The Calculator Tool for Tables

Most of the data screens with tables include a calculator button ① (Figure 1). Click this button to bring up a window with controls for transforming, resampling, or creating new values for a table. The controls on the dialog box depend on whether the table is 1D (two columns relating a single independent variable x to a dependent variable y) or 2D (two or more columns with every column except the first being associated with a second independent variable x_{col}).
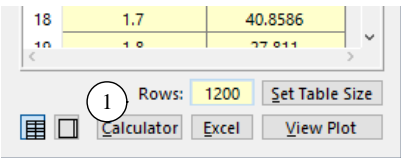

Figure 1. Controls for most tables in the VehicleSim (VS) Browser.

The calculator provides options for creating tabular data from scratch or transforming existing data. In both cases, symbolic formulas are used to define how values should be calculated.

The calculator recognizes the symbols X, Y, PI (3.141592…), S, G (9.80665), and DR (180/π = 57.29…), along with the basic arithmetic operators (+, -, *, /, ^) and functions listed in Table 1 (page 6) that are common for scientific and engineering calculations.

In addition to this tool, there is a library with similar capabilities for 1D tables, the **Calculator: Symbolic** library. This library does not support the options for handling 2D tables or resampling data, but it does support rotation of coordinate systems and can generate custom tables for clothoids. As a library, it has the advantage that datasets with equations used to generate data can be kept in the VS database for future use.

1D Tables

Figure 2 shows the calculator tool as it appears for 1D tables. The drop-down list ① has three modes. Depending on the selection, the appearance of the screen will change.
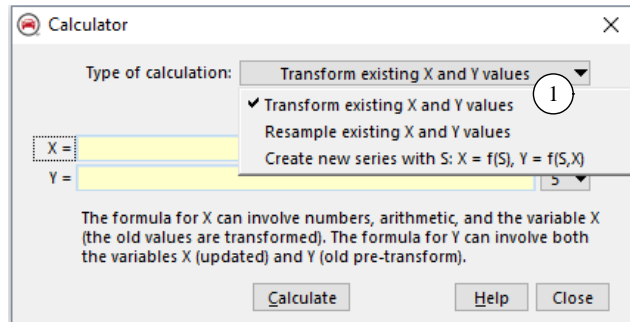
Figure 2. Drop-down control for calculation options with 1D tables.

Transform Existing Values

Figure 3 shows the screen in the mode for transforming the existing data ①. The fields for X and Y ② are used to enter equations for defining the X and Y values in the table. The number of significant digits for the calculated variables is also specified ③. Click the **Calculate** button ④ to apply the equations and see the results in the table. Click the **Help** button ⑤ to bring up the information in this section, and click the **Close** button ⑥ to close the window.
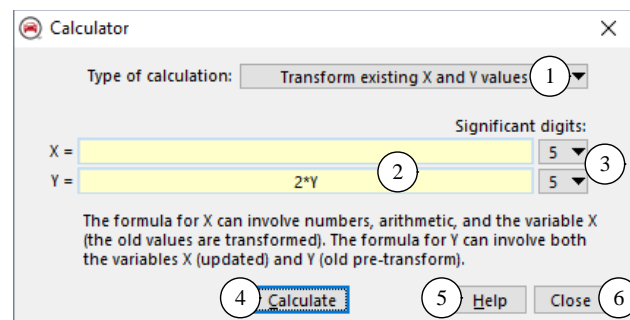

Figure 3. Calculator tool for 1D tables for transforming existing data.

For example, to scale the Y value 100% higher and leave the X values unaffected, leave the X field blank, and put the string 2*Y in the Y field.

Resample Existing Data

Figure 4 shows the screen in the mode for re-sampling existing data ①. In this case, the calculator tool will define the data at fixed increments of the independent variable, x, and linearly interpolate the existing data to obtain the value of the dependent variable, y. This can be used to either increase or decrease the number of data points in the table. There are two options for specifying how to resample the table: specifying an interval between adjacent points ⑦ and specifying the total number of rows ⑧.

These two numbers are related. If you set the number of rows ⑧, then the calculator will look at the values of X in the first row and last row, calculate the interval, and display it in the other field ⑦. On the other hand, if you specify the interval, the calculator will calculate and display the number of rows.
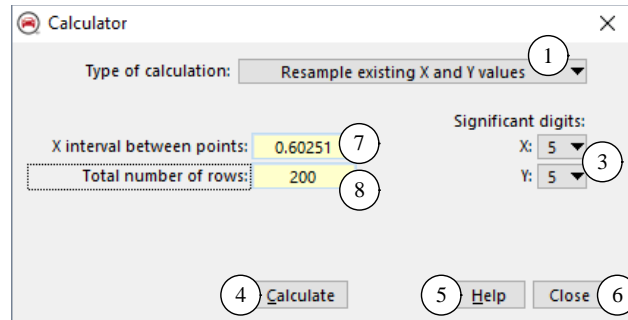
Figure 4. Resampling existing data with the calculator tool.

Create a New Series

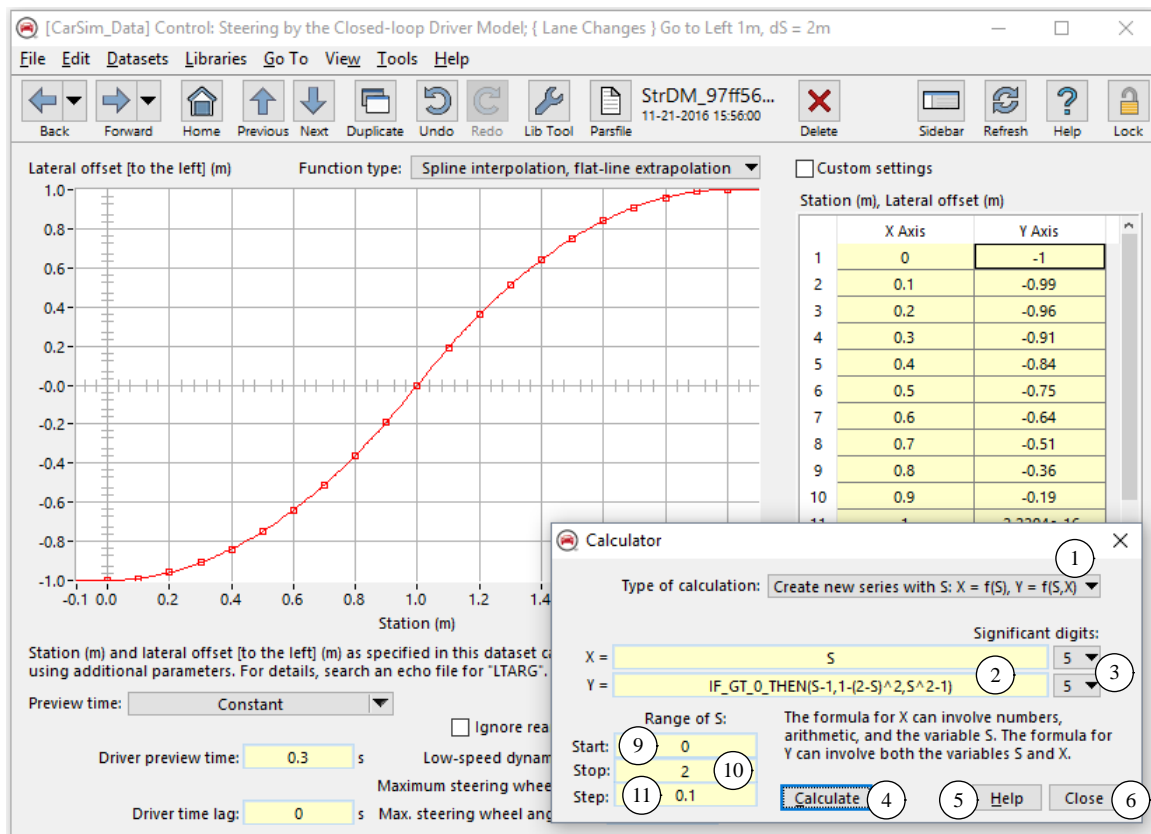When the drop-down list ① is set to create a new series, additional controls appear (Figure 5).

Figure 5. Creating new series with the calculator tool.

A new independent variable S is used that ranges from a specified minimum value ⑨ to a maximum value ⑩, increasing at a constant increment ⑪. In this case, the expression in the X field ② (if used) should define X as a function of S. The expression in the Y field should define Y as a function of S and/or X. The list of available mathematical functions appears in Table 1 (page 6).

2D Tables

The calculator tool that appears for 2D tables is similar to the one for 1D tables.

Transform Data

Figure 6 shows that the options for the drop-down list ① are to transform the existing values or resample existing values. Additionally, for transforming the data, another drop-down control ⑫ allows you to choose which columns to update. In this example, the calculator is used to divide all Y values by 6100, to normalize tire data.
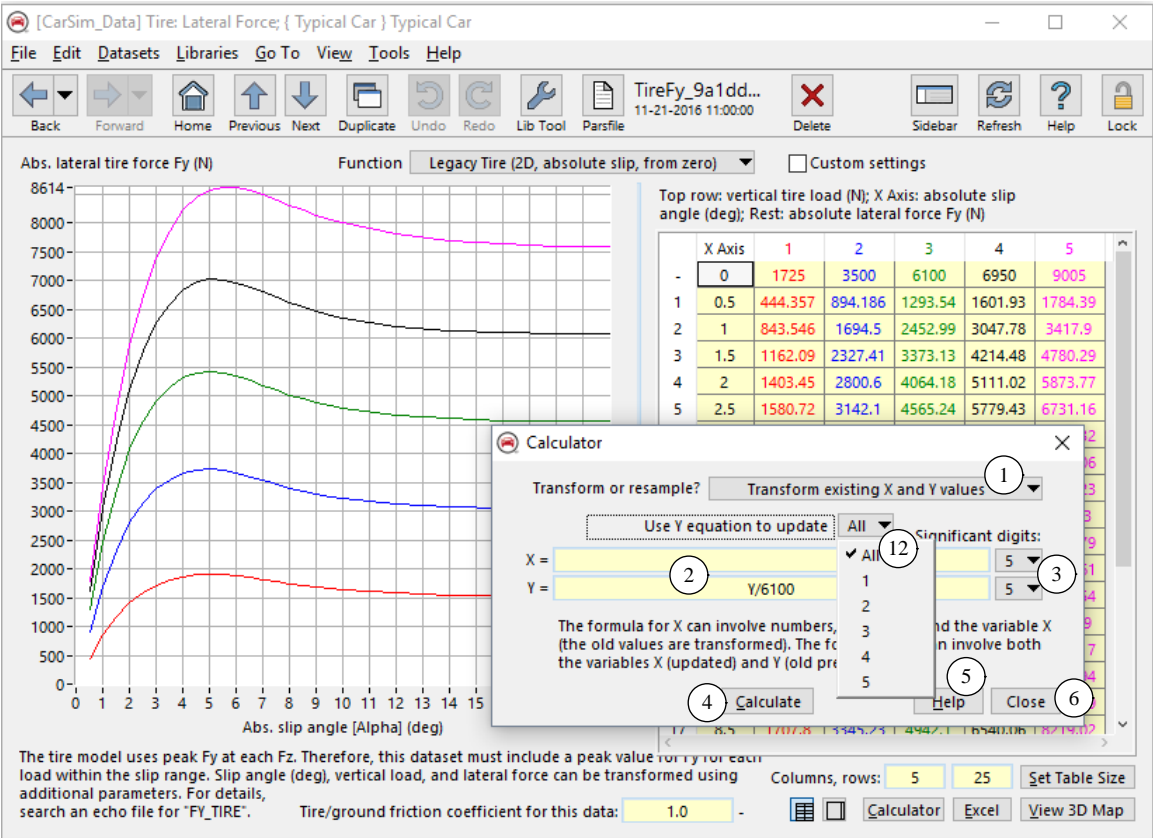

Figure 6. Using the calculator tool for a 2D table.

Resample Data

Alternatively, when the drop-down list ① is used to resample existing data, the screen appears as depicted in Figure 7.
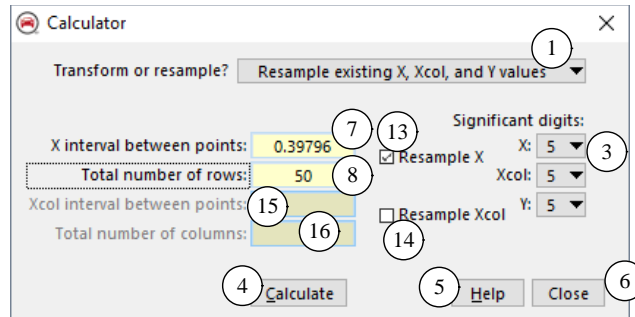
Figure 7. Resampling a 2D table with the calculator tool.

For 2D tables, the rows and columns can be resampled independently. The checkboxes ⑬ and ⑭ enable/disable re-sampling of the rows (*x*) and columns (*y*), respectively. Similar to the 1D case, the data can be resampled based on the interval between adjacent points (⑦, ⑮) or the total number of points (⑧, ⑯). Regardless of how the re-sampling is specified, the other related field will automatically be filled in. Linear interpolation is used between points to obtain the resampled value.

Functions Supported in the Calculator

Table 1 lists the functions that are supported in the formulas provided for the calculator. These are common for scientific and engineering calculations.

Table 1. Basic math functions supported in the VS calculator.

Function	Description
ABS(X)	Absolute value
FABS(X)	Absolute value
ACOS(X)	Arc-cosine
ADD(X, Y)	X + Y
ASIN(X)	Arc-sine
ATAN(X)	Arc-tan with result $\pm \pi/2$
ATAN2(X, Y)	Arc-tan(X,Y) with result $\pm \pi$
CEIL(X)	Smallest integer $\geq$ X
FLOOR(X)	Largest integer $\leq$ X
FIX(X)	Truncate to integer closer to zero
FMOD(X, Y)	Remainder of X/Y
COS(X)	Cosine function
COSH(X)	Hyperbolic cosine function
DIV(X, Y)	X/Y
EXP(X)	e^X
LOG(X)	Natural log (base e)
LOG10(X)	Base 10 log function
MAX(X, Y)	Maximum of two arguments
MIN(X, Y)	Minimum of two arguments
NINT(X)	Nearest integer to X
MUL(X, Y)	X*Y
POW(X, Y)	X^Y
POWER(X, Y)	X^Y
RAND(X)	Pseudo-random number (X is ignored)
SRAND(X)	Pseudo-random number with X as seed
SIN(X)	Sine function
SINH(X)	Hyperbolic sine function
SIGN(X, Y)	If Y > 0 Then |X| Else –|X|
SQRT(X)	Square root
SUB(X, Y)	X–Y
TAN(X)	Tangent function
TANH(X)	Hyperbolic tangent function
IF_GT_0_THEN(X, Y, Z)	If X > 0 Then Y Else Z
IF_NOT_0_THEN(X, Y, Z)	If X $\neq$ 0 Then Y Else Z

All functions take double-precision arguments and return double-precision values.