results in all the tables and graphs for best estimate of the distribution;
    - Optionally, change the weights entered by accident period in step 12 above, re-simulate the best estimate, and review the simulation results again; and
    - Compare stochastic and deterministic best estimates and, optionally, enter the selected total unpaid from your deterministic analysis in the last column in the **Deterministic Calculations** table, click to check the **Use Selected Unpaid as Mean** checkbox, and re-simulate. This will

shift the simulation results so that the mean of the distribution will match the deterministically selected total unpaid.

14. Repeat steps 6 to 10 above for each segment in the model.
15. From the **Home** ribbon, click on the **Run Diagnostics** icon and select the **Run Diagnostics for All Segments & Correlation** option, which will not only update all the diagnostic results for all the segments but it will also generate the correlation matrix tables on the **ODP Bootstrap Aggregation** area of the **Navigation Pane**.
16. In the ODP BOOTSTRAP AGGREGATION | ASSUMPTIONS | CORRELATION area of the **Navigation Pane**:
    - Review the various correlation matrices that are calculated for you in the calculated table.
    - In the **User Selected** window, enter correlation coefficients for each pair of segments or use one of the **Quick Fill** buttons to fill the correlation matrix either with values from one of the calculated tables that Arius has provided as suggestions or with the same value for each pair.
    - You may also change the **Degrees of Freedom for the T-distribution** (T-Dist DoF) to be used in the correlation process in the **User Selected** window.
17. From the **Home** ribbon, click on the **Run Simulations** icon and select **Run Simulations for All Segments & Aggregation** to run simulations for all segments and generate a final overall distribution considering the effect of correlation between the segments.

9. Exporting from Arius

Exporting data and tables from Arius can be performed in several different ways.

- Export to Excel
- Export to PDF
- Read and write using the API and a programming language (most common is VBA in Excel).

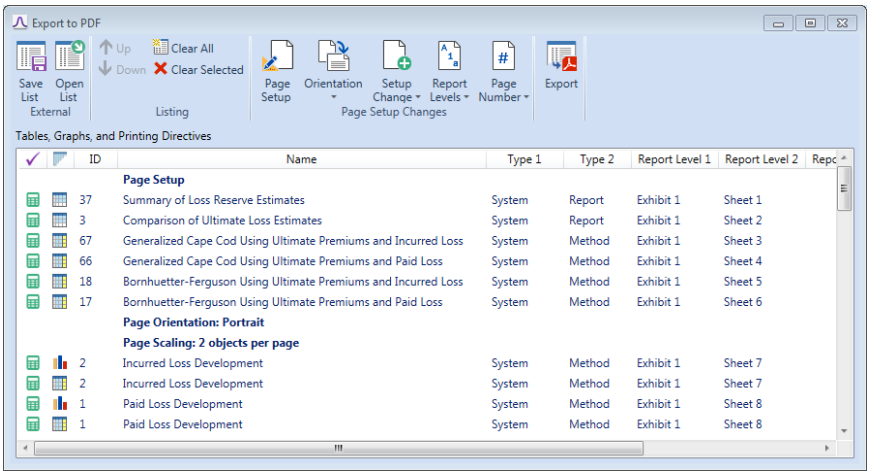
There are two menu items for exporting tables from Arius: **Export to Excel** and **Export to PDF**.

EXPORT TO EXCEL

1. Select FILE | EXPORT TO EXCEL
2. Drag individual tables from the **Object Library** or groups of tables from the **Navigation Pane** into the **Export** window to create a list of tables to export. (If you save the list in step 3, you will not need to complete steps 2-3 next time; you will simply click **Open List** and navigate to the list you saved earlier.)
3. Click the **Save List** icon to save this list for future use with this or any other Arius project.
4. Click **Export**.
5. Check the boxes to select which segments to include and click **OK**. A new Excel file will be created with one worksheet for each segment.

EXPORT TO PDF

1. Select FILE | EXPORT TO PDF



2. Drag individual tables from the **Object Library** or groups of tables from the **Navigation Pane** into the Export window to create a list of tables to export. (If you save the list in step 5, you will not need to complete steps 2-5 next time; you will simply click **Open List** and navigate to the list you saved earlier.)
3. Double-click the **Page Setup** entry in the first row to define initial settings for layout, headers/footers, and fonts.

4. Insert page setup changes within the list using icons in this window. For example, you could print the first three or four pages as portrait and then insert a new page setup to shift to landscape for the next several pages.
5. Click the **Save List** icon to save this list for future use with this or any other Arius project.
6. When the list of tables and settings is complete, click the **Export** button.
7. Check the boxes to select which segments to include, and optionally change the path or resolution, then click **OK** to create one PDF for each segment.

APPLICATION PROGRAMMING INTERFACE

An application programming interface (API) in Arius allows external tools to read from and write to Arius tables. The most common tool is Excel, using the Visual Basic for Application (VBA) programming language. Other potential languages include R and Python.

Several examples of using VBA in Excel to read and write Arius table data are provided as learning tools and starting points for exploration. They are installed with Arius and can be found in C:\...Documents\Milliman\Arius\API\ExcelVBA Samples.

A user manual for the API, the *Arius API User Guide,* can be found from HELP | USER DOCUMENTATION.