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Fun With Functions

Topic: Functions and Function Notation

NCTM Standard:
- Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules.
- Relate and compare different forms of representation for a relationship.
- Identify functions as linear or nonlinear and contrast their properties from tables, graphs, or equations.

Objective
The student will be able to use the Casio fx-9750GII to input data relating to functions as well as to evaluate functions using function notation.

Getting Started
Being able to understand functions in various forms empowers students to see patterns in relationships and make connections with functions to their everyday lives. Begin this activity by looking at various tables and gain an understanding of how that data relates to its graph on a coordinate plane. Students should be able to examine a table and/or a graph and be able to determine any specific trends or characteristics about that data set.

Prior to using this activity:
- Students should be able to graph points on a coordinate plane.
- Students should be able to read and interpret data presented in a table and graph.
- Students should be familiar with all key strokes involved in entering data into a table and entering a function into the graph editor window.
- Students should understand the formula for a linear function.
- Students should be able to correctly identify the independent (x) and dependent (y) variables.

Ways students can provide evidence of learning:
- When given a function, students can state and explain whether that function is increasing or decreasing.
- When given a function, students can evaluate it for a specific value of x or y.

Common calculator or content errors students might make:
- Students may incorrectly set the viewing window when showcasing a function.
- Students may enter data into a table incorrectly by switching the x- and y-coordinates.
Fun With Functions

The following will demonstrate how to store a value for a variable, input a function to generate a table, and enter data into a table to construct a graph with the Casio fx-9750 GII.

To store a value for a variable:

1. To store 5 for the variable x, input:
   \[ 5 \rightarrow x \theta t \text{ EXE} \].

To input a function and generate a table:

1. From the Main Menu, highlight the TABLE icon and press \[ \text{ EXE} \] or \[ 5 \].

2. To enter a function such as \(3x - 1\), input:
   \[ 3 \ x \theta t \rightarrow 1 \text{ EXE} \].

3. The equal sign to the right of \(Y1\): is highlighted to indicate this function is active.

4. To generate a table of values for the selected function, press \[ F6 \text{(TABL)} \].
   The default x-values for the table menu is \(x\) starts 1, ends at 5 and increases by steps of 1.

5. To navigate through the table, use the replay pad \[ \leftarrow \rightarrow \uparrow \downarrow \].

To adjust the values in a table:

1. Use \[ \text{ EXIT} \] to return to the TABLE home screen. Press \[ F5 \text{(SET)} \] to change the default table values.
   Enter 0 for the start value, 20 for the end value and a step value of 1, pressing \[ \text{ EXE} \] after each entry.
2. Press **EXIT** then **F6** (TABL) to display the table.

3. To display a corresponding y-value for a specific x-value, highlight any x-value and enter the desired value.

To display the corresponding y-value when \( x = 18 \), input **18 EXE**.

Note: You do not need to change the tables settings; you could just enter all given x-values and create a custom table.

To enter data into a list and graph the data:

1. From the Main Menu, highlight the STAT icon and press **EXE** or **2**.

2. In **List 1**, input: **1 EXE 2 EXE 3 EXE**.

3. Press **TABL** to move the cursor to **List 2**.

4. In **List 2**, input: **3 EXE 5 EXE 7 EXE**.

5. Press **F1** (GRPH), then **F1** to select Graph 1 (the default graph type is a scatterplot).

6. Press **F1** (CALC) for regression options.

7. Since the data appears linear, press **F2** (X) to calculate linear regression (line of best fit).

8. Press **F1** (ax +b) for slope-intercept form of a line. Substitute the a- and b-values displayed into the given formula.

When the correlation coefficient, r, equals 1, you have a perfect regression.
Functions help establish various types of numeric patterns, based upon whether those functions are linear, quadratic, cubic, etc. Building a strong foundation in Algebra includes a comprehensive study of linear functions. Functions are a rule used to calculate values. Functions are written using a specific notation called function notation. Each function has an independent and a dependent variable. The independent variable is the value you get to choose or control. The dependent variable is the value created when the independent variable is plugged into the function. Another name for the independent variable is the “input” and for the dependent variable is the “output”. We will define a series of coordinate points as a relation.

In this activity, we will explore how to assign a single value to a variable and evaluate a given function. We will also explore how to input a function and generate a table of values as well as enter points in a data set and determine the function.

Functions can be expressed in these different forms:

1. The **Slope-Intercept Form of a Line** is defined as $y = mx + b$; where $m$ represents the slope of the line, $b$ represents the $y$-intercept, $x$ represents the independent variable and $y$ represents the dependent variable.

2. The **Standard Form of a Line** is defined as $Ax + By = C$ where $A$, $B$, and $C$ are integers and $x$ represents the independent variable while $y$ represents the dependent variable.

3. $f(x)$ is often described as function notation. In this example, where $f(x) = 5x - 3$, $x$ represents the independent variable and $f(x)$ is synonymous with $y$, representing the dependent variable.

Remember when graphing a function, it must pass the Vertical Line Test. A function is defined as a relation where for every one $x$-value, there is one and only one $y$-value. When looking at the graph, if any two points appear directly above each other, the graph fails the vertical line test and thus, the relation is not a function.
Questions

1. Given the function f(x) = 3x + 7, evaluate the function at f(4).

2. Given the function f(x) = -2x - 5, evaluate the function where -5 ≤ x ≤ -1. (Let x = set of integers)

3. Given the function f(x) = 2x^2 + 6x - 5, evaluate the function at f(-2).

4. Enter the data into the calculator and determine the linear function.

<table>
<thead>
<tr>
<th>List 1</th>
<th>List 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
</tr>
</tbody>
</table>

5. Enter the data into the calculator and determine the linear function.

<table>
<thead>
<tr>
<th>List 1</th>
<th>List 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>8</td>
<td>47</td>
</tr>
</tbody>
</table>
6. Enter the data into the calculator and determine the linear function.

<table>
<thead>
<tr>
<th>List 1</th>
<th>List 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

7. Lauren works as a babysitter to earn some extra money. She charges her customers seven dollars an hour. Write a function to determine the amount of money Lauren will earn if she works \( x \) hours. How much money will she earn if she works 4 hours? 7 hours? 11 hours?

8. A cell phone company charges its customers $30 per month for phone calls plus an additional charge of seven cents per text message after the first 50 text messages. Write a function that accurately models how much money you will spend per month with this plan. How much money will you spend if you send 50 text messages per month? 100 text messages per month? 225 text messages per month? 500 text messages per month?

Extension

1. Create a data set that models a function which is non-linear.

2. Write a non-linear function and evaluate that function where \(-5 \leq x \leq 5\).
Solutions

1. \( f(4) = 19 \)

\[
\begin{array}{c|c}
4+x & 4 \\
3x+7 & 19 \\
\end{array}
\]

2. \( f(-5) = 5, f(-4) = 3, f(-3) = 1, f(-2) = -1, f(-1) = -3 \)

Table Func : V1= 
X | Y1= 2X-5 |
-5 | 5 
-4 | 3 
-3 | 1 
-2 | -1 
-1 | -3

Table Setting 

X 
Start: -5 
End: 1 
Step: 1

3. \( f(-2) = -9 \)

\[
\begin{array}{c|c}
-2+x & -2 \\
2x+6x-5 & -9 \\
\end{array}
\]

4. The function is: \( y = 3x - 1 \) or \( f(x) = 3x - 1 \)

5. The function is \( y = 5x + 7 \) or \( f(x) = 5x + 7 \)
6. This relation fails the vertical line test as evident by the two coordinates directly above each other. Since the relation fails the vertical line test, the relation is not a function.

7. The function is \( y = 7x \) or \( f(x) = 7x \). If Lauren works four hours, she will earn $28. If Lauren works seven hours, she will earn $49. If Lauren works 11 hours, she will earn $77.

8. The function is \( y = 0.07(x - 50) + 30 \) or \( f(x) = 0.07(x - 50) \). For 50 text messages per month, you will spend $30. For 100 text messages per month, you will spend $33.50. For 225 text messages per month, you will spend $42.25 and for 500 text messages per month, you will spend $61.50.

Extensions

1. Answers may vary.

2. Answers may vary.