Computational Methods in Inverse Problems, Mat–1.3626

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1. A patient with a lump in the breast undergoes a mammography. The radiologist who examines her mammogram believes that the lump is malignant, that is, the result of the mammogram is positive for malignancy. The radiologist's record of true and false positives is shown in the table below:

	Malignant	Benign
Positive mammogram	0.8	0.1
Negative mammogram	0.2	0.9

   The patient, with the help of the internet, finds out that in the whole population of females, the probability of having a malignant breast tumor at her age is 0.5 percent. Without thinking much further, she takes this number as her prior belief of having cancer.

   (a) What is the probability of the mammogram result being positive for malignancy?

   (b) What is the conditional probability of her having a malignant tumor, considering the fact that the mammogram resulted positive?

   (c) What problems are there with her selection of the prior, others than the possible unreliability of internet?

2. A person claims to be able to guess a number from 1 to 10 which you are thinking of. He has a record of having succeeded 8 times out of 10. You question the claim and in your mind assign a certain probability x of him having indeed such gift, but decide to give the poor devil a chance and let him try to guess the number between 1 and 10 that you are thinking. He guesses correctly, but you are still not convinced. In other words, even after his successful demonstration, you still think that he is a swindler and that the probability of such an extraordinary gift is less than 0.5. How low must your prior belief x have been for this to happen?

3. There are two kind of taxicabs in the town, blue and green. of all cabs, 82% are blue, the rest are green. A witness of a hit-and-run accident claims that the escaped taxi was green. When tested in similar conditions that prevailed during the accident, the witness recognized correctly the color of a taxicab in 70% of the cases. Should the jury trust the testimony?