

SEC1-FAE1-SIGUE,JP-FAE1

Github: <https://github.com/PatrickSigue/APM1110/blob/main/FAE1/SEC1-FAE1-SIGUE%2CJP-FAE1.md>

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A malicious spyware can infect a computer system through the Internet or through email. The spyware comes through the Internet 70% of the time and 30% of the time, it gets in through email. If it enters via the Internet the anti-virus detector will detect it with probability 0.6, and via email, it is detected with probability 0.8.

```
spyware <- data.frame(detected = c(0.6, 0.8), undetected = c(0.4, 0.2),
                      via = c(.70, .30), row.names = c("Internet", "Email"))
spyware
```

```
##           detected undetected via
## Internet         0.6          0.4 0.7
## Email            0.8          0.2 0.3
```

(a) What is the probability that this spyware infects the system?

*Infect = Undetected

$$P(I) = P(I|Internet) \cdot P(Internet) + P(I|Email) \cdot P(Email)$$

```
prob_infect <- round(.4 * .7 + .2 * .3, 4)

cat("The probability that this spyware infects the system is ",
    prob_infect * 100, "%", sep = "")
```

```
## The probability that this spyware infects the system is 34%
```

(b) If the spyware is detected, what is the probability that it came through the Internet?

*P(D) = 1 - P(I)

$$P(D|Internet) = \frac{P(Internet|D) \cdot P(Internet)}{P(D)}$$

```
prob_detect <- 1 - prob_infect
prob_det_int <- round((0.6 * 0.7)/(prob_detect), 4)

cat("The probability that the spyware detected came from the internet is ",
    prob_det_int * 100, "%", sep = "")
```

The probability that the spyware detected came from the internet is 63.64%

Of the emails you receive 20% are spam on average. Your spam filter is able to detect 90% of them but also misclassifies as spam 15% of the genuine emails.

```
email <- data.frame(correct = c(.90, .85), incorrect = c(.10, .15),  
                    recieved = c(.20, .80), row.names = c("Spam", "Genuine"))  
email
```

```
##           correct incorrect recieved  
## Spam      0.90      0.10      0.2  
## Genuine   0.85      0.15      0.8
```

(a) If an email arrives and is marked spam, what is the probability that it really is spam?

$$P(S|C) = \frac{P(C|S) \cdot P(S)}{P(Spam)} P(Spam) = P(C|S) \cdot P(S) + P(I|G) \cdot P(G)$$

```
prob_spam <- round((.90 * .20 + .15 * .8), 4)  
prob_spam_c <- round(((.90 * .20) / prob_spam), 4)  
  
cat("The probability of an email marked spam that is spam is ", prob_spam_c * 100, "%.", sep = "")
```

The probability of an email marked spam that is spam is 60%.

(b) If an email arrives and is not marked spam, what is the probability that it is legitimate?

$$P(G|C) = \frac{P(C|G) \cdot P(G)}{P(Genuine)} P(Genuine) = P(C|G) \cdot P(G) + P(I|S) \cdot P(S)$$

```
prob_gen <- round((.85 * .80 + .10 * .20), 4)  
prob_gen_c <- round(((.85 * .80) / prob_gen), 4)  
  
cat("The probability of an email marked genuine that is genuine is ", prob_gen_c * 100, "%.", sep = "")
```

The probability of an email marked genuine that is genuine is 97.14%.