GRAPHING PIECEWISE FUNCTIONS ON CALCULATORS

Consider the following piecewise function:

\[
f(x) = \begin{cases} 
  x+1 & \text{for } x < -2 \\
  2x-5 & \text{for } -2 \leq x \text{ and } x \leq 4 \\
  2.5x-15 & \text{for } 4 < x \text{ and } x \leq 9 
\end{cases}
\]

Function #1

The following series of screens illustrate the technique for inputting this function into the TI–86:

The input for this function all on one line is shown below:

\[y1 = (x + 1)(x < -2) + (2x - 5)(-2 \leq x)(x \leq 4) + (2.5x - 15)(4 < x) (x \leq 9)\]

Note that what we are doing is defining each piece of the function within parentheses and then following the function definition with the conditions within parentheses. We cannot enter compound inequalities like \(-2 \leq x \leq 4\) so we must do each piece separately. \(-2 \leq x \leq 4\) must be entered as: \((-2 \leq x)(x \leq 4)\). We place + signs between each piece of the function and then we get the graph shown in figure 1 from the calculator when we graph in a standard window:

We can eliminate the vertical lines which appear on our graph by changing the style to dot mode. This will give a graph like the one shown in figure 2.
In order to make the same graph on a TI–89/92/92+/Voyage 200, we use the when command as shown in the following screens:

The input for this function all on one line is shown below:

\[
y_4(x) = \text{when}(x < -2, x + 1, \text{when}(-2 \leq x \text{ and } x \leq 4, 2.5 \cdot x - 15, 4 \text{ and } x \leq 9, 2), \text{when}(-4 < x \text{ and } x \leq 9, 2.5 \cdot x - 15, 10))
\]
The graph is shown in figure 3. Note that the same problem with vertical lines is present as was with the TI–86.

What we are doing is defining each piece of the function with a when command. The first entry is a condition, the second entry is the function definition under that condition, and the third entry is the value everywhere else. When we have more than 2 pieces to the function, the third entry becomes another when command which follows the same format. For this function, 3 when commands are needed. We cannot enter compound inequalities like $-2 \leq x \leq 4$ so we must do each piece separately. $-2 \leq x \leq 4$ must be entered as: $-2 \leq x$ and $x \leq 4$. The spaces on both sides of the and are required. The last entry of $1/0$ gives an undefined condition so that the calculator does not graph anything beyond $x = 9$.

As with the TI–86, we can eliminate the vertical lines by graphing with a style of dot. This is shown in figure 4.

If one wishes to enter a more complex command, the vertical lines can be eliminated by adding additional function definitions at the function transition points which make the function undefined as was done in the last command in the above function. This allows a solid line to be drawn without the vertical lines between the function pieces.

Other calculators like the TI–82, TI–83 and the TI–85 handle piecewise functions in the same or a very similar manner as the TI–86.

Note that what we are doing is defining each piece of the function within parentheses and then following the function definition with the conditions within parentheses. We cannot enter compound inequalities like $-2 \leq x \leq 4$ so we must do each piece separately. $-2 \leq x \leq 4$ must be entered as: $(-2 \leq x)(x \leq 4)$. We place + signs between each piece of the function and then we get the graph shown in figure 1 from the calculator.

An alternate method is to use a separate equations to represent each piece of the function. On the TI–89 this is done as follows:
When entering equations one at a time, the vertical line is read as “such that”, so the first equation says: \[ y_1 = x + 1 \text{ such that } x \leq -2 \]

Note in \( y_2 \) the use of the “and” between the inequalities. Compound inequalities cannot be used.

The graph of these 3 equations is shown below.

Note that when using this method, it is not necessary to graph in dot mode to remove the vertical lines. Since we have 3 separate equations, the calculator does not attempt to draw the vertical lines between the pieces of the graph.