T³ Workshop
Piecewise Functions

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Math Resource Site

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Define a piecewise function...
Define a piecewise function...

• a function whose definition changes depending on the value of the independent variable

• a function that is given by different expressions on various intervals
Evaluating piecewise functions:

\[ f(x) = \begin{cases} 
  x^2 + 1 & x < 2 \\
  3 - x & 2 \leq x 
\end{cases} \]

\[ f(x) = \begin{cases} 
  2x - 3 & x < 2 \\
  5 & x = 2 \\
  x + 1 & 2 < x 
\end{cases} \]
Graphing piecewise functions on TI-83/84:

\[ f(x) = \begin{cases} 
2x + 3 & x < -1 \\
x^2 & -1 \leq x \text{ and } x \leq 2 \\
6 - x & 2 < x 
\end{cases} \]

Choose Y=  

Enter first function in ( ) with conditional next to it in ( )  

Use 2\textsuperscript{nd} Math for inequality symbols

Let's graph what we have so far.
Suggestions on graphing other “pieces”?

\begin{align*}
\text{Plot1} & \quad Y_1 = (2X + 3) \quad (X < -1) \\
\text{Plot2} & \quad Y_2 = X^2 \quad (-1 \leq X \leq 2) \\
\text{Plot3} & \quad Y_3 = (6 - X) \quad (X > 2) \\
\text{Plot4} & \quad Y_4 = \text{for graphing other “pieces”} \\
\text{Plot5} & \quad Y_5 = \text{for graphing other “pieces”}
\end{align*}
We have a problem with the compound inequality \((-1 \leq x \leq 2)\).

There are two ways to correct this – use one of the following:

\((-1 \leq x)(x \leq 2)\)

or

\((-1 \leq x \text{ and } x \leq 2)\)

I like to use the second method. To get the “and” operator:

```
TEST       LOGIC
1: and
2: or
3: xor
4: not
```
Now we have:

\[ Y_1 = (2x + 3)(x < -1) \]
\[ Y_2 = x^2 \quad (-1 \leq x \text{ and } x \leq 2) \]
\[ Y_3 = (6-x)(x > 2) \]
\[ Y_4 = \]
\[ Y_5 = \]

Let’s change this up a bit. What if the third “piece” was \((x+1)\)?
Next, what if we want to evaluate different values for our function using the calculator?

We can make these 3 functions into one .....
Now we can evaluate any value with just one function:

\[ Y_1(-5) = -7 \]
\[ Y_1(1) = 1 \]
\[ Y_1(8) = -2 \]
How about a table:

<table>
<thead>
<tr>
<th>X</th>
<th>Y1</th>
</tr>
</thead>
<tbody>
<tr>
<td>-.97</td>
<td>.94</td>
</tr>
<tr>
<td>-.98</td>
<td>.96</td>
</tr>
<tr>
<td>-.99</td>
<td>.98</td>
</tr>
<tr>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>-.99</td>
<td>.9801</td>
</tr>
<tr>
<td>-.98</td>
<td>.9604</td>
</tr>
<tr>
<td>-.97</td>
<td>.9409</td>
</tr>
</tbody>
</table>

Note: your y-values may be rounded. If you arrow over to the y-value, it will show to more decimal places below.
TI-89:
\[ f(x) = \begin{cases} 
2x + 3 & x < -1 \\
x^2 & -1 \leq x 
\end{cases} \]

Press [F1] and select y1=

Press [CATALOG] and then “when” (instead of scrolling, choose alpha-w)

the < and > are located above ‘0’ and ‘.’
Note: Sometimes the TI calculators “connect” the graphs when they shouldn’t. In this case, you want to be in “Dot” mode.

For the TI-89, if you have more than two pieces, you will need to have nested when statements:

\[ f(x) = \begin{cases} 
2x + 3 & x < -1 \\
2x^2 & -1 \leq x \text{ and } x \leq 2 \\
6 - x & 2 < x 
\end{cases} \]

Would be input as \( y1=\text{when}(x<-1,2\cdot x+3,\text{when}(x\leq2,x^2,6-x)) \)
Let’s try some more:

\[ f(x) = \begin{cases} 
  x - 4 & x < 1 \\
  2 - x^2 & 1 \leq x 
\end{cases} \]

\[ f(x) = \begin{cases} 
  3 & x < -2 \\
  x^3 & -2 \leq x \text{ and } x < 3 \\
  2x + 1 & 3 \leq x 
\end{cases} \]

\[ f(x) = |x| \]
Limits:

How can we use this with limits?

Given:

\[ f(x) = \begin{cases} 
2x - 5 & x \neq 1 \\
4 & x = 1 
\end{cases} \]

Find \( \lim_{x \to 1} f(x) \)

Graph:

Table:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y_1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.85</td>
<td>3.3</td>
</tr>
<tr>
<td>0.9</td>
<td>3.2</td>
</tr>
<tr>
<td>0.95</td>
<td>3.1</td>
</tr>
<tr>
<td>1</td>
<td>3.0</td>
</tr>
<tr>
<td>1.05</td>
<td>2.8</td>
</tr>
<tr>
<td>1.1</td>
<td>2.5</td>
</tr>
<tr>
<td>1.15</td>
<td>2.2</td>
</tr>
<tr>
<td>( x = 0.85 )</td>
<td></td>
</tr>
</tbody>
</table>

On the TI-89, enter \( y_1=\text{when}(x \neq 1,2x-5,4) \). The \( = \) is obtained by pressing [+]