Activity description

In this activity, students use linear and quadratic functions to model data. They will also calculate percentage errors.

Suitability and Time

Level 3 (Advanced); 1–2 hours

Resources

Student information sheet, question sheet

Optional: slideshow

Equipment

Calculators
Optional: graphic calculators

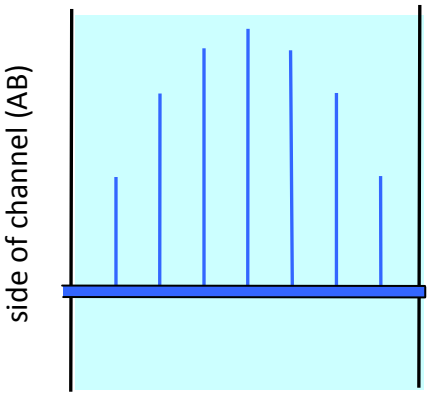
Key mathematical language

Linear, quadratic, percentage error, geometric transformation.

Notes on the activity

The 'Water flow' package includes an information sheet and a set of questions based on it. The data can also be used in other ways.

The slideshow can be used to introduce the context and aid class discussion. One slide shows the progress of the dye along the channel a short time after it is released – see diagram on the right. A sketch of this type could be discussed with students before they are asked to work on the data provided.



Before trying the questions, students need to know how to:

- fit linear and quadratic models to a data set
- describe geometric transformations
- find the equation of a curve after a geometric transformation.

During the activity

Ensure students are aware of the difference between the experimental data and theoretical models they are finding.

Points for discussion

Discuss questions included in the slideshow and student sheets, and others:

- Where in the channel is the water flowing most quickly?
- What is happening to the water at each edge?
- Looking at the diagram, what type of function is likely to provide a good model of velocity against distance?
- How can linear and quadratic functions be found to model data?
- How do you find the percentage error if the model does not match the data?

At the end of the activity discuss the work done and compare methods used.

Extensions

Fit different types of functions to the whole curve, or parts of it. Students could try other polynomials and trigonometric functions, as well as the linear and quadratic functions used in the questions.

Answers

a **Intercepts with x axis:** The velocity is zero at each side of the channel.

Turning point: The maximum velocity of 0.28 ms^{-1} occurs in the middle of the channel, at a distance of 0.4 metres from each side.

bi $u = 1.05x$; **ii** 0.015 ms^{-1}; **iii** 12.5%

ci $a = 1.75$, $b = 0.8$; **ii** 0.0025 ms^{-1}; **iii** 2.08%

di 25%; **ii** 0.16, 0.20, 0.20, 0.16 respectively

ei One way stretch in the u direction with scale factor $\frac{8}{7}$.

ii $u = 2x(0.8 - x)$

iii 0.24 ms^{-1}