



SCHOOL OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF DATA SCIENCE AND ANALYTICS
FALL 2024 – QUIZ 1

COURSE CODE: STA 4030A

UNIT NAME: BAYESIAN INFERENCE AND DECISION THEORY

DATE: 17TH SEPTEMBER 2024

TOTAL MARKS: 20 MARKS

INSTRUCTIONS:

For this exercise:

1. ANSWER ALL QUESTIONS
2. Do all your working in the Rmarkdown (.rmd).
3. Submissions should be in a **`.rmd` file**
4. NO SUBMISSIONS SHOULD BE DONE VIA EMAIL

QUESTIONS:

1. Marjorie is worried about whether it is safe to visit a vulnerable relative during a pandemic. She is considering whether to take an at-home test for the virus before visiting her relative. Assume the test has sensitivity 85% and specificity 92%. That is, the probability that the test will be positive is about 85% if an individual is infected with the virus, and the probability that test will be negative is about 92% if an individual is not infected.
 - a. Assume that about 2 in every 1,000 people in the population are currently infected. What is the posterior probability that an individual with a positive test has the disease?
 - b. Suppose case counts have decreased substantially to about 15 in 100,000. What is the posterior probability that an individual with a positive test has the disease?
 - c. Comment on your results.

2. Assume the following losses for Marjorie:

– Visit relative, not infected	loss = 0
– Visit relative, infected	loss = 100
– Does not visit relative, not infected	loss = 1
– Does not visit relative, infected	loss = 5

Suppose Marjorie is deciding whether to visit her relative and if so whether to test the disease before visiting. If the prior probability that Marjorie has the disease is 200 in 100,000, find the policy that minimizes expected loss. That is, given each of the possible test results, should Marjorie visit her relative? Find the EVSI. Repeat for a prior probability of 15 in 100,000. Discuss.

3. For the decision of whether Marjorie should visit her relative, find the range of prior probabilities for which taking the at-home test results in lower expected loss than ignoring or not taking the test (assuming the test is free). Discuss your results.