

Quiz 3

ECEn 370

Name: _____

1. Consider a forensic "paraffin test" used to determine if an individual has recently (e.g. in the past day) fired a gun. This tests for gunpowder residue on the hand.

A = Event that the test indicates a person has fired a gun.

B = Event that the person has fired a gun.

Assume that $P[A|B] = P[A^c|B^c] = 0.96$, i.e. probability of true positive and negative test results respectively. Assume $P[B] = 0.002$ in the general population, i.e. two in a thousand people have fired a gun in the last day. (In Utah during Sept.-Nov. this is much higher due to hunting season.)

- a) Find $P[B|A]$ (the probability a randomly selected person who the test says has fired a gun actually did). (Hint: use Bayes theorem. Recall $P[A|B^c] = 1 - P[A^c|B^c]$)

See example 1.7-2 from the text:

Applying Bayes' rule:

$$\begin{aligned} P[B|A] &= \frac{P[A|B]P[B]}{P[A|B]P[B] + P[A|B^c]P[B^c]} \\ &= \frac{(0.96)(0.002)}{(0.96)(0.002) + (0.04)(0.998)} \\ &= 0.0459 \end{aligned}$$

This is terrible!

- b) What does this say about the reliability of convicting a person for a shooting crime using the paraffin test as the determining evidence?

A randomly selected person who tested positive has only a 4.6% chance of actually having shot a gun! This test can only be used as a slight help in confirming an arrest based on other strong evidence. It cannot be used as the basis for an arrest.