Nonlinear Dynamics

PHYS 471 & PHYS 571

Problem Set # 1
Distributed January 8, 2013
Due January 17, 2013

Guidelines: Solutions consisting entirely of computer-generated output will not be graded. Each problem must be accompanied by human-generated text explaining succinctly what the computation is about. Enough information must be given so that a student next year (or yourself in two years) will be able to understand why the calculation was done and will be able to reproduce the results of the computation.

1. Choose your favorite random number generator (uniform random deviates in the interval (0,1)). Construct 10,000 random numbers, and bin them in intervals of length 0.01. Plot this histogram.

2. The standard version of the logistic map is $x' = \lambda x(1 - x)$, $x \in [0, 1]$. Choose λ in the range $3.7 \le \lambda \le 4.0$. Construct 10,000 iterates, and bin them in intervals of length 0.01. Plot this histogram.

3. The standard logistic map is $x' = \lambda x(1 - x)$. Another version is the 'fold map' $y' = a - y^2$. The two are related by a linear transformation of the form $y = mx + b$. Construct this relation explicitly.

Graduate Students: Test the histograms constructed in problems #1 and #2 for 'uniformity.' Use a χ^2 test and give a statistic indicating the confidence with which you reject, or fail to reject, the hypothesis that the distribution is uniform. If you feel like becoming a 'hero of the graduate program' use some other even more powerful statistical test (you can find some in *Numerical Recipes*.