Lab 2: Information

DUE: Monday, October 20, online on Blackboard by 2pm.
(Your report should be in Word format with a *.doc or *.docx extension.)

In this lab you will investigate the information content of the "symbolic dynamics" of the logistic map and of Portland weather..

1. Download "Lab2 information-content.nlogo" from the class web page. Open it in the same directory in which you downloaded Netlogo. The symbolic dynamics is calculated as follows: At each time step in the logistic map, whenever x_t is less than 0.5, a "0" is output; otherwise a "1" is output
    a. For each of R=2.0, 3.1, 3.49, 3.52, 4.0 (five different values),
        i. Set x_0 to 0.2
        ii. Repeatedly click "go" until the x_t value has settled to a single value, an oscillating value, or is chaotic (doesn't settle down to a pattern).
    b. In your lab report, for each of these values of R, record the symbolic dynamics (the string of 0s and 1s in the output window), the probabilities of 0 and 1, and the final value(s) of information content. Do your own calculation of Shannon information content using these values (from start to where you stopped), showing your work, and see if it agrees with the Netlogo model's results.
    c. Which values of R yields the highest information content, and why? Do you think this information content measure is a good measure of the complexity of the behavior of the logistic map? Why or why not?

2. Using weather data for Portland from 1941-2007 calculate the probability of a rainy day during the month of Oct: and the probability of a rainy day during the month of Dec.[data you need can be found here: http://www.wrcc.dri.edu/htmlfiles/or/or.01.html]. (A rainy day is defined as a day with > 0.01 inches of precipitation).
    a. What is the average information content per day that the Portland climate gives us about rain or not in a typical Oct.? In a typical Dec.? How do these numbers compare? Is there anything different you can say about them? Show your work.
    b. Use the following website to look up whether it rained or not in Portland during the first 10 days of Oct. this year (http://www.wunderground.com/history/). We will assume a "trace" of rain (indicated by a T) is NOT a rainy day (i.e. is < 0.01 inches)
    c. Calculate the average amount of information the climate gave Portlanders each day during the first days of Oct. this year (about whether it rained or not), given that the historical averages are the true probabilities.
    d. If the first 10 days of Dec. this year turn out to look the same as the first 10 days of Oct. (in terms of rainy days), how much information on average will the climate give Portlanders each day during the first 10 days of Dec.?
    e. Briefly explain the difference between the information content calculations for Oct. and Dec. using the idea that information is a measure of surprise.

    [Hint: Be sure you are clear on the difference between the average information content of the source (1941-2007 data) and the information in the particular message of a 10 day period this year. And, how they are related.]