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?

Let S be the event that an email is spam and F be the event that an email has

the “free money” phrase.

By Bayes’ Rule,

P(S|F) = P(F|S) P(S) / P(F)

= 0.1 · 0.8 / 0.1 · 0.8 + 0.01 · 0.2

= ( 80/1000 ) / ( 82/1000 )

= 80 / 82

= 0.9756.