SMARTSTAT 2.4

Automated Monte Carlo simulation generation to Excel spreadsheets

User's Manual

Austin, TX • College Station, TX • Oklahoma City, OK • Corpus Christi, TX

Mention of third-party products in this manual is for informational purposes only and does not constitute endorsement or recommendation. KBSI assumes no responsibility regarding the performance or use of these products.

IBM, PC-DOS, and IBM-PC are registered trademarks of International Business Machines.

Windows, Excel, Paintbrush, and Notepad are trademarks of Microsoft Corporation. Microsoft is a registered trademark of Microsoft Corporation.

Macintosh and Apple are registered trademarks of Apple Computers, Inc.

WITNESS is a registered trademark of Lanner Group, Ltd.

EasyABC is a registered trademark of ABC Technologies

AIØ WIN, PROCAP, PROSIM,and the KBSI logo are registered and SMARTCOST, SMARTER, SMARTCLASS, and KBSI are trademarks of KBSI.

About KBSI

KBSI is a dynamic analysis, modeling, and systems/software development company specializing in business redesign and corporate integration methods, tools, training, and consulting. Our professionals come from all over the United States and abroad, bringing with them a wealth of education and expertise in the areas of mechanical, industrial, electrical, and manufacturing engineering, as well as computer science, management science, artificial intelligence. This diversity and our customer-centered philosophy has established KBSI's reputation for innovative technologies and individualized problem solving.

Helping our customers build and maintain their competitive edge with a reliable combination of experienced people, innovative ideas, and proven technology, KBSI offers real-world solutions based on sound technology.

Research and Development

Since our founding in 1988, KBSI has been awarded countless research and development contracts from a variety of federal and commercial agencies including the Department of Defense, ARPA, NIST, NSF, SEMATECH, and NASA. KBSI's research contributions span a broad spectrum of technology and application areas, including Artificial Intelligence and Expert Systems, Geometric Reasoning, Computer-Aided Design and Manufacturing, Manufacturing Systems Design and Analysis, Systems Engineering, Enterprise Integration, Process Modeling, Computer Aided Software Engineering, Systems Simulation, Business Process Analysis, Neural Net-based Forecasting, and Total Quality Management. Our outstanding record of converting research results into usable, state-of-the-art technology contributes to KBSI's reputation as a world-class research and development company.

Knowledge-Based Tools

KBSI has set commercial and defense industry standards for the development and support of modeling and analysis tools and methods. KBSI's tools help today's business leaders significantly improve the effectiveness of business analysis efforts and reduce the time required to complete them. KBSI currently has six knowledge-based software tools on the market:

- AIØ WIN with ABC, for Activity Modeling and Activity Based Costing
- SMARTER, for Information Modeling and Database Design
- PROSIM, for Process Modeling, Simulation, and Process Knowledge Management
- PROCAP, for Process Mapping
- SMARTCOST, for Total Cost of Ownership Cost Model Generation
- PROJECTLINK, for Project Management Planning and Simulation Support

KBSI's software products may be used as stand-alone tools or as part of our configurable Intelligent Workbenches. KBSI's tools automatically share information with each other, as well as with a growing list of other software vendor tools (including all industry leaders in the respective areas), allowing our customers to successfully model, analyze, and implement new or improved business systems.

Customer-Driven Training and Consulting

For nearly a decade, KBSI's consulting team has provided innovative technical services to companies ranging from medium-sized businesses to Fortune 500 multinationals and U.S. Defense organizations. Our consulting

philosophy focuses on understanding the unique needs of each client, applying a structured analysis approach to documenting what that client's company does, analyzing what the systems requirements are, and determining what integrated systems solutions best fit those particular needs. KBSI's consulting professionals bring a wide range of capabilities to each job, including expertise in IDEF methods and analysis techniques, simulation modeling and analysis, activity based costing, and information system design and implementation. KBSI is a recognized leader in the design and development of IDEF methods and tools, including fully integrated activity, process, information, simulation, and cost modeling software.

We're proud of our success not only at providing solutions to the challenges of today's competitive global market, but also in fostering continued partnerships with each of our clients. KBSI focuses our strategy on technology transfer to our clients. We establish an organic capability that continues to profit our clients long after our work is completed. The combination of KBSI's expertise and customer-centered approach reflects our lasting commitment to the future growth of your enterprise.

KBSI Offices

KBSI has a nationwide network of offices serving a worldwide clientele. Our corporate offices, banking and financial systems division, and method and tool research center are located in College Station, Texas. Other offices include an Austin, Texas office that specializes in consulting, technical support, and software development focused on design, logistics, and data integration systems; a Corpus Christi, Texas office that supports consulting, training, and software tools for the Corpus Christi Army Depot; and an Oklahoma City, Oklahoma office that supports consulting, training, and software tools primarily for the Tinker Air Force Base Air Logistics Center and local manufacturing industries.

Corporate Headquarters:

One KBSI Place, 1408 University Dr. East, College Station, TX 77801
Phone: 979.260.5274 Fax: 979.260.1965

Offices:

11629 Manchaca Road, Suite B, Austin, TX 78748
Phone: 512.292.4614 Fax: 512.292.4615

4444 Corona, Suite 209, Corpus Christi, TX 78411
Phone: 361.814.9090 Fax: 361.814.1904

2912-C S. Douglas Blvd., Midwest City, OK 73130
Phone: 405.741.9090 Fax: 405.741.9044

Tech Support: support@kbsi.com or 979.260.5274

US Sales: products@kbsi.com **International Sales:** international@kbsi.com

Web: http://www.kbsi.com

1

Working with SMARTSTAT

Step-by-step instructions for performing statistical analyses in SmartStat including defining Excel cell parameters and generating statistical reports.

Overview

SMARTSTAT is a Monte Carlo simulation tool that, operating in conjunction with Microsoft® Excel®, provides decision-makers with quantitative assessments of variables and risk factors. SMARTSTAT allows you to assign statistical characteristics to independent variables and, using simulation, track the statistical behavior of dependent parameters over several simulation runs.

SMARTSTAT allows you to define the behavior of a parameter (or cell) by defining a distribution type (i.e., normal, uniform, exponential, triangular, or discrete distribution) for the parameter. Each distribution type requires certain inputs, which establish the boundaries for defining the possible patterns each cell can take. Once you've assigned distribution types, you can next identify target cells whose variations, resulting from changes in independent cell values, should be tracked.

The results of each simulation iteration are presented in an Excel "Statistical Report" spreadsheet that includes histogram charts for all the

dependent and independent variables as well as confidence intervals; average, mean, median, and standard deviation; minimum and maximum value; and range, skewness, and kurtosis for all the parameters selected.

Performing Statistical Analysis

The steps for performing statistical analyses on your workbooks include assigning statistical characteristics (including distribution types and parameters) to independent cells, designating the target cells to be tracked during the simulation, and running the simulation. As a part of this latter step you can also select from a number of report generation options including designating the content of reports and organizing data within the reports.

The following sections outline each of the steps for performing statistical analyses in SMARTSTAT.

Opening an Excel File

When you open an Excel file for use in SMARTSTAT, you'll be prompted to activate the SMARTSTAT macros within Excel. SMARTSTAT is a simulation engine that runs within the Excel environment.

To open an Excel file:

1. Launch SMARTSTAT by selecting *SmartStat* from *AIØ WIN Tools* under the File menu.

2. In the resulting Microsoft Excel dialog, click **Enable Macros**.

3. In the Open dialog, designate the Excel file to open in SMARTSTAT and click **Open**.

   Excel will immediately open the selected file.

Assigning Statistical Characteristics

Once your desired file is open, the next step is to begin assigning statistical characteristics to independent cells. Independent cells are those that contain numerical value rather then a formula. The user can define the statistical character by assigning a distribution type (i.e. normal, uniform, exponential, triangular, or discrete distribution) to the independent cell. Each distribution type requires certain inputs from the user, which establishes the basis for defining the possible patterns each cell can take.

In regard to assigning statistical characteristics, however, note that some changes to cells are not automatically updated by SMARTSTAT. If you activate a cell with a particular value and then subsequently change the value, SMARTSTAT will not automatically recognize the change—the cell must be reactivated first.

In a similar fashion, the examples in the following list are also not recognized by SMARTSTAT.

- Changing the location of a previously activated (or selected as target) cell by means of inserting cells.
- Changing the name of the Worksheet that has previously activated cells (or target cells).
- Changing the value of a previously activated independent cell or the formula of a previously selected target cell.

As a consequence, when making these types of changes, the best method is to first delete the statistical content, and then reactivate the cell.

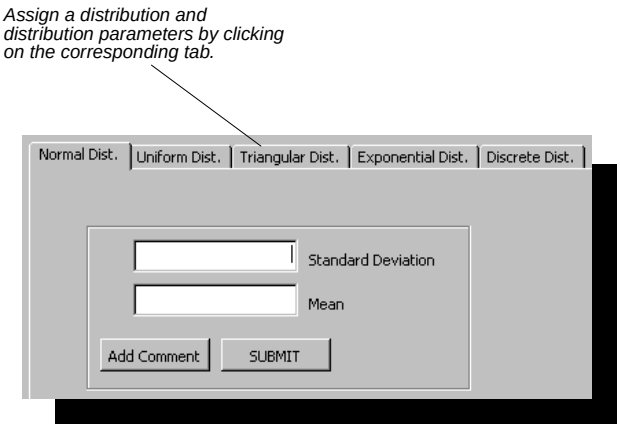
When changing the worksheet name, *all* cells in the sheet that contain statistical information should be deleted before renaming the worksheet.

To assign statistical characteristics to a cell:

1. With your cursor, select a cell an independent cell in the open workbook.

2. On the toolbar, click  . The resulting Statistical Analyzer dialog allows you to assign a name to the cell and to designate the cell's distribution.

3. Designate a distribution for the selected cell by clicking the corresponding Distribution tab. Define parameters in the available fields. Add comments describing the cell and cell distribution parameters by clicking **Add Comment**.



For a detailed description of each distribution type, click **Distribution Info**.

4. When you've finished defining distribution parameters, click **Submit**.

SMARTSTAT will close the Statistical Analyzer dialog and return you to the active workbook. Note that the active cell is now highlighted in yellow.

To delete statistical characteristics:

1. Select a highlighted independent cell and click  on the toolbar.

   This method will delete one cell at a time, regardless of the number of cells you have selected. If you have more than one cell selected, only the first cell in the range will be deleted.

Identifying Target Cells

Once you've activated independent cells and assigned statistical data, the next step is to identify target cells. Target cells are the dependent cells that should be tracked and their values change as a consequence of changes to independent cells.

To identify target cells:

1. Select a cell and click  on the toolbar.

2. In the resulting Set Target Cell dialog, enter a label for the target cell into the available field and click OK.

   The dialog will close returning you to the active workbook. Note that the target cell is now highlighted in red.

Running a Simulation

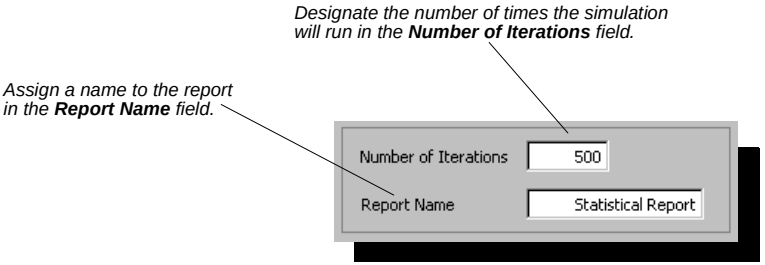
Once you've identified the target cells, the next step is running the simulation. For each simulation iteration—you can designate the number of iterations for the simulation— SMARTSTAT will generate data according to defined statistical characteristic and track data for the designated target cells.

As part of the run simulation step, you can also name and select options for the report automatically generated at the conclusion of the simulation. The Statistical Reports can include statistical information for target cells and independent cells and can include histogram charts, confidence intervals, average, mean, median, standard deviation, minimum value maximum value, range, skewness, and kurtosis for all the selected parameters.

To run a simulation:

1. Click  on the toolbar.

2. In the resulting Run Simulation dialog, assign a name to the simulation report in the **Report Name** field. Designate the number of iterations that the simulation will run in the **Number of Iterations** field.



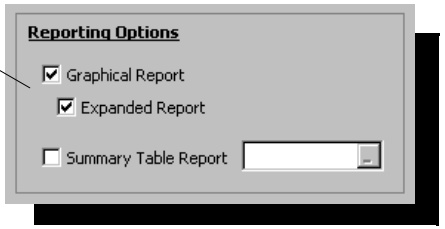
The dialog also allows you to set a number of options for the generated report.

To include an expanded range of report details:

Check the **Expanded Report option**.

Statistical reports in SMARTSTAT provide, by default, the name of the report, the date and time the report was created, and statistical information—including histogram graphs—for the target parameters.

Select additional reporting options including whether the report contains histogram charts and statistical detail.



When you check the **Expanded Report option**, SMARTSTAT will include data and histogram charts for the behavior of independent parameters in the model. In addition to this data, the reports will also include confidence intervals and statistical detail for each independent cell and target parameter. In addition to Range, Minimum Value, and Maximum Value, the statistical detail consists of the following items.

- **Average**—the arithmetical mean of all the numbers the parameter took during the specified number of iterations.

- **Median**—the middle number in a set of numbers that the parameter took during the specified number of iterations. Half the numbers have values that are greater than the median, while half have values that are less.

- **Standard Deviation**—the indicator of how widely the numbers are disbursed from the arithmetical mean.

- **Sample Variance**—the Standard Deviation squared.

- **Kurtosis**—the factor of deviation from a normal distribution. It indicates the flatness or peak of a distribution compared to a normal distribution curve. Positive kurtosis indicates peeked distribution, while negative numbers indicate a flatter distribution.

- **Skewness**—indicates the asymmetry of a distribution around its mean. Positive skewness indicates a distribution with an asymmetric tail extending toward more positive values. Negative skewness

indicates a distribution with an asymmetric tail extending toward more negative values.

To organize the report:

Click **Organize Report**. The resulting Organizer dialog allows you to arrange the order of data in your report.

- Click the **Dependent Variables tab** to order the sequence of target cell data.

- Click the **Independent Variables tab** to order the sequence of active cell data.

To move a data item up or down in the sequence, select the item and click the corresponding arrow button adjacent to the list.

3. When you've finished setting report generation options, click **Run** to initiate the simulation.

During the simulation, SMARTSTAT will assign random numbers to the activated independent variables according to the assigned statistical characteristics. In addition, SMARTSTAT tracks the behavior of the target cells. The simulation may take several minutes depending on the number of iterations, selected number of independent variables and targets, and CPU.

Saving Statistical Results

Each time you run SMARTSTAT, your previously generated reports are overwritten. You can, however, save reports once generated.

To save a report:

1. In Excel, right click on the Statistical Results worksheet tab at the bottom of the screen.

2. Select *Move or Copy* from the resulting menu.

3. In the Move or Copy dialog, select **(new book)** from the To book: drop down list.

4. Check the **Create a copy option** and click OK.

Excel will create a new workbook containing the Statistical Results spreadsheet. You can return to the original spreadsheet by selecting the desired workbook from the Windows menu.

Exiting SmartStat

To exit SmartStat, simply click EXIT on the toolbar.

When you click Exit, SmartStat will deletes all statistical content for the active workbook including the statistical report.

For information on saving the statistical report, see “Saving Statistical Results” on page 1-8.

Index

T