**ETGG 4803 Probability Assignment (50 points)**

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**Answer the following questions in the space provided. *Show all your work and carefully explain your answers*. You may work with *at most* two other people or you may work alone if you like. Put the names of each group member and submit just one copy per group.**

1. Suppose *M* and *E* are events. Use Bayes’s Theorem to calculate the following probabilities.

a. If **Pr**(*M*) = 0, then **Pr**(*M* | *E*) = 0.

b. If **Pr**(*M*) = 1, then **Pr**(*M* | *E*) = 1.

c. Parts **a** and **b** are called *Cromwell’s Rule*.Explain in English the meaning (or ramifications) of Cromwell’s Rule.

Given the evidence with the probability of the hypothesis; if the probability of the hypothesis is forced to be either 0 or 1, no matter how strong, no evidence can have any influence.

1. Suppose a statistical test is developed to test for a particular disease.
2. Complete the following table.

|  |  |  |  |
| --- | --- | --- | --- |
| **Sensitivity** | **Specificity** | **Rate of disease** | **Pr(**Illness | + test**)** |
| 99% | 99% | 0.5% | 0.332 |
| 99.5% | 99% | 0.5% | .33333 |
| 99% | 99.5% | 0.5% | .498741 |
| 99% | 90% | 0.5% | .0473911 |
| 90% | 99% | 0.5% | .311419 |
| 90% | 90% | 0.5% | .0432692 |
| 80% | 80% | 25% | .571429 |
| 99% | 99% | 25% | .970588 |

1. If you test positive for a disease, under what conditions should you feel fairly certain you actually have the disease? Under what conditions should you feel fairly certain that you do not have the disease? Give conditions in which the probability that you have the disease is 0.5.

The higher the specificity compared to the sensitivity accounting to the rate of true positive tests, the higher your probability of having the disease is.

1. A game is being played between E and O. In the game, a fair six-sided die is rolled. If the number showing is even, then E gets a point. If the number showing is odd, then O gets a point. The first player to 7 points wins the pot. The players add to their bets with each roll, so the pot gets larger with each roll. Unfortunately, the game is interrupted with E winning 4 – 2. The players decide to split the pot based on each individual’s probability of winning had the game continued. Suppose there was $100 in the pot when the game was interrupted.How much should each player receive? Convince me.

**E** would get $77 and **O** would get $23

The probability is based on the number of possibilities of rolling 3 total E’s or 5 total O’s multiplied by 1 / 2^number of rolls to get to that point.

1. A company has three programmers on a team. Person *A* produces 20% of the code but 5% contains errors. Person *B* writes 30% of the code with 3% containing errors. Person *C* creates 50% of the code with a 1% error rate.

To calculate Total error of overall code, multiply each persons’ amount of code written by the percentage of error in their code, and add all the values together.

1. What percentage of the code overall contains an error?

(20% \* 5%) + (30% \* 3%) + (50% \* 1%)

= (.2\*.05) + (.3\*.03) + (.5\*.01)

= .01 + .009 + .005 = .024

= 2.4% Code Error Overall

1. Suppose we find an error somewhere in the code.

Error for person = (Percentage Code Written \* percentage of code written contains errors) / Code error overall

1. What is the probability that it was created by Person *A*?

20% \* 5% / 2.4% = (.2 \* .05) / .024 = .01 / .024 = .416 = 41.6%

41.6% chance its person A’s code that is the error

ii. What is the probability that it was created by Person *B*?

30% \* 3% / 2.4% = (.3 \* .03) / 0.024 = .009 / .024 = .375 = 37.5%

37.5% chance its person B’s code that is the error

1. What is the probability that it was created by Person *C*?

50% \* 1% / 2.4% = (.5 \* .01) / .024 = .005 / .024 = .2083 = 20.83%

20.83% chance its person C’s code that is the error

1. You are captured by a particularly unfriendly group who happens to like torturing their captives with brain teasers. Two bowls of marbles are placed in front of you, one containing 50 red marbles and one containing 50 green marbles. You are allowed to move some marbles between the bowls as you wish. (You cannot remove any of the marbles by putting them in your pockets, eating them, or otherwise disposing of them.) After you have finished moving marbles around, you will be blindfolded. Your captors will then thoroughly mix each bowl, swap them left to right, and spin you several times. You then get to select either the bowl on your left or the bowl on your right, then reach in and take out one marble. If the marble is green, then you will be released. If you pick a red marble, then you will be given the dreadful disease from Question #1.
   1. Describe your plan for giving yourself the best chance of being released disease free.

Given the two bowls, move 49 of the green marbles into the same bowl as the red marbles. This gives you a 50/50 chance to pick the correct bowl. Where one bowl has 50 red and 49 green, and the other bowl has 1 green.

If the pick the bowl with a single green marble, then you win automatically. However, if you pick the bowl with the 50 red and 49 green marbles then your chances of winning are a little less than 50%, however your total chances of failure are about 26%.

* 1. What is the highest possible probability of freedom that you can guarantee?

The Highest chance for freedom you can guarantee is about 75%.

The reason being is that if you move 49 of the 50 green to the same bowl as the bowl of all red. Then you have a 50/50 chance of getting a guaranteed win if you pick the bowl with the single green marble, and if you pick the bowl with the 50 red and 49 green, your chances of winning are 49 to 50 or 49/99. Your total chances of success are about 74% and your failure chances are about 26%.