The Warehouse Problem

Teacher Notes

Introduction

This activity asks students to investigate a problem modelled on a real-world situation.
A warehouse is to be constructed to serve three stores. Where should it be located in order to minimise the distance travelled by delivery vehicles.

Thanks to Ron Lancaster, Senior Lecturer of Mathematics Education at the University of Toronto, for the initial idea and introduction to the many approaches to this problem.

Resources

Students start with a new, blank TI-Nspire document. A **worksheet** introduces the problem, suggests some suitable modelling assumptions and guides students, step by step, through the necessary construction. It goes on to consider a series of alternative mathematical models.

There is also a Marking Grid, which you may find helpful in assessing students' completed work.

Skills required

It is assumed that students will be able to carry out the following basic TI-Nspire processes.

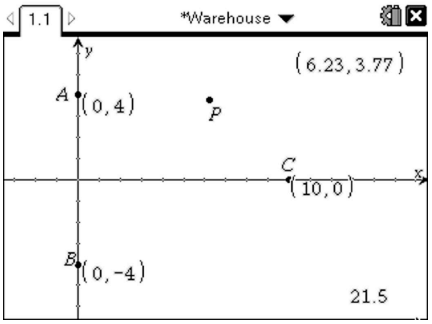
- ✓ Open and save a new .tns document.
- ✓ Use menus to select commands.
- ✓ Use ctrl menu to access contextual menus.
- ✓ Grab and move objects on a Graphs page.
- ✓ Enter text on a Graphs page.
- ✓ Add a new page to an existing .tns document.
- ✓ Draw the graph of a function on a Graphs page.
- ✓ Enter mathematical expressions that include powers and roots.

Other techniques are described in full on the worksheet.

The activity

Construction

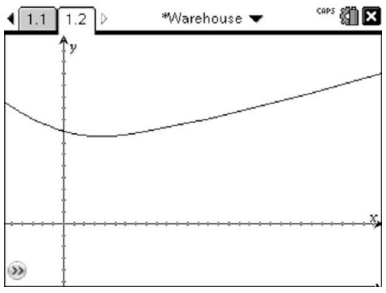
Students are guided, step by step, to create a Graphs page similar to the one shown below.



A, B and C represent the shops and P the warehouse. The coordinates of P are shown top right and the total distance of A, B and C from P is bottom right. Point P may be dragged around in order to find a minimum value for the total distance.

Model 1

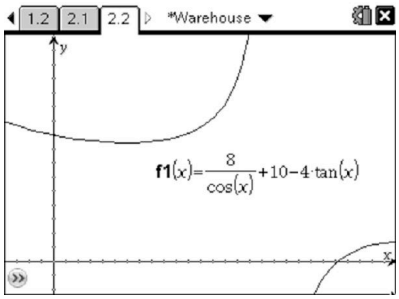
Assuming that the best location for P is on the x-axis at point (x,0), a function for the total distance is formed and its graph drawn on a separate page.



Other positions for A, B and C are considered.

Model 2

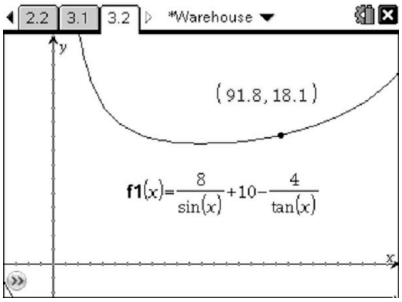
A different approach is tried in which rather than using the position of P on the x-axis, its location is described in terms of angle PAO. This leads to a function with a graph like this.



The two models are compared.

Model 3

This time the location of P is described in terms of angle APO leading to this function and graph.



Model 4

Students are now asked to produce a mathematical model of their own and suggestions made for further exploration. What about non-symmetrical situations? What if there are fewer or more shops?

