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## 13. Exercise: Bayes' rule and the false-positive puzzle

Exercises due Feb 12, 2020 05:29 IST Completed

Exercise: Bayes' rule and the false-positive puzzle

4.0/4.0 points (graded)

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.

1. Find the probability that a random person tests positive. (This answer will require an accuracy of 4 decimal places.)

0.0509 **Answer**: 0.0509

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

0.0186 **✓ Answer:** 0.01866

## **Solution:**

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

1. The desired probability is

$$\mathbf{P}(B) = \mathbf{P}(A)\mathbf{P}(B \mid A) + \mathbf{P}(A^c)\mathbf{P}(B \mid A^c) = 0.001 \cdot 0.95 + 0.999 \cdot 0.05 = 0.0509.$$

2. The desired probability is

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



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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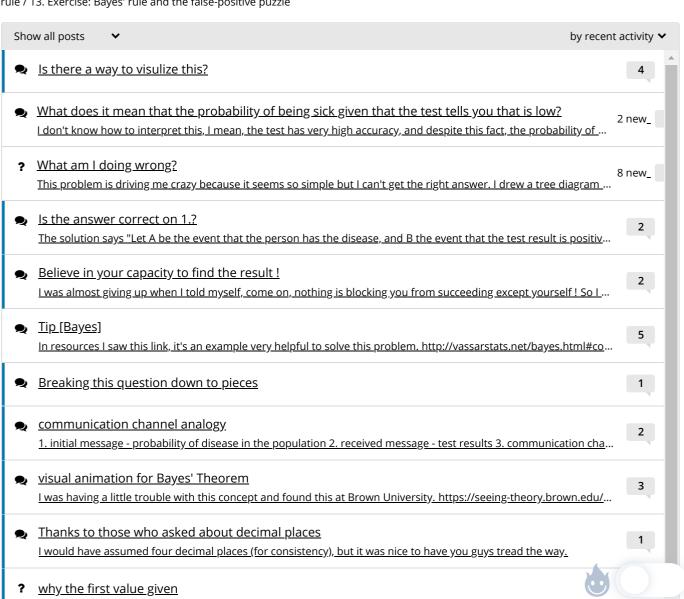
You have used 3 of 3 attempts

**1** Answers are displayed within the problem

## Discussion

**Hide Discussion** 

**Topic:** Unit 2: Conditioning and independence:Lec. 2: Conditioning and Bayes' rule / 13. Exercise: Bayes' rule and the false-positive puzzle



	A test for a certain rare disease is assumed to be correct 95% of the time - why is this given	1
Q	Got it right upto 4 decimals by only using the 'Radar intuition' (didn't even have to look up Bayes Rule!) <spoiler alert:="" answers="" but="" here,="" hints="" no=""> Honestly! I just drew out the tree - has disease, no disease, tests</spoiler>	1
2	Doesn't state precision on 2nd question, so I got it wrong  I nut the second question as a fraction(as it didn't state precision) and got it wrong ( Don't make the same mistak	2

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