1. A spam filter is designed by looking at commonly occurring phrases in spam. Suppose that 80% of email is spam. In 10% of the spam emails, the phrase “free money” is used, whereas this phrase is only used in 1% of non-spam emails. A new email has just arrived, which does mention “free money”. What is the probability that it is spam?

Solution:

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Solution 1 :

define events

S = Email is SPAM
N = Email is non SPAM
FM = 'Free Money' used in mail

$P(S) = 0.8$
$P(N) = 0.2$
$P(FM|S) = 0.1$
$P(FM|N) = 0.01$

We have to find $P(S|FM)$ that is email is SPAM when FM is used

$$P(S|FM) = \frac{P(FM|S)P(S)}{P(FM|S)P(S) + P(FM|N)P(N)}$$

: bayes Theorem

$$= \frac{(0.1)(0.8)}{(0.1)(0.8) + (0.01)(0.2)}$$

$$= \frac{0.08}{0.082} = 0.975$$