

Complete the following tasks. You need to show work for full credit. In particular, for integrals, you may use resources like *Wolfram Alpha* to check your answers, but you need to show your work during Math 32 written homework and exams. Some answers have been provided. Assemble your work into one PDF document and upload the PDF back into our CatCourses page.

1. This data came from a pre-employment drug screening.

	Positive Test Result (drug use is indicated)	Negative Test Result (drug use is not indicated)
Subject Uses Drugs	44 (true positive)	6 (false negative)
Subject is Not a Drug User	90 (false positive)	860 (true negative)

- (a) **False positive** Find the probability of selecting a subject with a positive test result given that the subject does not use drugs.
- (b) **False negative** Find the probability of selecting a subject with a negative test result given that the subject uses drugs.
2. In the state of California, 50.3% of residents are female. The probability that a resident develops breast cancer, given that she is female, is about 0.0833. The probability that a resident develops breast cancer, given that he is male, is about 0.001. Calculate the probability that a California patient is female, given that the patient was diagnosed with breast cancer.¹ Use a calculator to get an answer in decimal form.
3. In a quick audit of the tiered deployment of the Covid-19 vaccines in the state of California, the probability that a person has received a vaccine shot given that the person is elderly is 70 percent, whereas the probability that a person has received a vaccine shot given that the person is not elderly is 2 percent.² The proportion of Californians who are elderly is 0.111. Compute the probability that a person is elderly given that the person has received a vaccine shot.

¹Sources: http://www.breastcancer.org/symptoms/understand_bc/statistics and <http://quickfacts.census.gov/qfd/states/06000.html>

²Values loosely based on <https://www.mercurynews.com/2021/02/22/where-you-live-matters-significant-variation-in-covid-vaccination-rates-for>

4. **DUI Checkpoint** A breath analyzer, used by the police to test whether drivers exceed the legal limit set for the blood alcohol percentage while driving, is known to satisfy

$$P(A|B) = P(A^c|B^c) = x$$

where A is the event “breath analyzer indicates that legal limit is exceeded” and B “driver’s blood alcohol percentage exceeds legal limit.” On Saturday nights, about 5% of the drivers are known to exceed the limit.

- (a) Describe in words the meaning of $P(B^c|A)$
- (b) Determine $P(B^c|A)$ if $x = 0.95$
- (c) How big should x be so that $P(B|A) = 0.9$?

5. A tattoo enthusiast website³ claims that

- 47% of Millennials have tattoos
- 36% of Generation X have tattoos
- 13% of Boomers have tattoos

whereas the population proportions are 22%, 20%, and 22% for those generations respectively.⁴ Compute the probability that a person is a Millennial given that they have tattoos. (For homework brevity, let us assume that no one in other age groups have tattoos.)

6. A popular video game company sent their futuristic product to a couple of quality control operations in Arstotzka (Q_A) and Stardew (Q_S). The proportion of biomes sent to Arstotzka is 0.32, and the rest went to Stardew. Given that the biome was sent to Arstotzka, the probability that the quality control operation finds a bug is 13 percent. Given that the biome was sent to Stardew, the probability that the quality control operation finds a bug is 55 percent. Compute the Bayesian odds of Q_A to Q_S given that a bug was found.⁵

³Source: https://www.reddit.com/r/todayilearned/comments/dwy925/til_47_of_millennials_ages_18_to_29_have_tattoos/

⁴Source: <https://www.statista.com/statistics/797321/us-population-by-generation/>

⁵This was an exam question during the Spring 2021 semester

Some answers

1.

(a) $90/950$

(b)

2. 0.9883

3. 0.8138

4.

(a)

(b) 0.5

(c) 0.9942

5. 0.5069

6. 0.1112