The Logistic Equation – Information for teachers

This exercise is intended to be used as part of an introduction to modelling a weather system.

The students should be introduced to the fact that in order to forecast the weather it is necessary to gather thousands of items of meteorological data over a vast geographical area.

The accuracy of any future forecast is limited by the accuracy of the data collected (i.e. how far apart are the recording stations are), and by how far in the future the forecast is.

The logistic equation is a chaotic system like the weather. Students will be able to see that a small change in the initial conditions leads to a large change in the future results of the function. This needs to be linked to the weather – if a small change arises in atmospheric conditions, and this is not collected by forecasters because the resolution of their collecting is not small enough, large effects on the future weather could go unpredicted.

The student sheet provides detailed instructions, but below is given some further guidance.

Varying the k value between 2.4 and 3.5 will introduce periodicity in the function. Going beyond 3.5 should be tried, and at around 3.7 some chaotic aspects become apparent.

The next step, to vary x in and out of the chaotic region is important.

Below k=3.5, in the 'normal' region, varying x has small, limited in time effects on the system.

However, repeating this exercise in the chaotic region, say with k=3.75 results in large and unpredictable changes down the line. In non-chaotic, predictable systems, changes in initial conditions do not have the effects they can have in chaotic systems.