

## **Range – Monte Carlo**

**Overview: Provides mathematical justification for the ranging of variables based on a limited number of samples.**

### **Entry into Module:**

This module of the program is normally entered by clicking on the **REC-TEC** block in the upper left of the **REC-TEC Window** causing the drop-down menu to appear. Place the cursor on the **Statistical Range (Monte Carlo)** block to initiate this module.

Under certain circumstances, the user may choose to use the **Files** block instead of the drop-down menu approach. Selecting any file with an **.RMC** extension in the **Dialog box** accessed from either the **Open Single File** or **Open Multiple Files** block opens this module.

Selecting **AutoLoad [ON]** from either the **Setup Menu** or the **AutoLoad Icon** on the upper right side (third line) of the **REC-TEC Window** automatically loads the scenario that was on the screen when the module was closed, either individually, or when the program was closed. With **AutoLoad [OFF]** on the main **REC-TEC Window**, modules will start without loading a file.

### **Data Entry:**

This module contains the following data entry blocks within the leftmost frame:

#### **Variable Description – Enter a description of the Variable in question**

#### **Data Points: 1 - 15**

- **Enter the Test Data Points of the variable in question for the first 15 samples in the blocks**

Entry of required information in the data boxes (including the Alpha block) is sufficient to generate a solution and causes output information to appear in the **Output** frame. As the input data is changed, the output data is automatically updated without the need to tell the program to update the output. Clicking on the Arrow buttons will bring up the additional sets of 15 blocks for additional Data Point entries.

### **Output:**

The output from this module consists of the Summary Statistics, Significance (User Input), Confidence Interval (Mean) and Upper Bound (Variance). The second Output Frame contains the Monte Carlo routine. The user can select the number of random samples used for the analysis. Clicking on the Compute Monte Carlo Results button

initiates the analysis and brings up a moving indicator showing the progress of the analysis. The Help button displays a document by Jeremy Daily discussing the background and operation of this module of REC-TEC.

### **Options:**

Several **Command Buttons** appear in a frame located at the lower right corner of the module Window. The **Command Buttons** allow the user to engage options including the option to **Open** and **Save** the data required to generate the scenario shown on the screen at the time the file was saved.

- **Open .RMC File** – Calls up a **Dialog box**, which **Opens** any pre-existing **.RMC** file and displays the output results. Opening the file now automatically loads the array associated with that file.
- **Save .RMC File** – Calls up a **Dialog box**, which **Saves** data on the screen to files with any user-selectable filenames. This is independent of the automatic saving as “**LastFile.RMC**” of the data at the close of this module or the close of the program. Saving the file now automatically saves the array associated with that file.
- **Help** – Opens a document File by Jeremy Daily describing the background and operation of this module of the program. This document, while copyrighted is supplied with the permission of the author.
- **Graphics (Small on the Data Screen or Full Screen)** – The primary display shows the cumulative density function (CDF) distribution - Monte Carlo curve. Variable is shown on top and bottom scale. Numbers of Samples is shown on left and right scales. The graphics boxes indicate the significance region as input by User, the Upper and Lower Bounds, and the Mean (MC and Normal Distribution). The positions of the Input Samples are shown as red circles. Press [**Esc**] to Cycle through the various curves. The cycle goes from all curves through the individual curves to all curves and then off.

The **Yellow curve** extends from the Monte Carlo Lower Bound on the left to the Monte Carlo Upper Bound on the right. The combined Yellow/Red curve is the plot of the Monte Carlo cumulative density function (CDF) distribution curve.

The **Green curve**, bounded by the same values, shows the distribution of random samples when the spread of the array is evenly divided into segments. The total number of samples in each segment is plotted on the vertical axis. The value shown in the upper left corner next to the total number of samples is the number of samples in that segment of the array shown as the maximum height. The vertical axis is the number of samples in the segments and the spread of the variable is the horizontal axis. The number of samples in a segment divided by the total number of samples will give an estimated probability of the actual value of

the variable in question falling in that actual segment. This is known as a histogram. When this curve is isolated, the top of the plot is expanded to the top of the graphic to show detail.

The **Blue curve** is the plot of all of the samples in the array and their relationship with the mid-point of the samples.

The **White curve** is the plot of the probability density function (PDF) of the Monte Carlo distribution curve. The Monte Carlo distribution has a mean and standard deviation that is computed from the Monte Carlo sample data. When this curve is isolated, the top of the plot is expanded to the top of the graphic to show detail.

The **Magenta curve** is the plot of the probability density function (PDF) of the most likely normal (Gaussian) distribution curve. The most likely normal distribution has a mean and standard deviation that is computed from the Input sample data. When this curve is isolated, the top of the plot is expanded to the top of the graphic to show detail.

The **Red box** on Graph 1 / Graph 4 is defined by the Upper and Lower bounds of the Monte Carlo distribution.

The **Light Cyan box** on Graph 1 /Graph 4 is defined by the Upper and Lower Bounded Significance on the most likely Normal Distribution.

- **View Array** – Prints the Monte Carlo Array and calls a document with the printout using the word processor selected by the user.
- **N** – This button toggles a graphical number pad on the screen that can be used to enter data into the input boxes without using your keyboard number pad. This may be useful for presentations as data entry can be accomplished using a wired/wireless mouse.