

1. (15 points) Your friend Alice (who lives in New Zealand where it is now spring) likes to go on picnics in the month of November. There is a probability of rain on any given weekend of 20%. If it doesn't rain, the probability that she goes on a picnic is 75%. If it rains, however, the probability that she goes on a picnic is only 5%.
 - (a) Alice tells you that she didn't go on a picnic last weekend and asks you to guess whether it rained weekend? Is it more likely that it rained or that it didn't rain? Show and explain your work.
 - (b) What is the probability that Alice goes on a picnic on any given weekend in November? Show and explain your work. Do you have to calculate this probability in order to answer the previous question?

2. (30 points) Bob walks into a doctor's office and tells the doctor that he has a headache. Around this time of year, 20% of the patients that come to see the doctor have the flu (i.e. influenza). Half of the patients that come to see the doctor have a headache.
 - (a) The probability that a patient who has the flu has a headache is 0.75, and the probability that a patient has a headache (without any other information) is 0.50. What is the probability that Bob has the flu? Show and explain your work.
 - (b) The doctor takes Bob's temperature and finds that Bob has a fever. The probability that a patient who has the flu has a fever is 0.60, and the probability that a patient has a fever (without any other information) is 0.30. Now what is the probability that Bob has the flu? Assume that having a fever and having a headache are conditionally independent given that a patient has the flu. Show and explain your work.

3. (25 points) For this problem, you are to use the Bayes Naive classifier to classify a new instance based on probabilities you will estimate from training data. Instances in this problem have three binary attributes, A, B, and C. The goal predicate (i.e. classification) is either Y or N. You have five examples in the training data:

A	B	C	Goal
0	0	1	Y
0	1	0	Y
0	1	1	N
1	0	0	N
1	0	1	N

You are to estimate probabilities using "m-estimates" with an equivalent sample size of 6 and the following prior probabilities:

	variable		
	A	B	C
P(variable = 0 Goal = Y)	2/3	1/3	1/6
P(variable = 1 Goal = Y)	1/3	2/3	5/6
P(variable = 0 Goal = N)	1/2	5/6	2/3
P(variable = 1 Goal = N)	1/2	1/6	1/3

You should estimate the prior probability for the goal predicate value based solely on the training data.

What is the classification of the example: A=1, B=1, C=0 with the Bayes Naive classifier? Show and explain your work.