

MATH 123 Homework Section 17 False Positive – False Negative

Show all work and setups. Creating probability tables for each problem would be helpful. Respond using complete sentences when appropriate.

1. A dog allergy test for people has a 98% accuracy rate. Only 1% of the population has an allergy to dogs (actually it is much smaller than that!). Fill in the table by choosing a sample population, then answer the questions below (see your notes if you are not sure how to do this).

	Test Shows Positive	Test shows Negative	Total
Has Allergy			
Not Allergic			
Total			

- a. If you have a dog allergy, what is the probability you will test positive?
- b. If you tested positive, what is the probability you have a dog allergy?
- c. If you tested negative, what is the probability you have a dog allergy?
2. Suppose .01% of the residents of a city with 1 million people are terrorists. The city buys facial recognition software that can identify these terrorists with 99% accuracy.
- a. If the police receive a 'hit' on a recognized face, what is the probability that it was a false positive?
- b. If you are a terrorist, what is the probability that the software will recognize you?

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3. Polygraph tests have an accuracy rate of about 90% meaning it will detect 90% of people who lie and 90% of people who are telling the truth. A company of 5000 employees has everyone submit to a polygraph test. It turns out there are 50 employees who will lie during their polygraph. If someone does not pass their polygraph test, what is the probability they lied (*a table may help with this*)? Write a paragraph about your analysis.

	Test shows lie	Tests shows not lying	Total
Lie			
Don't Lie			
Total			

4. The Center for Disease Control and Prevention estimates the number of persons aged 13 and older living with HIV is 1.2 million. Assume the US population aged 13 and older is 300 million. The test for HIV has an accuracy rate of 99%. If someone tests positive for HIV, what is the probability they actually have HIV? Write a paragraph explaining your findings. (Hint: Set up a table of possibilities to find the number of expected positive test results, true positives, and false positives.)

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5. Read the following article regarding genetic testing for breast cancer indicators. One of the companies offering the BRCA gene testing is Quest, and this company claims a 99% accuracy rate. Use the information from the article and this accuracy rate to determine the likelihood someone has the BRCA mutation if they test positive.

	Tests Positive	Tests Negative	Total
Mutation			
No Mutation			
Total			

NewScientist

How was Angelina Jolie's breast cancer risk calculated? -- 16:05 15 May 2013 by Tiffany O'Callaghan

Yesterday Angelina Jolie shared her experience as a carrier of a *BRCA1* genetic mutation that confers a very high lifetime risk of developing invasive breast cancer. *New Scientist* spoke to breast cancer specialist Allison Kurian, of Stanford University in California who has developed a tool that enables women to determine how different treatment options can reduce their overall risk.

For carriers of a *BRCA1* mutation, the lifetime risk for invasive breast cancer is 65 percent. What is that based on?

It's based on very large studies of thousands of women. When we're counseling people, we give them average numbers because they're the most robust.

Angelina Jolie said her lifetime risk was 87 per cent, where did that figure come from?

That 87 per cent number is from some of the earlier studies. The *BRCA1* and *BRCA2* genes were discovered in the mid-90s and the earliest research mostly studied very striking families who came to doctors because everybody had cancer. When you look at those families, you're going to make a very high estimate of risk. But then when you do bigger studies, the average risk is lower.

So that 87 per cent figure is probably not a calculation of her personal risk?

I am not involved with her care, but I doubt it's a personal assessment. I see that number often and in general think of it as coming from slightly older, smaller studies. Most of us in this field tend to use the newer numbers from the larger studies.

From that 65 percent average, what makes an individual carrier of a *BRCA1* mutation more or less likely to get breast cancer?

That's the million-dollar question. There's great interest in understanding why one person with a *BRCA1* mutation might develop cancer in their 30s whereas another might never get cancer at all.

But if a woman has a *BRCA1* mutation and most of her relatives have developed very early breast cancer, I worry about her a little bit more than a woman in a family with a *BRCA1* mutation where, for whatever reason, they don't seem to have as many cancers.

Is there a way to accurately calculate someone's individual lifetime risk of developing invasive breast cancer?

I don't think we're quite there yet. The BRCA decision tool we developed makes the average estimate based on large numbers, because that is the safest thing to do.

The tool then compares different options a person might choose. For example, one might choose preventive mastectomy, like Angelina Jolie did; other women might choose a very intensive screening strategy. Our tool helps to compare those different options and what they would provide in terms of survival and quality of life.

Angelina Jolie wrote in *The New York Times* that her double mastectomy cut her risk of getting breast cancer to 5 percent. Is that typical of women who undergo this procedure?

That would be about right. Most of the studies estimate that whatever a person's risk might be, the surgery will reduce that risk by 90-95 per cent. If her risk was about 65 percent you're going to get down to a single digit number.

Not everyone currently has access to – or can afford – BRCA screening tests. Do you think they should be offered to all women?

I'd certainly like to see expanded access to healthcare of all kinds. But I don't think that every woman needs to be tested for BRCA mutations because they're rare. On average, if you pull people in off the street, about one in 400 would carry a BRCA mutation. But I think when there are red flags – like early breast cancer, multiple breast cancers, ovarian cancer or male breast cancer – all of those families should be offered genetic testing.

As a geneticist specializing in breast cancer, were you glad to see Angelina Jolie share her experience of being someone with a *BRCA1* mutation?

Absolutely, I think she was extremely courageous. I think it greatly increases the opportunity that we would diagnose people who are at high risk and offer them life-saving interventions. I'm very impressed; it's a very generous thing to do.

Source: <http://www.newscientist.com/article/dn23545-how-was-angelina-jolies-breast-cancer-risk-calculated.html>