Time of death

Teacher Notes

Introduction

Imagine a murder has been committed and the body is cooling. A Crime Scene Investigator (CSI) measures the temperature of the body as 25˚C while the room temperature is 22˚C. One hour later, the body's temperature is 24˚C. Normal body temperature is 37˚C.
The CSI is able to estimate that the crime occurred 1.5 hours previously. How is this done?

A model of this can easily be set up in the classroom with a beaker of luke-warm water representing the body. The class is challenged to find out when the body 'died', i.e. when did the water have a temperature of 37˚C?

Newton's Law of cooling states that an object will cool at a rate proportional to the temperature above the surrounding or ambient temperature. This means that the temperature of the body will decrease exponentially to the ambient temperature. In this activity Exponential Regression is applied to two temperature readings and the resulting function used to show when the temperature must have been 37˚.

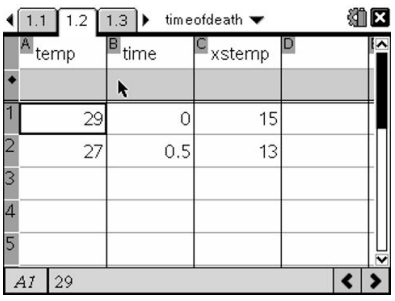
Resources

There is a TI-Nspire document entitled timeofdeath.tns.

The activity

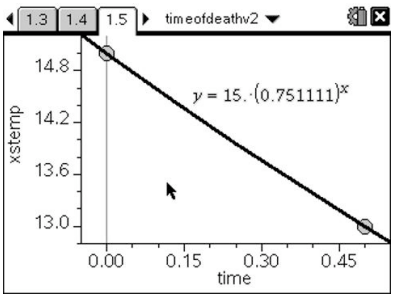
Stage 1

1. Connect an EasyTemp temperature sensor to the TI-Nspire handheld.
2. Select *Meter Only*, press *tab* and *ok*, then note the ambient temperature.
3. Take two temperature measurements of a glass of warm water about half an hour apart. Imagine this is a body cooling from 37°C after death.
4. Subtract the ambient temperature from the two measured values, to give the excess temperature, xstemp.
5. Enter these data on a Lists & Spreadsheets page as shown.



Stage 2

1. Open a Data & Statistics page and plot xstemp against time.
2. The temperature must be decreasing exponentially and even if students do not know exactly what that means they can fit an exponential regression to the two points.
   To do this press menu, select *Analyse/Regression/Show Exponential* and press *enter.*
   It is actually a curve but at this stage will appear to be a straight line.

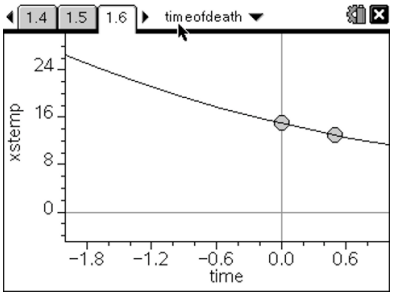


Stage 3

Adjust the window to show a few hours before the first temperature was taken. To do that:

Press *menu*, select *Window/Window Settings* and choose suitable values for the axes.

Now you can see the shape of the curve.



Stage 4

You can estimate the time of death from the Data & Statistics representation by simply estimating the time when the temperature was (37°C–14°C), i.e the initial temperature of the body above the ambient temperature.

However, a better way may be to display the regression function **f1(x)** on a Graphs & Geometry page and change the window settings as above.

1. Put a moveable point on the curve by pressing menu and selecting Points & Lines/Points On.
2. Drag the point back until the xstemp is 23°C (37°C –ambient temperature). N.B. Remember that our zero temperature is now the ambient temperature.
3. Simply read the x-coordinate to find the time of death – in this case 1.49 hours before the first measurement was made.