



Bookmarks



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Unit overview

Lec. 2: Conditioning and Bayes' rule

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Lec. 3: Independence

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Problem Set 2

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EXERCISE: BAYES' RULE AND THE FALSE-POSITIVE PUZZLE (4/4 points)

A test for a certain rare disease is assumed to be correct 95% of the time: if a person has the disease, the test result is positive with probability 0.95, and if the person does not have the disease, the test result is negative with probability 0.95. A person drawn at random from a certain population has probability 0.001 of having the disease.

- Find the probability that a random person tests positive.

0.05090



Answer: 0.0509

- Given that the person just tested positive, what is the probability he actually has the disease?

0.01866405



Answer: 0.01866

Answer:

Let A be the event that the person has the disease, and B the event that the test result is positive.

- The desired probability is

$$P(B) = P(A)P(B | A) + P(A^c)P(B | A^c) = 0.001 \cdot 0.95 + 0.999 \cdot 0.05 = 0.0509$$

- The desired probability is

$$P(A | B) = \frac{P(A)P(B | A)}{P(B)} = \frac{0.001 \cdot 0.95}{0.0509} \approx 0.01866$$

Note that even though the test was assumed to be fairly accurate, a person who has tested positive is still very unlikely (probability less than 2%) to have the disease. The explanation is that when testing 1000 people, we expect about 1 person to have the disease (and most likely test positive), but also expect about $1000 \cdot 0.999 \cdot 0.05 \approx 50$ people to test positive without having the disease. Hence, when we see a positive test, it is about 50 times more likely to correspond to one of the 50 false positives.

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