

Bayesian Data Analysis

PHY/CSI/INF 451/551

HW 4w

Show all work

In this Assignment, we explore the application of Probability Theory and Bayes Theorem.

In the following problem, show your work and refer to the rules/principles used in each step (eg. sum rule (marginalization), product rule, Bayes theorem)

1. CS Employment

A particular computer science department produces students who have gone into the following areas of employment:

Computer Programmer: 20%

Software Engineers: 25%

Computer Security: 17%

Network Administrator: 10%

Database Administrator: 15%

Web Developer: 13%

a. Only the Network and Database Administrators take positions where they are in charge of a team of people. What is the probability that a graduating CS student will take a position where they are in charge of a team of people?

b. Google hires 10% of the software engineers and 5% computer security students produced by the department. What is the probability that a graduating CS student will work for Google?

c. Given that a person is a CS graduate that works for Google, what is the probability that this person is a software engineer?

d. A later survey reveals that among Google employees that one third of their computer security employees and one fourth of their software engineers start a family within three years of starting employment. So among the CS graduates at Google, what is the probability that a student will start a family within three years?

The following problems rely on Bayes Theorem

Explicitly list the hypotheses and data involved as well as the prior probabilities and likelihoods.

2. Parts Suppliers

Two different suppliers, A and B, provide a manufacturer with the same part. All supplies of this part are kept in a large bin. In the past, 3% of the parts supplied by A and 7% of the parts supplied by B have been defective. A supplies four times as many parts as B.

Suppose you reach into the bin and select a part, and find it is nondefective.

What is the probability that it was supplied by A?

3. You are a laptop repair person. When a laptop stops working, it is due to a failed power supply 30% of the time. If a laptop's power supply has failed, there is a 45% probability that plugging it in will produce smoke. If a laptop's power supply is OK, but something else is wrong, there is only a 5% chance that plugging it in will produce smoke. A customer brings you a malfunctioning laptop. You plug in the laptop and find that it produces smoke. What is the probability that a smoke-producing laptop has a failed power supply?

4. The blue M&M was introduced in 1995. Before then, the color mix in a bag of plain M&Ms was (30% Brown, 20% Yellow, 20% Red, 10% Green, 10% Orange, 10% Tan). Afterward it was (24% Blue, 20% Green, 16% Orange, 14% Yellow, 13% Red, 13% Brown).

A friend of mine has two bags of M&Ms, and he tells me that one is from 1994 and one from 1996. He won't tell me which is which, but he gives me one M&M from each bag. One is yellow and one is green. What is the probability that the yellow M&M came from the 1994 bag?

5. Crime Scene

A crime has been committed. It is known that the crime was committed by exactly one person and that there are 1000 people who could have committed the crime. In the absence of evidence each of these 1000 people are equally likely to have committed the crime.

A piece of evidence was found that would have a probability of 0.99 of being found if the crime were committed by a particular person, which we shall refer to as A. However, it has only 0.0001 probability of being found if it were committed by anyone else.

Given the evidence, what is the probability that person A committed the crime?