



Teacher Notes for Tables, Functions & Graphs

Compatibility: TI-83+/83+SE/84+/84+SE

Run The Program Called: **TFG**

► Summary

This program develops and tests students knowledge of the relationships between a table of values, a function and its graph.

There 3 modes of use: **Formula to Table**, **Table to Formula** and **Graph to Formula**. Each of these modes is described in detail below.

QUESTION OPTIONS

FORMULA to TABLE
 TABLE to FORMULA
 GRAPH to FORMULA

☒ ← Press to QUIT

On nearly all screens and in all modes, there are **QUIT** buttons on display in the bottom left hand corner of the screen. To **QUIT**, press the **Y=** button.

QUIT MENU

USE UP + DOWN + ENTER

Return to program
 Restart
 Quit

► Features common to both **TABLE to FORMULA** and **FORMULA to TABLE** mode:

- From the start menu, the option of **y=mx+c FORMAT** or **MIXED FORMATS** gives control over the format of the function that is presented.
- There are also options for using variables other than x or y, but when data are presented as co-ordinates, then it always uses the letters x and y.

Examples:

y=mx+c FORMAT display

$$y = 4\frac{2}{3}x + 5 \qquad y = \frac{14}{3}x + 5$$

$$y = \frac{14x}{3} + 5$$

MIXED FORMATS display

$$y = 5 + \frac{14}{3}x \qquad 3y = 14x + 15$$

$$14x - 3y - 15 = 0 \qquad -14x + 3y = 15$$

- The complexity of the formula is decided by the **START LEVEL** which is altered from 1 to 25 using the up and down arrows. In the following level table *a*, *b*, *c* and *d* are all positive integers.

- | | | | | |
|-----------------|-------------------------|-----------------------------|-----------------------------|------------------------------|
| 1. $y = ax$ | 6. $y = -ax$ | 11. $y = \frac{1}{a}x + b$ | 16. $y = -\frac{a}{b}x$ | 21. $y = a\frac{b}{c}x + d$ |
| 2. $y = c$ | 7. $y = -ax + b$ | 12. $y = \frac{1}{a}x - b$ | 17. $y = a\frac{b}{c}x$ | 22. $y = \frac{a}{b}x - c$ |
| 3. $y = -c$ | 8. $y = -ax - b$ | 13. $y = -\frac{1}{a}x + b$ | 18. $y = \frac{a}{b}x + c$ | 23. $y = a\frac{b}{c}x - d$ |
| 4. $y = ax + b$ | 9. $y = \frac{1}{a}x$ | 14. $y = -\frac{1}{a}x - b$ | 19. $y = -\frac{a}{b}x + c$ | 24. $y = -a\frac{b}{c}x + d$ |
| 5. $y = ax - b$ | 10. $y = -\frac{1}{a}x$ | 15. $y = \frac{a}{b}x$ | 20. $y = -\frac{a}{b}x - c$ | 25. $y = -a\frac{b}{c}x - d$ |

- **DOWN** from level 1, or **UP** from level 25 is the level **TEST**. This presents the user with 10 questions for which they have only one attempt. At the end of the 10 questions, the user is presented with their summary score of questions right, the total number of mistakes made and the levels on which they made those mistakes. Watch out for the happy and sad faces on this final score screen! The 10 levels are pseudo-randomly selected from the 25 available and are

presented in progressive order. Once a user has completed the **TEST**, they could then revisit the levels that they answered incorrectly, or change the format options (ie **MIXED FORMAT** and **MIXED VARIABLES**) and try the **TEST** again.

- The **TIMER ON** switch has the calculator display after each completed question the total time taken to answer it correctly, in seconds. The timer continues to count when viewing the graph of the function and when deciding whether to **SUBMIT** or **RETYPE**.

Level: 8.01 

$$y = -3x - 9$$

x	0	1	2	3
y	-9	-12	-15	-18

Time taken: 29.4 secs
Perfect! Next

LEVEL 2
COMPLETED!
MEAN TIME PER QUESTION
5.5 secs

Press ENTER

This continual ticking is indicated by the rotating symbol around the letter **T** in the top right hand corner of the screen. At the end of a completed level, the mean time to answer that level's questions is displayed, before moving onwards and upwards to the next level. The timer is automatically switched **OFF** when conducting a **TEST** or in **GRAPH to FORMULA** mode.

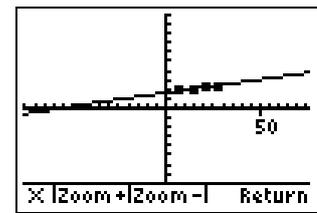
Level: 7.03

$$y = -2x + 1$$

(1 , ?) (□ , 5)
(5 , □) (□ , -15)
Enter a number for?:
X] Graph

- The relevant co-ordinate data for each level is presented in either a table, or as co-ordinates with brackets - every 3rd question on each level is presented as co-ordinates. The increments in the table/x-coordinates also changes from 1, 2, 3, 4 to other incremental values, depending on the question being done and how many attempts at that level have been made. All co-ordinates and table entries are integers.

- When entering any answers, pressing the **GRAPH** button displays a graphical representation of the problem. There are controls to **Zoom In** and **Zoom Out** and the scale is marked on the positive x-axis. The y-axis has the same scale.



- Where the user is attempting **TABLE to FUNCTION** challenges, the points are plotted and the line is drawn on the axes. For the **FUNCTION to TABLE** challenge, only the line is drawn.
- The entry of information is restricted to the digits 0 to 9, +, - and negative signs, where appropriate. In addition, the number of digits are limited to what the correct answer should be. For example, if the correct answer for a number is 7, then the user cannot enter a 2 digit number, say 13, or -8, as it's expecting a single character input. This restriction can help guide the students, but also it prevents inputs such as 1000000 being entered which would disrupt the displayed information.
- After an answer has been entered the user can decide whether to **SUBMIT** or **RETYPE** it. If **RETYPE** is chosen, re-entry of all information starts, with no penalties incurred (but the timer continues to tick, if it is switched on)

► **Features of FORMULA to TABLE mode:**

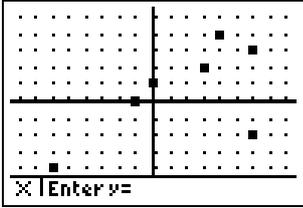
- Depending on the question being tackled, the table either:
 - shows 4 x values and the user must input 4 y values
 - or shows 3 x values and a y value and the user must input 3 y values and an x value
 - or shows 2 x values and 2 y values and the user must input 2 y values and 2 x values
- This was incorporated so that students don't just blindly plug in numbers to variables without thinking about what the implications are!
- Where the function is $y = 4(\text{say})$, then any integer between -999 and 999 inputted for the x coordinate will be considered correct.
- When **MIXED VARIABLES** have been selected, then the variable in the top row of the table corresponds to what would normally be the x -coordinate. This is the variable that is plotted along the x -axis when the graph is viewed.

► **Features of TABLE to FORMULA mode:**

- All formula are entered bit-by-bit. In other words, the user is presented with a format for the formula which they must adhere to, and they enter in the signs and values of the numbers where prompted by the ? symbol. This approach has allowed a variety of different formats of formula to be brought into the exercise.
- **Important note:** for the entry of answers, the program considers the negative sign and the subtraction operation as different. For example, when entering the formula $y = -9x - 3$, the symbol in front of the 9 is a negative sign, whilst that in front of the 3 is a subtraction operation. This is consistent with the calculator's normal syntax rules.
- All fractions in formulae must be entered in their simplest form - it will not consider $\frac{10}{12}$ inputted for $\frac{5}{6}$ to be correct.

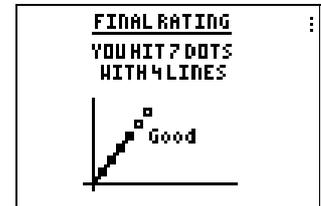
Level: 23.01				
x	0	2	4	6
y	-3	16	35	54
$y = ? \frac{\square}{\square} x \cdot \square$				
Enter a number for ?:				
\times				Graph

► **Features of GRAPH to FORMULA mode:**



The user can select from 2 to 10 randomly placed points on a set of axes they wish to try to hit with lines generated from entered formulae. All points have distinct values for their y co-ordinate.

- For the entry of the formula, the user has access to digits 0 to 9, the operations +, - and divide (but not multiplication, as this is implied when numerals are adjacent to variables) and brackets.
- To enter in the variable x, press the X,T,θ,n button
- If the user wishes to enter an equation of the form “ $x = \dots$ ”, press **MODE** to change. Press it again to change back to “ $y = \dots$ ”. When in “ $x = \dots$ ” mode, only the digits 0 to 9, brackets, division operation and negative sign may be used - there is no option to add or use variables.
- If the user enters in an invalid formula which causes an error, then they can **Quit** or **Goto** the error. If they choose the latter, then they will enter the **Y=** editing screen. Once the problem has been diagnosed, the user can restart the program (by typing **prgmTFG**), choose **GRAPH to FUNCTION** mode and then selecting **EXISTING POINTS**. This option returns the user to the exact place prior to the error occurring.
- At the end, the users' tally of the number of lines used to hit the given number of points is evaluated. Ratings range from “Inaccurate” to “Take Care!”, “Average”, “Good”, “Excellent” and finally “Fantastic!”. This last category can be achieved if a student exceeds a mean number of 2 dots hit per line (ie they hit 3 dots with a single line, and all the other lines hit at least 2 dots). The rating is presented on an animated, rising line graph!



► Suggestions

It can often be beneficial for the teacher to spend the last 5/10 minutes of the previous lesson demonstrating via a viewpanel to the class, the program that they will subsequently be using themselves. This aids their familiarity with the task they will face and the menu options they will have to choose from, without the distraction of having a calculator in front of them at the time.

The options of this program are best tackled in their increasing order of difficulty: **Formula to Table**, **Table to Formula** and then **Graph to Formula**.

In each case, start the students off at the first level, or in the case of **Graph to Formulae**, with the minimum number of points.

It is crucial that the students become familiar with the task they are faced with and that they develop strategies for answering questions with the easier tasks before they encounter the harder challenges.

Many students are initially confused by the table of values transforming into co-ordinate pairs, until they have it explained/reminded about standard (x,y) notation!

► Acknowledgements

This program was originally created for the publication "Lessons for the Maths Framework using ICT" written by Derek Ball and Barbara Ball and published by Pearson Education Ltd in 2003.

Sections of code incorporated in this program are gratefully acknowledged to have come from Raymond Bonneau and Richard Homard.