*Problem Part I*

For a given part of a road:

1. If a road is closed, 80% the time the driver avoids it.
2. If a road is not closed, 5% of the time the driver avoids it.
3. Roads are closed 0.1% of the time.

If the driver avoids the road what is the probability that it is closed?

*Solution Part I*

It turns out this is a simple problem involving conditional probability. Let’s name two

events, A and B, as follows:

Event A = {“The road is closed.”}

Event B = {“The driver avoids the road.”}

From the given information, we know that

“The probability of B given A is 0.8.”

“The probability of B given A-compliment (not A) is 0.05.”

“The probability of A is 0.001.”

We want to find

“The probability of A given B, the road is closed knowing that a driver avoided it.”

The fundamental equation we use in this problem is

In words, it means that if we know B happened, the probability of A can be expressed as the probability of (both A and B) divided by the probability of B. Intuitively it makes sense, but Wikipedia’s “Conditional Probability” can probably explain it better than I can.

Anyway, using this equation (the variables are interchanged) we have

“The probability that the driver avoids the road and the road is closed is 0.008” and

“The probability that the driver avoids the road and the road is not closed is 0.049”.

Now we can find

“The probability that the driver avoids the road is 0.057”.

Finally, making use of our original equation again, we have

Thus, *if a driver avoids a road, the probability that it is closed is only about 15%*. This is because we have a lot of drivers avoiding roads that are not closed.

*Problem Part I*

A 15% chance is not good enough for us to accurately decide if the road is indeed closed. How do we improve our chances of making the correct decision? We do have data from multiple cars, so what is the probability that the road is closed if

2 cars avoid the road?

3 cars avoid the road?

5 out of 6 cars avoid the road?