Department of Mathematics
Mathematics 3062
Non linear dynamics and chaos
BD/2/2005

PROJECT

Due date – Friday October 21st, 2005

This project is concerned solely with the iteration of the sine map

$$x_{n+1} = f(x_n), \quad f(x) = q\sin(\pi x).$$

Note that I have not indicated the iteration interval or the parameter range. The definition given in the text is that $x \in [0,1]$ and $q \in [0,1]$, since the map is unimodal in this range. Feel free to experiment, and to question the outcome.

Important

This is *not* a regular assignment — it should be regarded as an essay project of $\simeq 2000$ words in length. It must be all your own original work – collusion will not be tolerated. It should integrate your results, including those which stem from the suggestions overleaf, into an essay-style report. This should be illustrated by a judicious selection of computer graphics, and where appropriate, other figures prepared by yourself. Simply presenting masses of computer generated output will not gain credit. Projects which are unnecessarily long may also be penalised.

The marking scheme is given overleaf. Notice that marks are reserved for the originality, adequacy and lucidity of explanation and for the justification of results, not just for treating the marking scheme as a set of questions on an assignment. In addition, there are interesting features of this dynamical system beyond those which have been covered in the lectures/tutorials.

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Marking scheme

1. Presentation and research (20).

2. Theoretical analysis of the simplest bifurcations (5).

3. Analysis of the main period doubling sequence, Feigenbaum scaling (5).

4. Analysis of periodic windows and intermittent behaviour (5).

5. Analysis of chaotic and fractal structures (5).

6. Appropriate use of Lyaunov exponents, Fourier analysis, and other numerical tools (5).

7. Interesting observations beyond those explicitly covered in lectures (5).