String Graphs – Part 1

Student

7   8   **9**   **10**   11   12

TI-Nspire   Investigation   Student   45 min
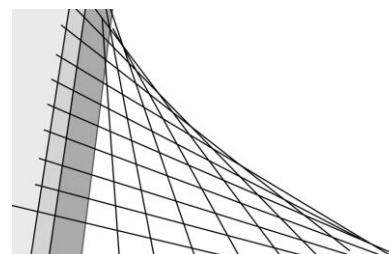
Aims

- Determine a series of equations of straight lines to form a pattern similar to that formed by the cables on the Chords Bridge in Jerusalem.
- Determine a general equation for the family of straight lines.
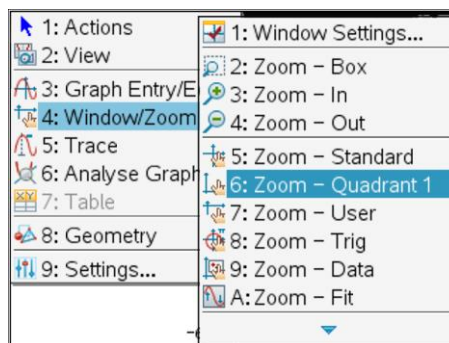
Determining Equations

Video Tutorial:

Start a **new document** and insert a **Graphs application**.

https://bit.ly/Yr10StringGraphsPart1

Adjust the window settings:

[**Menu**] > **Window/Zoom** > **Quadrant 1**.

A series of straight line graphs will be constructed to form a string pattern similar to that on the Chords bridge.

The first straight line graph passes through the points:

(0, 10) & (1, 0)

Press the **TAB** key to quickly navigate to the equation entry line. When you follow the steps on the next page, this is the graph that you will see. Use the following questions to determine the equation for this line and all subsequent lines.
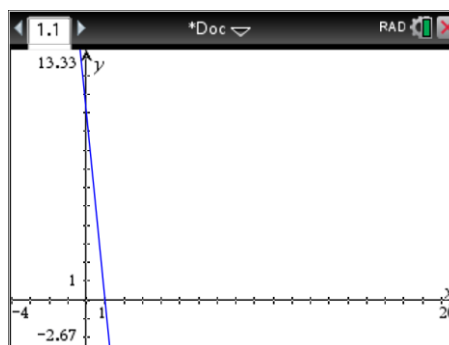
The equation to any straight line can be expressed in the form: $y = mx + c$

m = gradient = $\dfrac{rise}{run}$ c = y-axis intercept

Author: P.Fox

Question: 1.

Determine the equation of this first line, passing through the points: (0, 10) & (1, 0)

a)   Write down the y-axis intercept of the first line.

b)   Calculate the gradient of the first line.

c)   Write down the equation of the first line and graph it on the calculator.

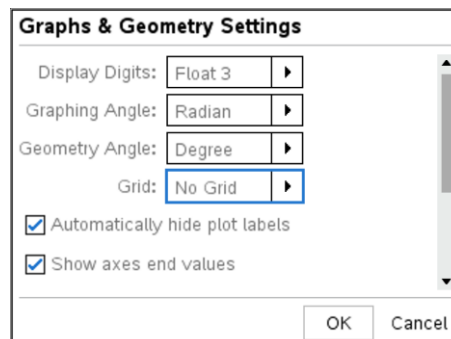Once the first line is completed, try the second line.

The second straight line graph passes through the points:

(0, 9)   &   (2, 0)

As more graphs are added it may be desirable to remove the equation labels.

[Menu] > Settings > Automatically hide plot labels

Press **[Enter]** to accept and apply the changes.

Graphs & Geometry Settings

Display Digits:	Float 3 ▸
Graphing Angle:	Radian ▸
Geometry Angle:	Degree ▸
Grid:	No Grid ▸

☑ Automatically hide plot labels
☑ Show axes end values

OK   Cancel

Question: 2.

Determine the equation of the line, passing through the points: (0, 9) & (2, 0).

Question: 3.

Determine the gradient and y – intercept for the remaining straight lines in this family of lines. Express results using fractional values where appropriate. Graph all 10 equations on the same set of axes.

Eqn. No.	Point 1	Point 2	Gradient	y-Intercept	Equation
1	(0, 10)	(1, 0)			
2	(0, 9)	(2, 0)			
3	(0, 8)	(3, 0)			
4	(0, 7)	(4, 0)			
5	(0, 6)	(5, 0)			
6	(0, 5)	(6, 0)			
7	(0, 4)	(7, 0)			
8	(0, 3)	(8, 0)			
9	(0, 2)	(9, 0)			
10	(0, 1)	(10, 0)			

⚠️ As you answer more and more questions in this calculator document you will need to start saving your work. Press **DOC > File > Save As** and save your document as "String Graphs".

Author: P. Fox

TEXAS
INSTRUMENTS

Graphing a Family – Using a Parameter

Use the document key: [doc▾] to insert a new problem.

> **[Doc]** > **Insert** > **Problem**

When prompted, add a Calculator Application to this new problem.

You will notice that the page number is different. The problem is numbered 2.1. The '2' signifies it is problem 2 in the same document and the '1' that it is page 1 of this problem.

You can navigate between pages in a single document using the Ctrl key and the Navigation pad.

> Ctrl + Left = Previous Page

> Ctrl + Right = Next Page

To help understand how a parameter works in an equation a series of linear graphs will be generated.

In this case: 't' will be the parameter and take on the first five integer values:

> t:={1, 2, 3, 4, 5}

The ":=" is referred to as 'assigned equal to', the button can be accessed by pressing Ctrl then the maths template key.

> [ctrl] + [▦{³]

Note that it is important that 'curly' braces are used as this denotes a set of values. Try typing t^2 and see what is returned.

Insert another **Graphs** application into this problem.

Adjust the window settings:

> **[Menu]** > **Window/Zoom** > **Quadrant 1**.

Press TAB or Ctrl + G to go to the graph entry line.

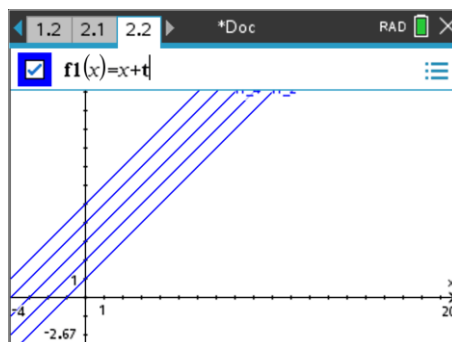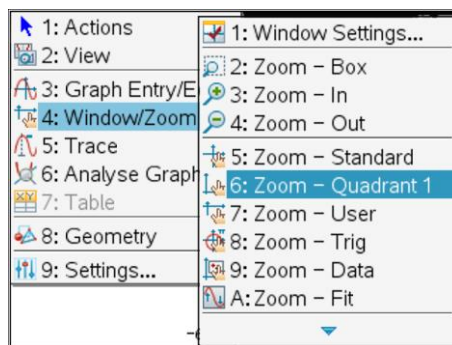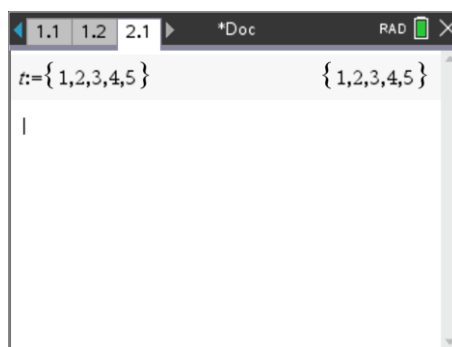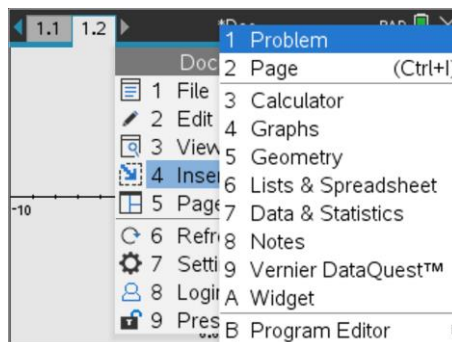Enter the equation: $f_1(x) = x + t$ (See opposite)

The calculator automatically graphs the family of straight lines:

> $y = x + 1$ $y = x + 2$ $y = x + 3$

> $y = x + 4$ $y = x + 5$

The aim of this section is to generate all the graphs in the first problem using a single equation by using a parameter.

Note: The parameter: *t* has been defined and appears bold.

Author: P. Fox

TEXAS INSTRUMENTS

A single equation can be determined to graph all 10 equations by using a parameter (*t*) for the equation number. Study each of your equations and compare with the equation 'number'.

Question: 4.

The general equation is of the form: $y = \dfrac{a}{b}x + c$ where *a*, *b* and *c* are expressions in terms of *t*.

a)   Determine an expression for *a* in terms of *t*.

b)   Determine an expression for *b* in terms of *t*.

c)   Determine an expression for *c* in terms of *t*.

d)   Write down the general equation for the family of straight lines using each of the expressions for t in parts (a), (b) and (c). Verify your equation by substituting a range of values for *t* and comparing with the corresponding original equation.

Return to the Calculator Application (Page 2.1) and define *t* as the set of integers: {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}

Define your general equation in terms of the variable *x* and parameter *t*. The word 'define' can either be typed or by using:
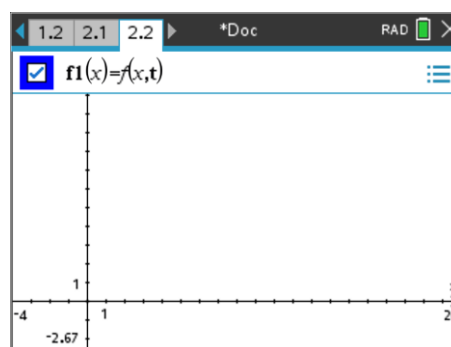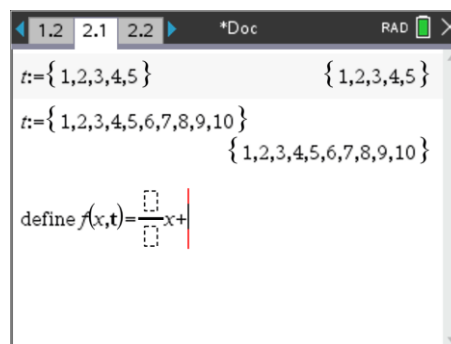
[menu] > Actions > Define

The fraction template can be obtained using Ctrl + ⌗÷⌗

Return to the Graphs application and graph your function:

$$f(x,t)$$

Remember press the TAB key to quickly access the graph entry line.

Question: 5.

Describe the shape and behaviour of the curve formed by the family of straight lines.

Question: 6.

Enter another family of straight lines in: $f_2(x) = f(x, t+10)$

Question: 7.

Enter another family of straight lines in: $f_3(x) = f(x, t-10)$

To get a better view of the family of straight lines it is convenient to zoom out.

[Menu] > Window/Zoom > Zoom Out

The mouse changes to a magnifying glass with a minus sign. Use the navigation pad to move the cursor to the desired centre of the screen and then click by pressing on the centre of the navigation pad.

TEXAS
INSTRUMENTS