Use the following notation of events

S- Message is spam

Hs- Spam message is blocked by high security mode

Ls – Spam message is blocked by low security mode

HNS – Non spam message is blocked by high security mode

LNS – Non-spam message is blocked by low security mode

H- message is blocked by high security mode

L- message is blocked by low security mode

Mathematically expressing the probabilities in the problem, we have

P(S) = 0.80

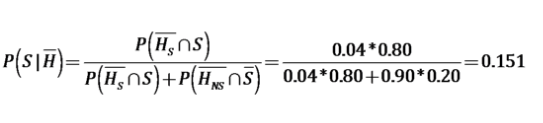
P(Hs) = 0.96

P(Ls) = 0.90

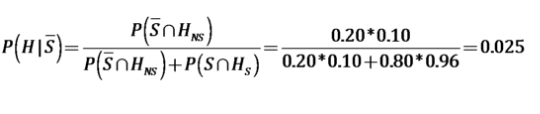
P(HNS) = 0.10

P(LNS) = 0.04

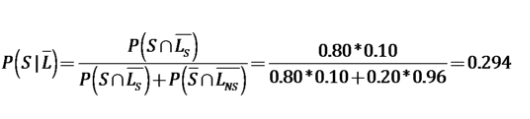
1. Let denote the conditional probability that a message that is not blocked by the spam filter operating in the High-Security-Mode is actually a spam message. Estimate .



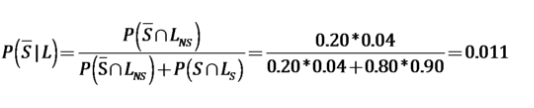
1. Let denote the conditional probability that a message that is blocked by the spam filter operating in the High-Security-Mode is actually not a spam message. Estimate .



1. Let denote the conditional probability that a message that is not blocked by the spam filter operating in the Low-Security-Mode is actually a spam message. Estimate .



1. Let denote the conditional probability that a message that is blocked by the spam filter operating in the Low-Security-Mode is actually not a spam message. Estimate .



1. If the cost of not blocking a *spam* message is $1 and the cost of blocking a *non-spam* message is $10, should the organization operate the spam filter in the High-Security-Mode? Why?

No, they should not operate the spam filter in the High Security Mode because of the high cost implications. Cost of blocking a non spam message is $10, considered to be high and blocked percentage 10% which is higher than Low Security Mode. Another factor to consider is critical mail taken to be spam. As per organization estimates getting only 20% emails are not as spam message, higher mode blocked such valid emails is 10% so high. The organization can loose any important email blocked by higher mode.

1. Recall that the cost of not blocking a *spam* message is $1. At least how high should the cost of blocking a *non-spam* message be for a risk-neutral rational decision maker to prefer operating the spam filter in the Low-Security-Mode?

During Low Security Mode the organization mainly used a software to block spam emails, as per Low Security Mode it is blocking only 90% when we compare to high mode, it gives low percentage, even though it is blocking non spam message at the rate of 4% which is very low to high mode, $4.

1. Let be the amortized cost per message of operating the spam filter. Write a short memo the CIO of the organization explaining at most how high could be for the organization to use the spam filter with the specified performance?

To: CIO

From : Chief Data Scientist

Subject : Spam Filter Modes and Impacted Performance

Date: 10/03/2016

I am sending you this memo to explain the difference between the performance of the spam filter’s operational mode, the impact that the modes have and the mode I recommend that we should use. The spam filter has two modes of operation, these are, high and low mode. The high mode has a higher percentage of blocking non-spam messages and low mode has a reduced percentage of blocking non-spam messages.

I strongly recommend operating in the spam filter in the low mode due to the reduced non spam blocking percentage. By selecting the high mode important emails will be lost, in high mode 10% of *non-spam* message are blocked. I believe this percentage is too high. In the high mode 96% of spam messages are blocked which is only slightly higher compared to the lower mode having 90% a difference of 6%. For that 6% value it is better we not loose 10% of our non-spam messages.

I strongly recommend to use the spam filter as low mode.