

Introduction to Bayesian Data Analysis

Homework 1

This homework assignment is due by midnight of 3/7. Please submit your homework through eeclass. 50% penalty will be applied if it is submitted on 3/8. No submission will be accepted after 3/8.

1. Consider trying to diagnose a rare disease. Suppose that in the general population, the probability of having the disease is only one in a hundred thousand. This is our prior belief that a person selected at random has the disease. Suppose that there are two independent tests for the disease: Test A has a 99% hit rate and Test B has a 90% hit rate. Suppose also that both these two tests have a false alarm rate of 5%.
 - A. (40 points) Suppose we sample a person at random from the population, administer Test A, and it comes up positive. What is the posterior probability that the person has the disease?
 - B. (40 points) Suppose for the same person who received positive result from Test A, we administer Test B, and it comes up positive again. Suppose that these two tests are independent, what is the posterior probability that the person has the disease?
 - C. Now suppose that in the general population, the probability of having the disease is one in a hundred. What will be the answers of the above questions in A and B?
2. (40 points) Consider the following Figure, where a circle is inscribed in a square. If a large number of points are randomly generated in the square, the ratio of the points in the circle to all the points should be $\pi/4$. Please write a Python program to compute the value of π based on this idea. You can set the total number of points to be 10^2 , 10^3 , 10^4 , and 10^5 to compute π , and draw a figure using the exponent of 10 as x value and the estimated π as y value.

