

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?

- **Given**

- Probability of spam = $P(\text{spam}) = 0.8$

- Probability of not spam = $P(\text{not spam}) = 0.2$

- Probability of phrase 'Free Money' for spam email = $P(\text{free money/spam}) = 0.1$

- Probability of phrase 'Free Money' for not spam email = $P(\text{free money/not spam}) = 0.01$

- **To find** - $P(\text{spam/free money})$

- **Solution**

$$P(\text{spam/free money}) = \frac{P(\text{free money/spam}) * P(\text{spam})}{P(\text{free money/spam}) * P(\text{spam}) + P(\text{free money/not spam}) * P(\text{not spam})}$$

Substituting the values

$$P(\text{spam/free money}) = \frac{0.1 * 0.8}{0.1 * 0.8 + 0.2 * 0.01} = 0.9756$$