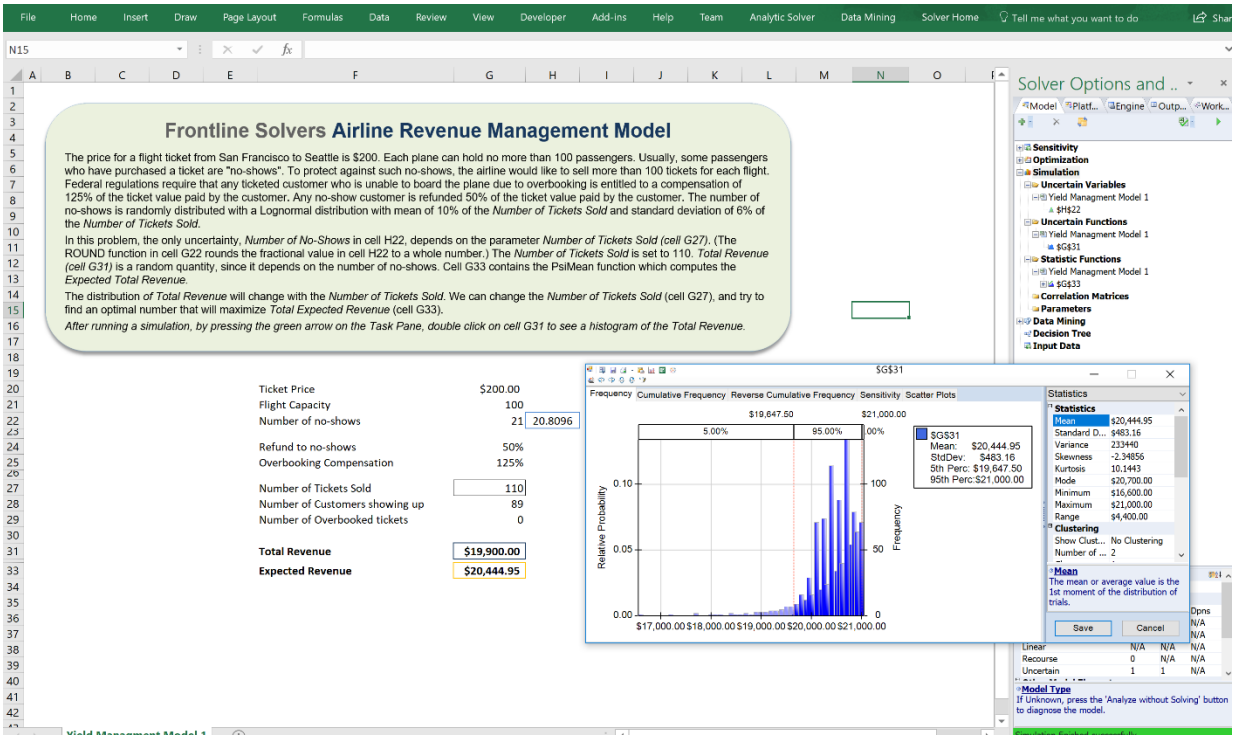
FRONTLINE solvers

Quick Start Guide

Analytic Solver



Quick Start Guide
Version 2018

Congratulations. With your download of Frontline System's Analytic Solver you now have access to the most powerful and fastest optimization and simulation tool for Excel. With this product you get:

1. The confidence you want from knowing you can solve every type and size of optimization and simulation problem you may face now or in the future.
2. The efficiency you need by being able to use a tool you are already familiar with, Excel, and learning just one integrated and easy to use add-in, Analytic Solver.
3. The results you demand with the ability to run the fastest simulations and use the best solver engines available.

You can rest assured that you are in good company, since Frontline Systems not only built the basic Excel Solver but also offers powerful upgrades that are the leading optimization and simulation tools in Excel, preferred by over 7,000 businesses and universities around the world.

This Quick Start Guide covers key pieces of information to help you get started quickly and successfully with our Solver upgrade products. Everything discussed in this Quick Start Guide applies to our most powerful product, Analytic Solver Comprehensive, but can also be applied to its subset products Analytic Solver Optimization, Analytic Solver Simulation, Analytic Solver Upgrade and Analytic Solver Basic. You'll be able to use Analytic Solver Basic, our evaluation product, on a free trial basis.

For more information on any of these steps or topics, refer to the User Guide and Reference Guide, available in the Support section of Solver.com, or from within Excel by going to the **Help** menu on the **Analytic Solver** tab and selecting **User Guides**.

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Enhancements in Recent Years

Frontline Solver products have been rapidly and continually enhanced for more than two decades. Below is a brief summary of enhancements in the last 6 years.

- In our V10.x (2010) releases, we included faster algorithms, 64-bit versions, and new Windows HPC Server cluster computing capabilities.
- In our V11.x (2011) releases, we introduced tabu and scatter search methods in the Evolutionary Solver, Guided Mode in Premium Solver Pro, and the Distribution Wizard and Constraint Wizard.
- In our V12.0 (2012) release, we included Excel 2013 support, GPU support in the Evolutionary Solver, new stochastic decomposition, and solving on a corporate server with Solver Server.
- In V12.5 (2013) release, we introduced Analytic Solver Platform with data mining capabilities, new data visualization features for both data mining and Monte Carlo results, improved Guided Mode, and Support Live Chat integrated into Excel.
- In our V2014 release, we introduced a fundamental new way to build Excel-based optimization and simulation models: Dimensional Modeling, with concepts such as dimensions and cubes, and tools to build and solve larger scale, better structured, more maintainable models using these concepts.

- In our V2014-R2 release, we introduced a completely re-engineered, far more powerful data mining and forecasting capability named XLMiner Platform. New data mining algorithms were up to 100 times faster, constantly exploit multiple processor cores, and offer greater accuracy and numeric stability.
- Our V2015 release introduced a wide range of new features, including powerful text mining, ensemble methods for classification and prediction, feature selection, partitioning "on-the-fly," ROC/RROC curves, and enhanced linear and logistic regression; extensive chart enhancements, distribution fitting, and new Six Sigma functions in Monte Carlo simulation; and support for "publishing" optimization and simulation models to Excel Online and Google Sheets.
- Our V2015-R2 release made it easy to share analytic model results in popular Business Intelligence software, including Microsoft Power BI and Tableau, both popular interactive data visualization tools, and it linked your Excel workbook with Big Data in compute clusters running Apache Spark.
- Our V2016 release introduced a new **Create App** feature that translates your Excel optimization or simulation model into Frontline's new **RASON** modeling language – radically simplifying the path to create an application that can run in a **web browser**, or a **mobile app** for phones or tablets. New SQP-GS and Feasibility Pump methods greatly improved the performance of the Evolutionary Solver on challenging non-smooth models.
- Our V2016-R2 release added support for **compound distributions** and **correlation using copulas** (Gaussian, Student and Archimedean forms), in Monte Carlo simulation; new "GA methods' for integer variables in the **Evolutionary Solver**, speed and memory improvements in **Dimensional Modeling**, and support for the **Web Data Connector** in Tableau 9.1.

What's New in Frontline Solvers V2017-R2

In Frontline Solvers V2017 (released earlier this year), we introduced commercial users to **AnalyticSolver.com**, a new cloud-based platform for both predictive and prescriptive analytics models that you can use via a **web browser** – including all the optimization, simulation, and data mining power found in the desktop version. The AnalyticSolver.com **user interface** works just like our Excel user interface, with a Ribbon and Task Pane. Both V2017 in Excel and AnalyticSolver.com include a new "Solver Home" tab on the Ribbon that makes it easy to move Excel workbooks and other files between desktop and cloud. And access to AnalyticSolver.com is ***included*** with your V2017 license for desktop Excel.

V2017 also uses a **new licensing system** that offers you more flexible ways to use the software, both desktop and cloud. Your license is associated with **you**, and may be used on **more than one PC**. For example, you can install the software on your office PC, your company laptop, and your PC at home. But only **you** can use Analytic Solver, and only on **one** computer **at a time**.

V2017 introduces **Analytic Solver Basic**, as described above, to give you access to **all** Analytic Solver features, **all** the time, for learning purposes using small models. It also includes a new **License/Subscription Manager** and a **Product Selection Wizard** that makes it much easier to upgrade or change your license subscription on a self-service basis, and a new **Test Run/Summary** feature that lets you see exactly how your model will run with an Analytic

Solver upgrade, even a plug-in large-scale Solver Engine, before you purchase the upgrade – and do this any time, not just during a 15-day free trial.

Feature Enhancements in V2017

V2017 includes major enhancements to **data mining**: Automatic support for **categorical variables** in many classification and prediction algorithms that 'normally' require continuous variables; **ensembles** that combine nearly any type of algorithm as a 'weak learner', not just (for example) classification and regression trees; general-purpose **Rescaling** as a new Data Transformation method that can also be applied 'on-the-fly' when training a model; greatly enhanced multilayer **neural networks**; ability to export models in **PMML**; and many report and chart enhancements.

The V2017 **Evolutionary Solver** includes another set of major enhancements in its handling of non-smooth models with integer variables – enough so that *most* such models will solve *significantly* faster.

And there's support for the Tableau Web Data Connector 2.0, and a new SolverSetup program that *automatically* installs the correct **32-bit or 64-bit** version of the software.

Feature Enhancements in V2017-R2

V2017-R2 includes major enhancements to Monte Carlo simulation/risk analysis and optimization. It's now possible to **fit copula** parameters to historical data – a complement to distribution fitting that is sometimes called "correlation fitting." You can use a new family of probability distributions, called the **Metalog distributions**, even more general than the Pearson distributions – members of the family can be chosen based directly on historical data (even just a few observations), without a distribution fitting process.

The V2017-R2 PSI Interpreter includes major **speed enhancements** for large linear and nonlinear **optimization models** – users with large models are likely to see a dramatic speedup in "Setting Up Problem…" Also part of this release are new, higher performance versions of the Gurobi Solver Engine (based on Gurobi 7.5), the Xpress Solver Engine (based on Xpress 30.1), and the Knitro Solver Engine (based on Knitro 10.3).

Creating Power BI Custom Visuals

The most exciting new feature of V2017-R2 is the ability to turn your Excel-based optimization or simulation model into a **Microsoft Power BI Custom Visual**, with just a few mouse clicks! Where others must learn JavaScript (or TypeScript) programming and a whole set of Web development tools to even begin to create a Custom Visual, you can to create one right away.

You simply select rows or columns of data to serve as changeable parameters, then choose **Create App – Power BI**, and save the file created by V2017-R2. You click the Load Custom Visual icon in Power BI, and select the file you just saved. What you get isn't just a chart – it's your *full optimization or simulation model*, ready to accept Power BI data**, run on demand** on the web, and display visual results in Power BI! You simply need to drag and drop appropriate Power BI datasets into the "well" of inputs to match your model parameters.

How does *that* work? The secret is that V2017-R2 translates your Excel model into **RASON**® (RESTful Analytic Solver Object Notation, embedded in JSON), then "wraps" a JavaScript-

based Custom Visual around the RASON model. See the *Frontline Solvers User Guide* chapter "Creating Your Own Application" for full details!

What's New in Frontline Solvers V2018

V2018 extends Analytic Solver's forecasting and data mining features with a new capability called **data mining workflows** that can save a lot of time and eliminate repetitive steps. You can combine nearly any of Analytic Solver's data retrieval, data transformation, forecasting and data mining methods into a single, all-inclusive workflow, or pipeline.

Using the new Workflow tab in the Task Pane, you can either **"drag and drop"** icons onto a "canvas" to create a workflow diagram, or you can simply turn on a **workflow recorder**, carry out the steps as you've always done by choosing menu options and dialog selections, and the workflow diagram will be created automatically. Once the diagram or pipeline is created, you can "run" it in one step – each data mining method in the workflow will be executed in sequence.

In previous releases, you could use the trained model from a *single* data mining method (such as a Classification Tree or Neural Network) to "score" new data, by mapping features (columns) between the training set and new data set. In V2018, you can apply an *entire workflow* – including data transformations, partitioning, model training, and more – to a new dataset, by mapping features (columns) between the dataset used to create the workflow, and a new dataset.

Creating Tableau Dashboard Extensions

Another exciting new feature of V2018 is the ability to turn your Excel-based optimization or simulation model into a **Tableau Dashboard Extension**, with just a few mouse clicks! This is quite similar to the ability to create Power BI Custom Visuals introduced in Analytic Solver V2017-R2. It works (only) with Tableau version 2018.2 or later.

You simply select rows or columns of data to serve as changeable parameters, then choose **Create App – Tableau**, and save the file created by V2018. In Tableau, drag the **Extensions** object onto your dashboard, and choose the file you just saved. You'll be prompted to match the parameters your model needs with data in Tableau. What you get isn't just a chart – it's your *full optimization or simulation model*, ready to accept Tableau data**, run on demand** (using our **RASON** server), and display visual results in Tableau!

Installing the Software

To install Analytic Solver to work with any version of Microsoft Excel, simply run the program **SolverSetup.exe**, which installs all of the Solver program, Help, User Guide, and example files in compressed form for both 32-bit and 64-bit Excel. SolverSetup.exe checks your system, detects what version of Office you are running (32-bit or 64-bit) and then downloads and runs the appropriate Setup program version.

Your copy of the Setup program will usually have a filename such as SolverSetup_12345.exe; the '12345' is your user account number on Solver.com.

Logging in the First Time

The first time you run Analytic Solver V2018 after installing the software on a new computer, when you next start Excel and visit the Analytic Solver tab on the Ribbon, **you will be prompted to login**. Enter the **email address** and **password** that you used to register on Solver.com or AnalyticSolver.com. Once you've done this, your identity will be "remembered," so you won't have to login every time you start Excel and go to one of the Analytic Solver tabs.

Using Your Existing Models

All Analytic Solver versions are 100% compatible upgrades to the basic Excel Solver, from Analytic Solver Basic to Analytic Solver Comprehensive. This means you can solve your existing models immediately, taking advantage of Analytic Solver's faster speed, additional solving methods, and larger problem size limits, without having to make any changes to your model or existing VBA code. Simply open the workbook containing the model and use the **Solver Parameters** dialog, or just click the **Optimize** button on the Ribbon (see below).

> ***Online Resource:*** *You can see an overview video of a model built using the Excel Solver and how to solve it in Analytic Solver as-is. In addition, you can also see how to quickly and easily build the same model from scratch using the Ribbon and Task Pane interface by clicking here.*

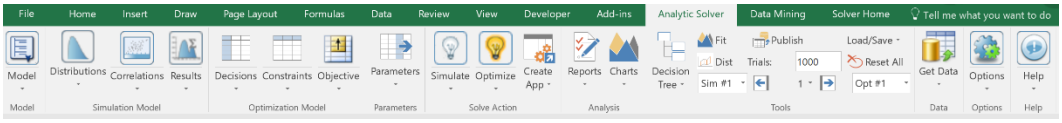
Using the Ribbon and Task Pane

This section contains an overview of the Ribbon and Task Pane interface, as well as the alternative Solver Parameters dialog (similar to what you've used in the basic Excel Solver).

> ***Online Resource:*** *You can also see a short overview video of the Ribbon and Task Pane interface on our website by clicking here.*

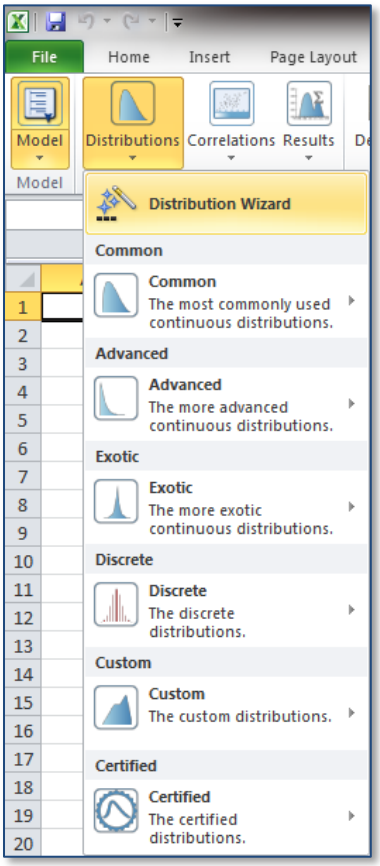
The Ribbon is your 'gateway' to Analytic Solver's graphical user interface. Most often, you simply click on the arrow at the bottom of a button on the Ribbon to open a dropdown gallery with more buttons, and then you click one of these choices.

Analytic Solver Ribbon appears as a tab on the standard Ribbon at the top of the Excel application window, and it stays in this position:



The small downward pointing arrow below each of the buttons indicates that you can open a **dropdown gallery** of options (shown on the next page) related to that button. For example,

clicking on the downward arrow for Distributions opens a list of options for different types of probability distributions built into Analytic Solver:



The buttons on the Ribbon play the following roles:

- Clicking the **Model** button displays or hides the Task Pane (see more on this below). Click the down arrow to add Dimensional Modeling capability to build compact, easy to read models.

- The *Simulation Model* group of buttons relate to setting up simulation models:
  - Clicking the **Distribution** button gives you a range of pre-defined probability distributions you may choose to represent uncertainty in your model and access to our new Distribution Wizard.
  - Clicking the **Correlations** button brings up a dialog to allow you to easily create, edit or delete correlation matrices. The down-arrow allows you to turn the use of correlations on and off.
  - Clicking the **Results** button opens a gallery of options that allow you to designate a cell as an output cell for an uncertain function (to obtain statistics, charts or other simulation results), or insert calls to PSI Statistics functions to compute statistics, risk measures, or range values for uncertain functions.

- The *Optimization Model* group of buttons relate to setting up optimization models:

- Clicking the **Decisions** button creates a new "normal" decision variable using the currently selected cell. Clicking the down arrow allows you to designate a cell as a decision variable, and in stochastic optimization, choose normal or recourse decisions.
- Clicking the **Constraints** button opens the Add Constraint dialog which lets you easily define constraints, including bounds and integer restrictions on decision variables, and chance constraints in stochastic optimization. Clicking the down arrow allows you to do all of the above plus gives you access to our new Constraint Wizard.
- Clicking the **Objective** button opens the Add Objective dialog which allows you to designate a cell as the objective function, and choose whether it should be maximized or minimized. Clicking the down arrow allows you to do all of the above plus "summarize" an objective containing uncertainty if solving a stochastic optimization model.

- Clicking the **Parameters** button allows you designate a cell as a parameter to be varied across multiple optimization or simulation runs, or designate a cell range as input data for runtime use. You can even find *candidate* cells for parameters *automatically*, displaying a tornado chart that shows which cells have the greatest impact on your model results.

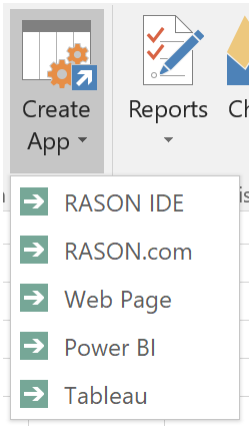
- The *Solve Action* group of buttons relate to *solving* your optimization or simulation model:
  - Clicking the **Simulate** button turns on *Interactive Simulation*, and lights up the bulb; clicking it again turns off *Interactive Simulation* and the bulb. The down-arrow allows you to run a single simulation at a time.
  - Clicking the **Optimize** button runs an optimization, while clicking the down-arrow gives you a list of choices for how to solve the model. You can use the Analyze Without Solving option to find out what type of model (linear, nonlinear, etc.) you've defined, and what Solver Engine can be used to solve it.
  - Click the **Create App** button drops down a menu with a list of choices that automatically convert your existing optimization, simulation or simulation optimization model into a model written in the new RASON Modeling Language. The converted model can be solved using either the RASON Desk IDE, the Web IDE on RASON.com or from within a customized Web application. Select **RASON IDE** or **RASON.com** to automatically open either the RASON Desk IDE or RASON Web IDE containing your model written in the RASON modeling language. Select **Web Page** to create a web application that will solve your model, which has been converted to a RASON model, by calling the RASON Interpreter from within a customized web app. This feature reduces months of development work to a single button click!

    Beginning with V2017-R2, Analytic Solver has the ability to turn your Excel-based optimization or simulation model into a **Microsoft Power BI Custom Visual**. Simply select rows or columns of data in your Excel model to serve as changeable parameters, then choose **Create App – Power BI**, and save the file created by Analytic Solver. Afterwards, you will click the Load Custom Visual

icon in Power BI, and select the file you just saved. Then, simply drag and drop appropriate Power BI datasets into the "well" of inputs to match your model parameters to create your *full optimization or simulation model* in Power BI!

Analytic Solver V2018 also includes the ability to turn your Excel-based optimization or simulation model into a **Tableau Dashboard Extension**! Note: This new feature works (only) with Tableau version 2018.2 or later.

Simply select rows or columns of data to serve as changeable parameters, then choose **Create App – Tableau**, and save the file created by Analytic Solver. In Tableau, you'll see the newly-created file under **Extensions** on the left side of the dashboard, where you can drag it onto your dashboard. You'll be prompted to match the parameters your model needs with data in Tableau. Much like with Power BI, what you get isn't just a chart – it's your *full optimization or simulation model*, ready to accept Tableau data**, run on demand** (using our **RASON** server), and display visual results in Tableau!



- The *Analysis* group of buttons relate to analyzing your results:
  - Clicking the **Reports** button gives you access to a full range of reports for optimization, simulation, sensitivity analysis, and discriminant analysis.
  - Clicking the **Charts** button lets you create and manipulate charts related to your optimization, simulation, or sensitivity analysis results – including charts that cover multiple optimization or simulation runs, with varying parameters.

- The *Tools* group of buttons is covered more fully in the User Guide: They allow you to set up decision trees, create probability distributions that fit historical data, see the results of specific simulations or optimization, manage results and publish an optimization or simulation model to the new Excel Online Solver app or Google Sheets Solver add-on.

- Compute summary measures (sum, average, standard deviation, minimum or maximum) for variables in a dataset with up to billions of rows, stored across many hard disks in an external compute cluster running Apache Spark (https://spark.apache.org/), by clicking the **Get Data** icon. The results, which can be obtained immediately upon completion or at a later time, will include the number of variables included in the dataset and their names along with data counts for categorical variables. This kind of summary data is often what

you need as input parameters to an optimization or simulation model. See the Analytic Solver Data Mining User Guide for more help on this new feature.

- Clicking the **Options** button displays a dialog of options for controlling the optimization and simulation processes as well as for formatting charts and graphs.

- Clicking the **Help** button displays online Help. The arrow allows you to open examples or an online tutorial, access the User and Reference Guides, check your version and license status, or enter a license code.

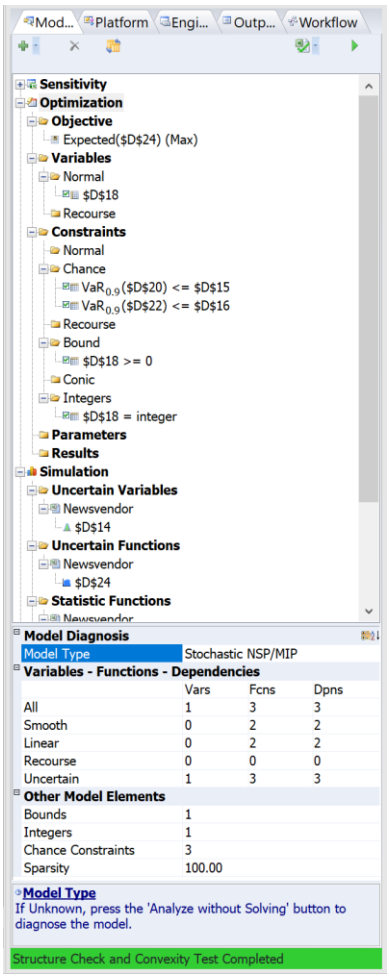
Each of these GUI functions is described more in depth in the Reference Guide chapter "Using the Ribbon and the Task Pane."

Alternatively, if you've used the basic Excel Solver we developed for Microsoft, you'll find the **Add-Ins** tab contains a **Premium Solver** button which displays a **Solver Parameters** dialog very similar to the one you've used before. Changes you make to a model here are reflected in the Task Pane, and vice versa.

You can easily switch between the Solver Parameters dialog, and the Ribbon and Task Pane as often as you wish, without having to restart Excel or close and re-open any open workbooks.

The Task Pane

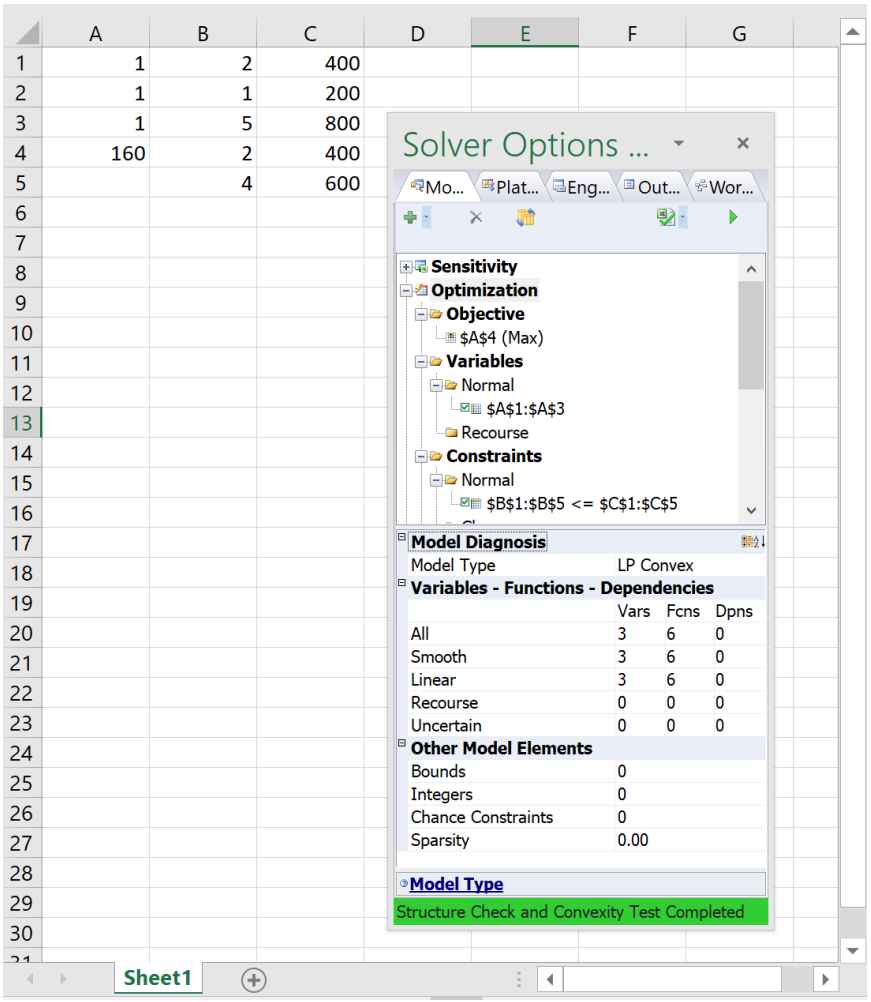
Clicking the **Model** button displays or hides the Task Pane, normally docked at the right edge of the Excel window. On the Task Pane **Model tab**, you'll see an outlined list of all the elements of your model: (i) objective, decision variables, and constraints for optimization models, (ii) uncertain variables, uncertain functions, statistics, and correlations for simulation models, (iii) parameters for both kinds of models and (iv) data sets and results for data mining, text mining or time series analysis models. As explained below, other tabs on the Task Pane provide quick access to option settings, a log of events that occur during an optimization or simulation, and for long-running optimization models, a continually updated status report plus a dynamic chart of the objective.



As you can see, the Task Pane Model tab and the Solver Parameters dialog contain the same information. But where the basic Excel Solver Parameters dialog is *modal* (moving the mouse outside the dialog displays a wait cursor – you must close the dialog to do anything else), the Task Pane is *modeless*: You can move the mouse outside the pane, edit formulas on the worksheet, or use other commands.

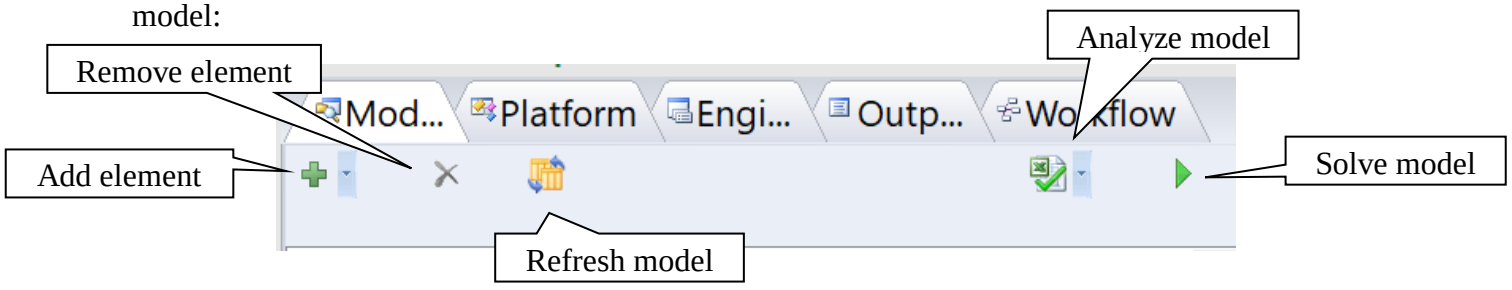
The Task Pane is initially docked to the right side of the Excel window, but you can select its title bar with your mouse, **drag** it to another position, and **resize** it, as shown on the next page. To "re-dock" the Task Pane, select its title bar with the mouse, drag to a position just beyond the right edge of the Excel window, then release the mouse.

Use the **Model tab** to view your model in outline form, and optionally edit model elements in-place. Use the **Platform tab** to view or change Platform options, such as the number of optimizations or simulations to run, or default bounds on decision variables or uncertain variables. Use the **Engine tab** to select a Solver Engine and view or change its options. Use the **Output tab** to view a log of solution messages, or a chart of the objective values.

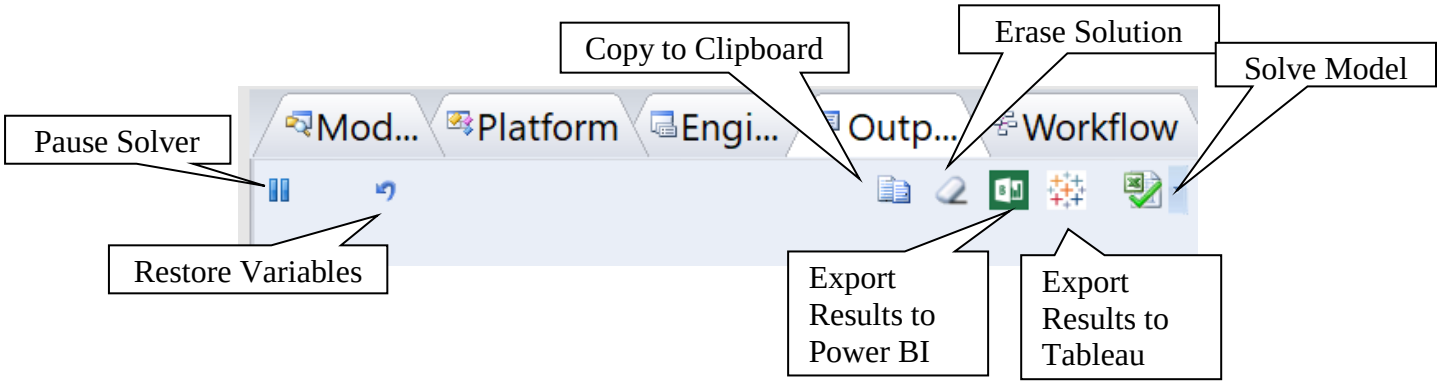


Using Buttons on the Task Pane

Use the **buttons** at the top of the **Model tab** to add or remove model elements (you can also use the Ribbon options to do this), refresh the model outline when you've made unusual changes to the worksheet, **analyze** the structure of your model, or **solve** (run) the optimization or simulation model:



Use the **buttons** at the top of the **Output tab** to pause or stop the Solver, **restore** the original values of the decision variables**, copy** the solution message log to the Windows Clipboard (so you can paste it into another application), **erase** the solution log, **export** the Solver results to **Microsoft's Power BI** or **Tableau**, **analyze** or **solve** the model.



Building Your First Optimization Model

While you likely already know how to build a basic optimization model, in the User Guide there is a chapter called "Examples: Conventional Optimization" which contains a section on building your first optimization model, as well as an overview of examples included with Analytic Solver. These examples will be useful for ideas as you look to build more ambitious models that better capture the business challenges you face.

> ***Online Resource:*** *You can see an overview video on our website of how to build an optimization model from scratch by clicking here.*

You can access the User Guide from within Excel by clicking on **Help** on the Analytic Solver Ribbon and choosing **User Guides**, then **User Guide**. In addition, see below for links to helpful introductory videos in addition to the one above.

Building Your First Simulation Model

Better *understanding* the range of potential outcomes in a situation, and *optimizing* your decision given that range, can be a very powerful way to make even better decisions. In the User Guide there is a chapter called "Examples: Simulation and Risk Analysis" which contains a section on building your first simulation models as well as an overview of examples included with Analytic Solver.

> ***Online Resource:*** *You can see an overview video on our website of how to build a simulation model from scratch by clicking here.*

Again, you can access the User Guide from within Excel by clicking on **Help** on the Analytic Solver Ribbon and choosing **User Guides** and then **User Guide**. In addition, see below for links to helpful introductory videos in addition to the one above.

Exploring Example Models

Finding the Examples

Use **Help – Examples** to open workbooks with a list of optimization, simulation, forecasting/data mining, stochastic optimization, simulation optimization and decision tree examples you can open by clicking hyperlinks.

Using the Example Models and User Guide

The Frontline Solvers and Analytic Solver Data Mining User Guides provide help and advice for building your optimization or simulation model, as well as step-by-step instructions for data mining. Example models used in these guides can be found by clicking **Help – Examples** and relate to:

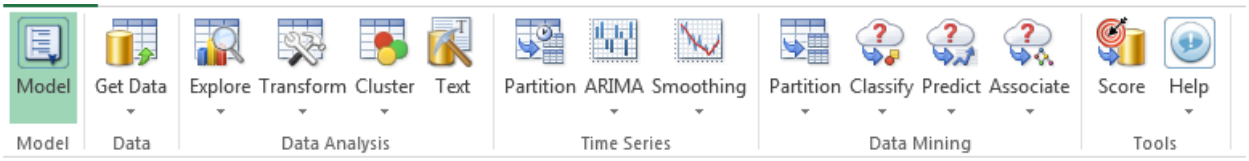
- Conventional Optimization
- Simulation and Risk Analysis
- Forecasting/Data Mining
- Stochastic Optimization
- Sensitivity Analysis
- Decision Trees

Mastering Optimization and Simulation Concepts

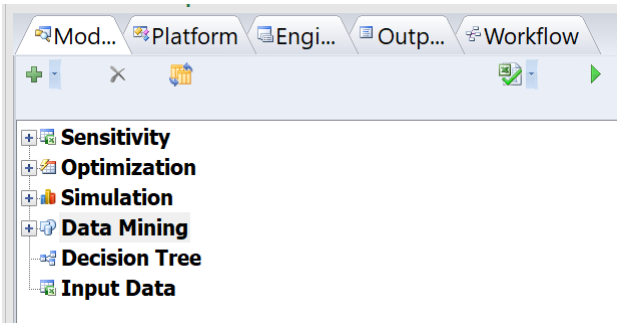
Go from beginner to expert, and learn how to fully exploit the software by reading the **Mastering Concepts** chapters in the Frontline Solvers User Guide.

Features for Forecasting and Data Mining

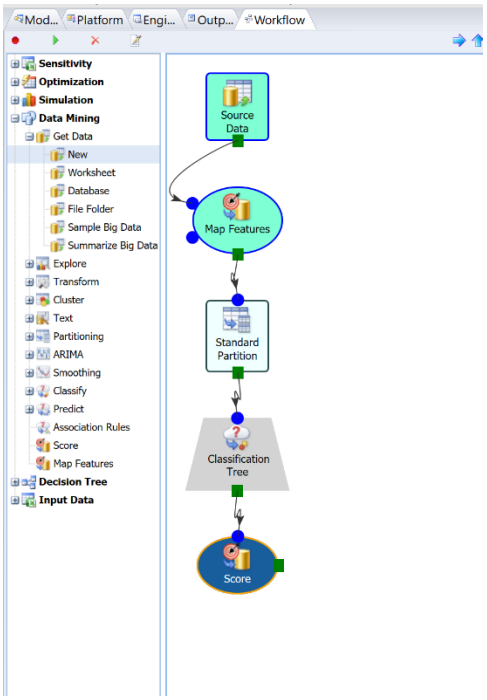
Analytic Solver includes powerful features for forecasting and data mining, based on the popular XLMiner add-in, which is now the Frontline Systems' product Analytic Solver Data Mining – and a subset of Analytic Solver Comprehensive. You can explore these features during your free trial – just click the Data Mining tab on the Excel Ribbon:



- Use the Model button to display the Model Task Pane. From the Model pane, you can easily navigate between worksheets containing datasets, from within the Data folder, and Data Mining results from within the Reports and Transformations folders.



The Workflow tab, *new in V2018*, allows the combination of all available data mining techniques into an all-inclusive workflow, or workflows. Once the workflow, or pipeline, is created, either manually or simply by recording your actions, each data mining method included in the workflow will be executed sequentially.



- Use the **Get Data** button to draw a random sample of data, or summarize data from a (i) an Excel worksheet, (ii) the PowerPivot "spreadsheet data model" which can hold 10 to 100 million rows of data in Excel, (iii) an external SQL database such as Oracle, DB2 or SQL Server, or (iv) a dataset with up to billions of rows, stored across many hard disks in an external compute cluster running Apache Spark (https://spark.apache.org/), using the newly added **Big Data** feature.

- You can use the **Data Analysis** group of buttons to explore your data, both visually and through methods like cluster analysis, and transform your data with methods like Principal Components, Missing Value imputation, Binning continuous data, and Transforming categorical data. Text Miner, Frontline's text mining feature, analyzes a collection of text documents, extracts their meanings, and calculates any patterns or trends that might appear in the collection. The Feature Selection tool, under Explore, gives insights on which variables are the most important or

relevant, and will provide the most information when included in a classification or production model.

- Use the **Time Series** group of buttons for time series forecasting, using both Exponential Smoothing (including Holt-Winters) and ARIMA (Auto-Regressive Integrated Moving Average) models, the two most popular time series forecasting methods from classical statistics. These methods forecast a single data series forward in time.

- The **Data Mining** group of buttons give you access to a broad range of methods for prediction, classification, and affinity analysis, from both classical statistics and data mining. These methods use multiple input variables to predict an outcome variable, or classify the outcome into one of several categories.
  - Use the **Predict** button to build prediction models using Multiple Linear Regression (with variable subset selection and diagnostics), k-Nearest Neighbors, Regression Trees, and Neural Networks.
  - Use the **Classify** button to build classification models with Discriminant Analysis, Logistic Regression, k-Nearest Neighbors, Classification Trees, Naïve Bayes, and Neural Networks.
  - Use the **Associate** button to perform affinity analysis ("what goes with what" or market basket analysis) using Association Rules.

If forecasting and data mining are new for you, don't worry – you can learn a lot about them by consulting our extensive in-product Help. Click **Help – Help Text** on the Data Mining tab, or click **Help – Help Text – Forecasting/Data Mining** on the Analytic Solver tab (these open the same Help file).

If you'd like to learn more and get started as a 'data scientist,' consult the excellent book *Data Mining for Business Intelligence*, which was written by the original XLMiner designers and early academic users. You'll be able to run all the Forecasting and Data Mining examples and exercises available in Analytic Solver.

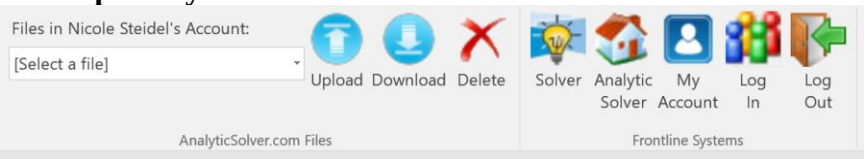
Cloud Version and Solver Home Tab

With your free trial or paid license, you can use *both* Analytic Solver in desktop Excel, and its cloud-based counterpart: AnalyticSolver.com is a comprehensive, cloud-based SaaS (Software as a Service) toolkit for predictive and prescriptive analytics. It shares technology with Analytic Solver desktop version. Both platforms offer a Ribbon user interface with three tabs featuring nearly-identical buttons and menus, and a Task Pane that summarizes models and provides access to Platform and Engine options. Both platforms use the same modeling languages (Excel formulas and our RASON® modeling language, handled by our PSI Interpreter), and use the same algorithmic "engines" for mathematical optimization, Monte Carlo simulation and risk analysis, forecasting, data mining and text mining. Nearly all optimization, simulation, and data mining related functions available in Analytic Solver desktop version are also available in AnalyticSolver.com.

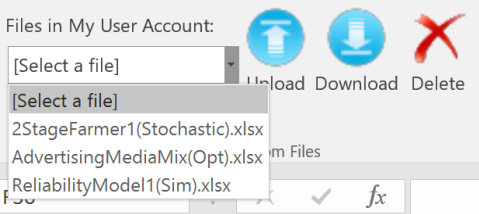
Analytic Solver V2018 features a *Solver Home* tab. This tab allows you to **login** and **logout**, and easily **upload** and **download** files to/from Analytic Solver in Excel and AnalyticSolver.com. You can also navigate to Frontline Solvers Website at www.solver.com

and the AnalyticSolver.com Home page as well as access your AnalyticSolver.com account by clicking the appropriate icons on this tab.

Desktop Analytic Solver Home Tab

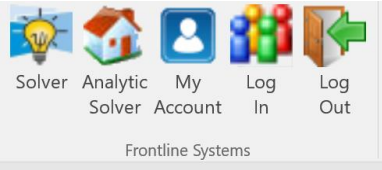


Using the icons in the *AnalyticSolver.com Files* section of the **Solver Home** tab, you have the ability to upload files to your AnalyticSolver.com account – subject to certain size limits or storage charges, depending on your account type.



The icons in the Frontline Systems portion of the Solver Home Ribbon allow you to access Frontline's website at www.solver.com, the AnalyticSolver.com home page, and your AnalyticSolver.com account settings

To switch users, click **Log In**. Enter the **email address** and **password** that you used to register on Solver.com or AnalyticSolver.com. After this, your user identity is "persisted" so you don't have to log in again every time you start Excel. If you are on a shared-use computer, we strongly recommend that you click **Log Out** when finished using Analytic Solver. Then, the next time Analytic Solver is accessed, the new user will be asked to Log in.



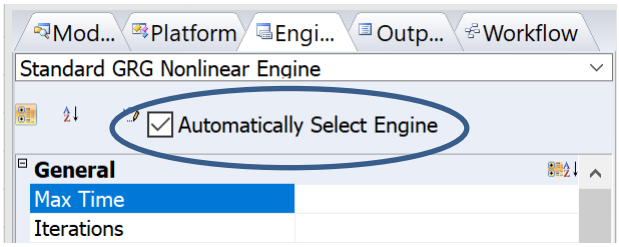
For more information on the Solver Home tab, please see the section "Solver Home Tab" within the Frontline Solvers User Guide.

Solver Engines for Optimization

Using the Included Solver Engines

Your trial of Analytic Solver Basic includes a comprehensive set of built-in Solver Engines which can be used to solve the entire range of problems you are likely to face including linear, non-linear, quadratic, non-smooth, and mixed integer problems, among others. Each Solver Engine has different strengths making it better suited to solving a particular class or range of problems. You can choose which one you want to use by going to the **Engines tab** in the Task Pane, clicking on the drop down menu at the top, and selecting a Solver Engine.

Don't worry if you aren't sure what type of problem you have or which Engine is best for it. If you wish, our "Automatic Mode" will analyze your model for you and automatically select the best choice from the available Engines to get you the best results. Simply go to the **Engines tab** in the Task Pane and make sure the "Automatically Select Engine" box is checked:



In addition, the Solver Engine Option Reference chapter of the Reference Guide includes details for each Solver Engine bundled in Analytic Solver Comprehensive, Analytic Solver Optimization, Analytic Solver Simulation, Analytic Solver Upgrade and Analytic Solver Basic. It also briefly describes how these options may be examined or set using VBA, or in another programming language using Frontline's Solver SDK Platform.

Using Large-Scale Solver Engines

In addition to the included Solver Engines, Analytic Solver Comprehensive and Analytic Solver Optimization, allow you to use additional plug-in Solver Engines.

Using the installation program SolverSetup, you can install the optional plug-in Solver Engines: Gurobi, MOSEK, OptQuest, XPRESS, and KNITRO, as well as our own Large Scale SQP, Large Scale GRG, and Large Scale LP solvers. These Solver Engines allow you to solve virtually unlimited sized models at amazing speeds. Again, our Automatic Mode can automatically choose the best one for your particular problem. You can learn more about each Engine here. The Large Scale Solver Engine(s) will appear in the dropdown engine list shown at the top of the Task Pane Engine tab.

Using VBA Code in your workbooks

You don't have to know or use VBA to use Analytic Solver. But if you are familiar with the power of VBA, the User Guide includes two very useful chapters: "Automating Optimization in VBA" and "Automating Simulation in VBA." These chapters explain how to use the Object Oriented API in Analytic Solver to create, modify, and solve optimization and simulation models under the control of a custom application you've written in VBA.

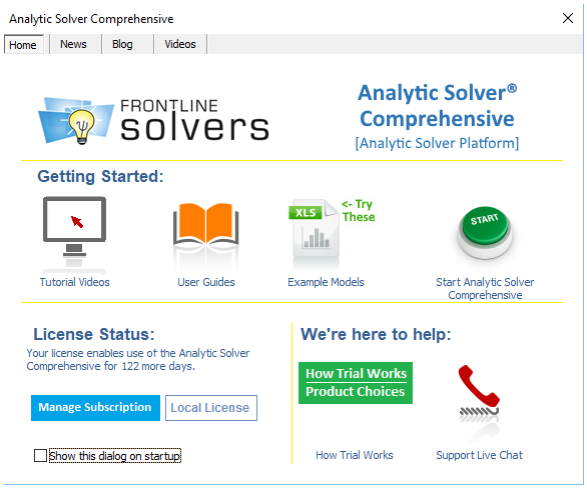
Getting Help

Installation Help

Should you run into any problems downloading or installing any of our products, we're happy to help. Call us at 775-831-0300, start a Live Chat on any page of www.solver.com, or email us at support@solver.com.

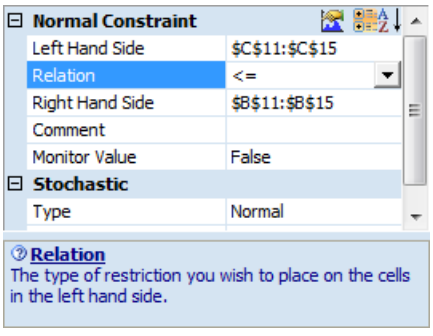
Accessing Resources

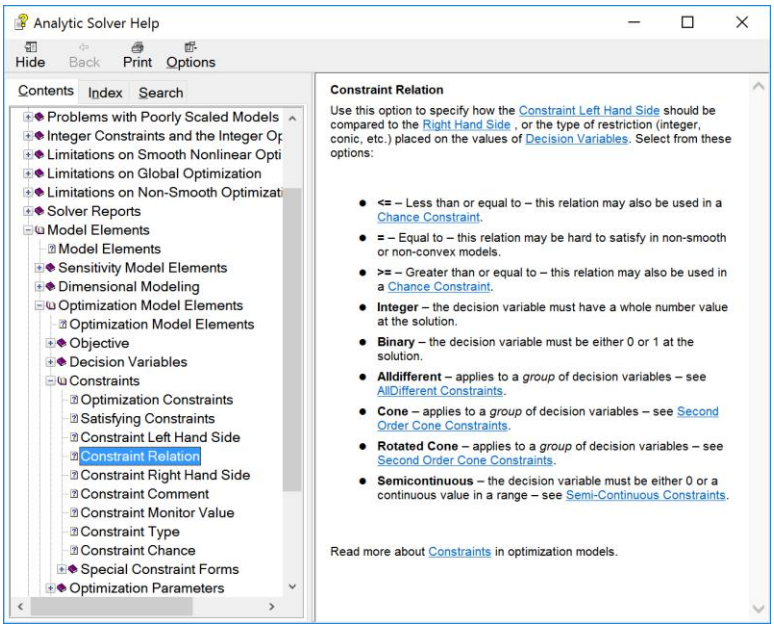
By going to **Help – Welcome Screen** you can easily access a range of support and training resources.



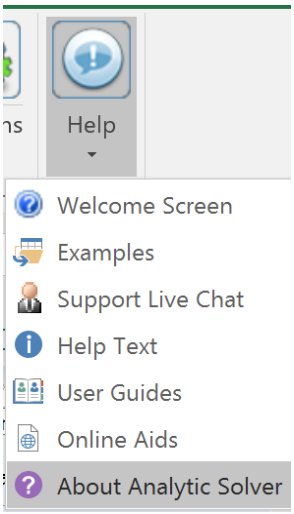
Using Online Help available In-Product

Analytic Solver's online Help appears when you click the Help button in the Ribbon. More Help options appear on the dropdown menu below the Help button. You can also get help on Solver Result messages, Platform options, or any element of your model, by clicking the hyperlink that appears at the bottom of the Task Pane. For example, clicking the **Relation** hyperlink displays the Help window shown on the next page.





As with other buttons on the Ribbon, clicking the first menu choice has the same effect as clicking the main button: It opens the online Help viewer.



Click the **Examples** menu choice to open a workbook with a range of optimization, simulation, and decision tree examples. Opening and working with these examples is a great way to learn more about Analytic Solver and both optimization and simulation modeling techniques and approaches.

Click **Support Live Chat** to connect to Frontline Systems technical support, from right inside Excel. Read more about this below under "Technical Support."

Click **Help Text** to access Help on any Platform option, Engine option, or Model element or you can quickly access Help on any Solver Result message that appears in the Task Pane Output tab, any option that appears on the Engine tab or Platform tab, or any element of your model that appears on the Model tab by clicking the underlined hyperlink. Click the **User Guides** to open PDF files of our Quick Start Guide, Excel Solver Guide, User Guide, Reference Guide, Engine User Guide, or Data Mining User Guide. Click the **Online Aids** menu choice to open a Web browser to the right point on Frontline's Website www.solver.com:

- **Online Aids – Support Online:** Here you'll find the latest news, hints, frequently asked questions and more example workbooks that you can download.

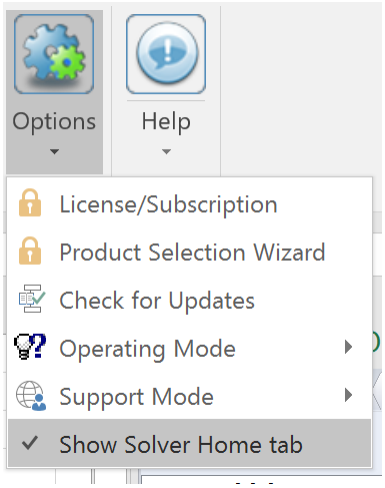
- **Online Aids – Video Demos Online:** You'll find a range of useful video overviews from building your first model to an overview of key optimization and simulation concepts.

- **Online Aids – Tutorial Online:** Read our optimization and simulation tutorials. This is another great way to get started with Analytic Solver whether you are focused on optimization, simulation, or both.

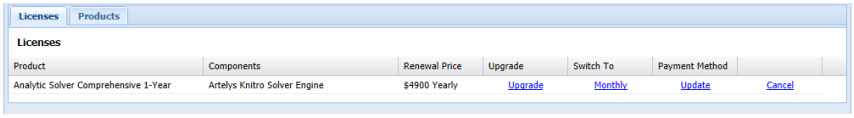
Click the **About Analytic Solver** menu choice to display copyright and trademark information, and Frontline Systems contact information.

Using the Options Menu

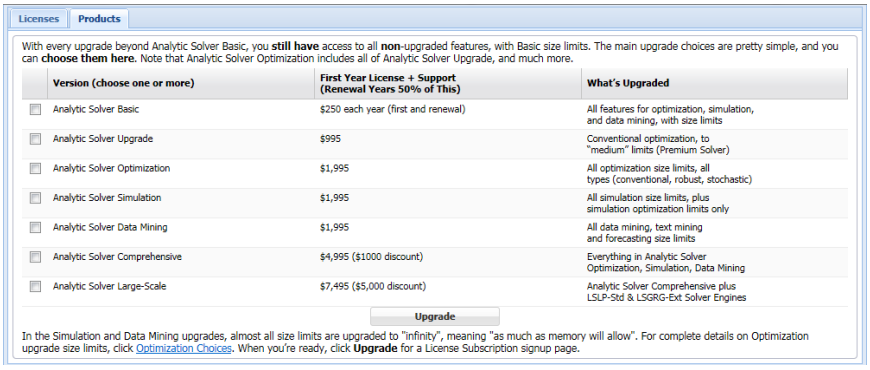
The Options menu appears when you click the down arrow under the Options icon on the Analytic Solver Ribbon.



Click **License/Subscription** to login to Frontline Systems Web Subscription Manager. Login using your AnalyticSolver.com credentials to view the status of your license. With Frontline Solvers V2018, purchasing is *automated*: You can review your subscription status, renew, upgrade or downgrade your subscription, or add plug-in Solver Engines, all 'self-service' using the License / Subscription Manager – accessible via the blue button in the Welcome Screen, **or Options - License / Subscription** on the Analytic Solver Ribbon. The next page shows an example of the License / Subscription Manager dialog.

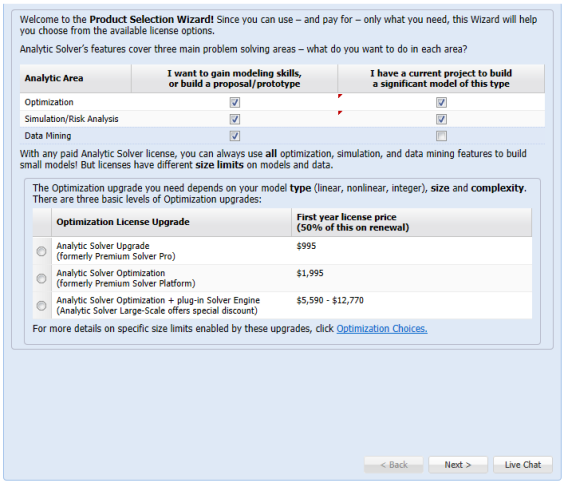


Click the Products tab to upgrade your existing Analytic Solver product or purchase a new one.

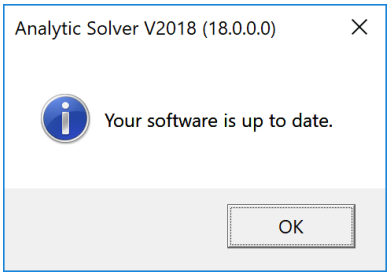


Click **Product Selection Wizard** to open a series of dialogs that will help you determine which product will best meet your needs based on past and predicted future performance. On the final

dialog, the Product Selection Wizard will recommend a product or products based on your answers on the previous screens. To purchase the recommended product(s) click **Upgrade**. If at any time you'd like to chat with a member of our Technical Support staff, click **Live Chat**. For more information on the Product Selection Wizard, see the Frontline Solvers User Guide.



Click **Check for Updates** to verify that you are using the latest release of Analytic Solver. If not, you'll be redirected to www.solver.com to download the latest version. Otherwise, you'll receive a dialog as shown below.



Click the **Operating Mode** menu choice to switch between Guided Mode, Auto-Help Mode and Expert Mode. We highly recommend starting out with Guided Mode, and leaving Auto-Help Mode on all the time.

Click the **Support Mode** menu choice to switch between Active Support, Standard Support and Basic Support. We highly recommend Active Support for most users.

Click **Show Solver Home tab** to remove or add the Solver Home tab to the ribbon.

Technical Support

If you run into any issues with the product itself we're here to help. When you're using the software, the *best way* to get help is to choose **Support Live Chat** from the **Help menu**. This will start a Live Chat during our business hours (or send us a message at other hours), just as if you were to start a Live Chat on www.solver.com, but it saves you and our tech support rep a lot

of time – because the software reports your latest error message, model diagnosis, license issue or other problem, without you having to type anything or explain verbally what's happened.

You can also call us at 775-831-0300, or email us at support@solver.com.

Help Building Models

We also offer consulting assistance, from helping you define the problem, to building and solving the model, to interpreting and communicating results. You can learn more online on our Consulting Assistance Page.