Trial and Improvement

Teacher Notes

Introduction

The mathematical aim of this activity by Chris Olley is for students to use a trial-and-improvement method to find the roots of a quadratic function. The TI-Nspire is used to calculate and tabulate possible solutions. Drawing the graph of the function reveals the existence of two roots and the tabulated solutions are also plotted as a scatterplot, producing multiple representations.

Very basic TI-Nspire tools are used which makes the activity suitable for new users of the technology. At the end of these notes several extra facilities are suggested which will allow students to gain further insights.

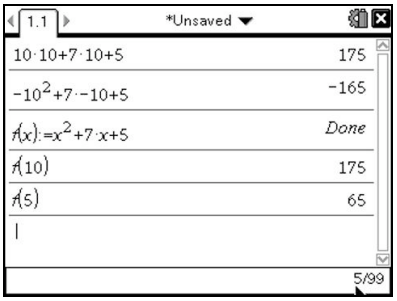
There is no pre-written tns file associated with this activity so start with a new blank document.

Starter Activity

When does $x^2 + 7x + 5 = 0$?

On a new calculator page try a couple of possibilities.

e.g. Try x =10,
10x10 + 7x10 + 5
get 175 no use!



How could you improve on this process?

On the calculator page define the function: $f(x) := x^2 + 7x + 5$
(Press ctrl var to get :=)

Try $f(10)$, then improve with $f(5)$. Try more.

Main Activity

Open a new Lists & Spreadsheet page.
You will need headings for columns A and B for the number to test and the outcome of the test, for example type **number** in column A and **outcome** in column B.
Use the TouchPad to navigate to the space next to the A, type the word **numbe**r, then press enter, etc.

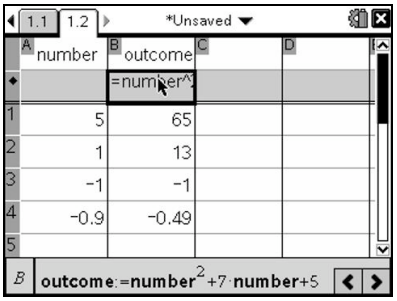
In the space below **outcome** type the function as a formula:
=number^2 + 7·number + 5

Now you are ready to start finding the roots by trial and improvement.

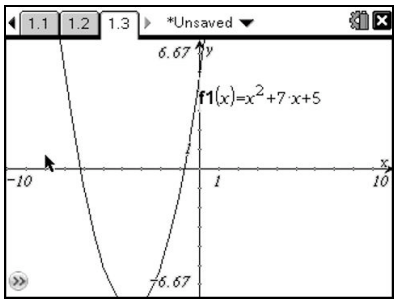
Navigate to cell A1 and try a first guess and press enter.

Now enter an improved guess in cell A2 and press enter.

Students should write down a commentary on how they are choosing their next 'guess' and get more specific as they get close to a solution.



Create a new Graphs page and draw a graph of the function:
type $x^2 + 7x + 5$ into the entry line for f1(x);
press (enter).



Interpret the solution from the first process of trial and improvement referring to the graph.
Notice that there is a second solution and note roughly where it is.

Go back to the spreadsheet page. ((ctrl)◀)
Use trial and improvement to find the second root.
Students should describe how they choose the next 'guess' and describe the accuracy of their solutions.

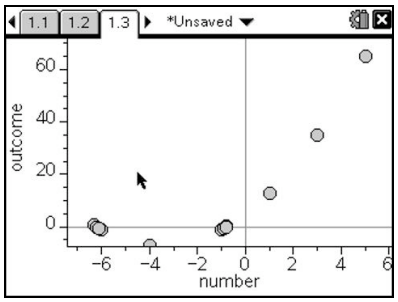
Plenary

When both solutions are found to a suitable level of accuracy, review the function like this.

Create a new Data and Statistics page.
Here you are going to produce a scatter plot using the data entered in the columns of the spreadsheet.
Use the TouchPad to navigate to the bottom where a box appears saying **Click to add variable**.

Click in it, ensure the list called **number** is highlighted and press (enter).

Now navigate to the left hand side of the screen, click in the box, ensure the list called outcome is highlighted and press (enter).

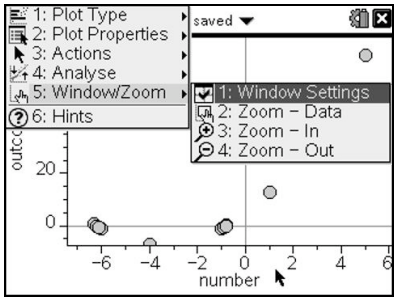


Discuss the shape of the scatterplot and how it was created.
Use this discussion to review the solutions to roots of the equation.

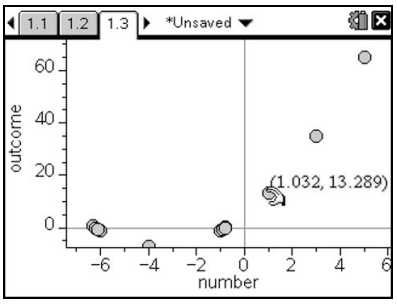
Other TI-Nspire features to explore

Any of the following facilities may provide extra mathematical insights. You may wish to point them out to students during or after the initial activity suggested above.

a) It is possible to zoom in on the scatterplot to see the plotted points converging towards the root. There are various options in the Window/Zoom menu that allow students to do this.

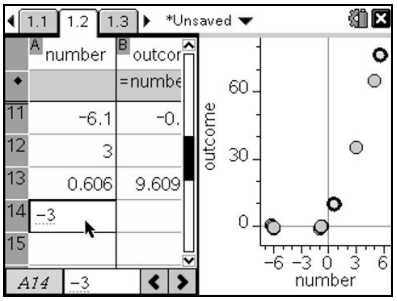


b)
On page 1.4, the Data & Statistics page, try grabbing and dragging any plotted point. You will find that it can only be gragged along the shape of the quadratic.



Why is it constrained like this? – look at what is happening on the spreadsheet page.

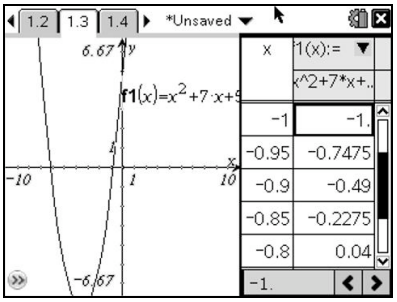
c)
On page 1.2, the Lists and Spreadsheet page, try using the Quick Graph tool (press menu 3 6) to produce the Scatterplot on the same split screen.



To move between the two parts of the screen press ctrl tab

Add an extra number in column A of the spreadsheet and see the point plotted immediately.

d)
On page 1.3, the Graphs page, try using the Show Table tool (press menu 2 9). The settings of the function table may be edited (press menu 5 5) and the roots of the equation explored.



e)
To investigate roots of a different equation you can either start again with a new TI-Nspire "problem" (press doc 4 1) or edit the existing functions.
To do this you must:

- on page 1.2 change the formula at the top of column B
- clear the data in column A (move to the top shaded cell and press menu 3 4)
- on page 1.3 edit the function (press ctrl G to open the entry line and ▲ to display and edit f1).

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