Section 2.7: Bayes' Rule

Thursday, January 24, 2019 3:07 PM

suppose you know $P(A)$, $P(B|A)$, and $P(B|\bar{A})$, but you want to know $P(A|B)$ instead. How do you do it?

- there's a single calculation which I will detail at the end of the section
- but drawing the tree diagram is a much easier approach

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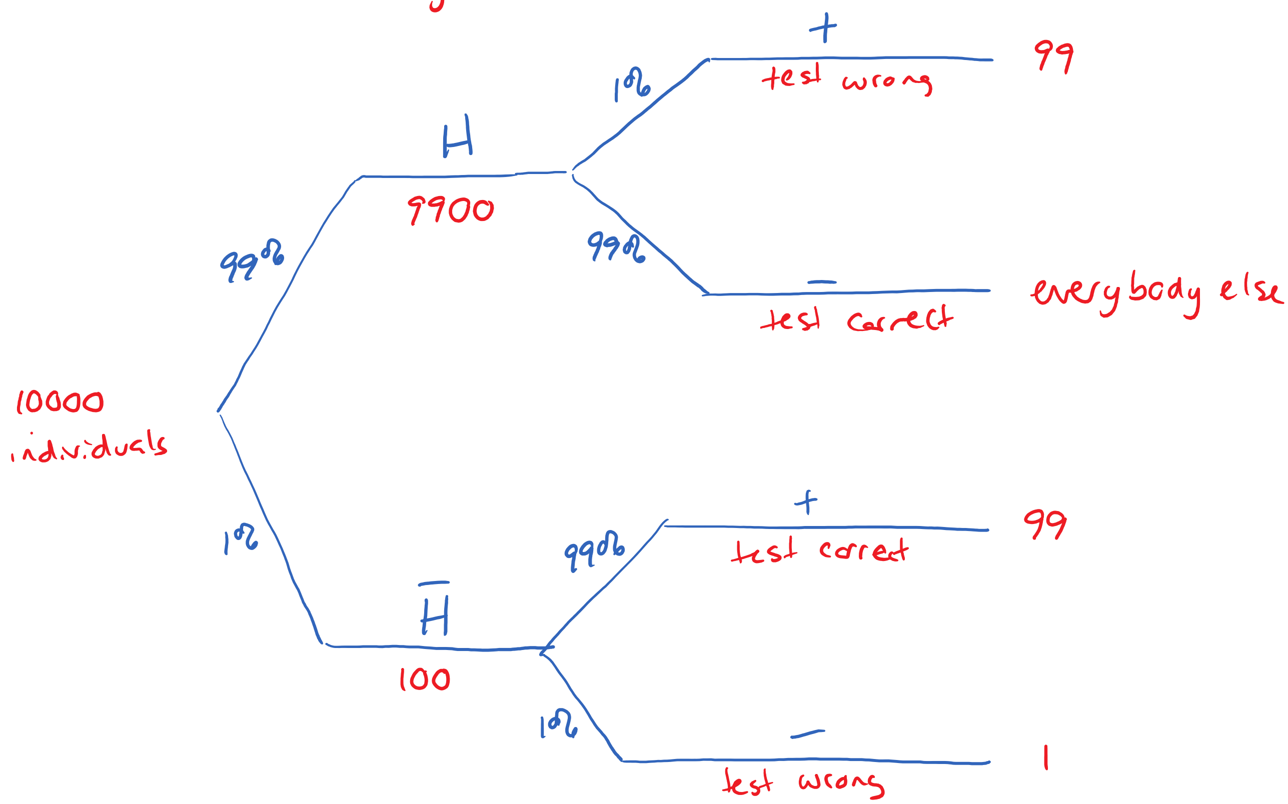
example: The test for a rare disease has 99% reliability. Only one percent of the population has this rare disease.

If the entire population is tested, then some who are healthy will have the test be positive (false positive) and some who have the disease will test negative (false negative).

→ If an individual test positive, what is the probability that they actually have the disease?

hint: if you prefer, consider the population to be 10,000 individuals and determine how many individuals fall into each group

let H = healthy
$\bar{H}$ = has disease
$+$ = test says have disease
$-$ = test says don't



→ question is: if an individual tests positive, what is the probability that they actually have the disease?

$$P(\bar{H} \mid +) = \frac{n(\bar{H}\,+)}{n(+)} = \frac{99}{2(99)} = \frac{1}{2} = 50\%$$

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theory : (single calculation)

$$P(A|B) = \frac{P(AB)}{P(B)}$$

← how did we get this?

$$= \frac{P(B|A)\,P(A)}{P(B|A)P(A) + P(B|\bar{A})\,P(\bar{A})}$$

in general:

$$P(A_i|B) = \frac{P(B|A_i)\,P(A_i)}{\sum P(B|A_i)\,P(A_i)}$$