

### Assignment 7:

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:* 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,

$$P(S|F) = \frac{P(F|S)P(S)}{P(F)} = \frac{0.1 \cdot 0.8}{0.1 \cdot 0.8 + 0.01 \cdot 0.2} = \frac{80/1000}{82/1000} = \frac{80}{82} \approx 0.9756.$$