APM1110 - FA 3 - Dacanay

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2) A binary communication channel carries data as one of two sets of signals denoted by 0 and 1. Owing to noise, a transmitted 0 is sometimes received as a 1, and a transmitted 1 is sometimes received as a 0. For a given channel, it can be assumed that a transmitted 0 is correctly received with probability 0.95, and a transmitted 1 is correctly received with probability 0.75. Also, 70% of all messages are transmitted as a 0. If a signal is sent, determine the probability that:

(a) a 1 was received;

First, let t1 be the event that a one is transmitted. Second, let r1_t1 be the event that a one is received given that one is transmitted. Thirdly, let t0 be the event that a zero is transmitted. Lastly, let r1_t0 be the event that a zero is transmitted given that zero is transmitted.

```
t1 <- 0.3
r1_t1 <- 0.75
t0 <- 0.7
r1_t0 <- 0.05

p_r1 <- (t1 * r1_t1) + (t0 * r1_t0)
```

ANSWER

```
print(paste0("The probability that a 1 was received is ", p_r1, " or ", p_r1 * 100, "%."))
```

```
## [1] "The probability that a 1 was received is 0.26 or 26%."
```

(b) a 1 was transmitted given that a 1 was received.

In this problem, we'll use all the data provided in Section 2.a. Additionally, we'll include the 'p_r1', which represents probability that a 1 was received.

```
p_t1_r1 <- (t1 * r1_t1) / p_r1
p_t1_r1_rounded <- round(p_t1_r1, 4)
```

ANSWER

```
print(paste0("The probability that a 1 was transmitted given that a 1 was received is ", p_t1_r1_rounded, " or ", p_t1_r1_rounded * 100, "%."))
```

```
## [1] "The probability that a 1 was transmitted given that a 1 was received is 0.8654 or 86.54%."
```

7) There are three employees working at an IT company: Jane, Amy, and Ava, doing 10%, 30%, and 60% of the programming, respectively. 8% of Jane's work, 5% of Amy's work, and just 1% of Ava's work is in error.

(a) What is the overall percentage of error?

Let j be the event of Jane's work percentage, am be the event of Amy's work percentage, and av be the event of Ava's work percentage. Additionally, let j_e be the event of error in Jane's work, am_e be the event of error in Amy's work, and av_e be the event of error in Ava's work.

```
j <- 0.1
am <- 0.3
av <- 0.6

j_e <- 0.08
am_e <- 0.05
av_e <- 0.01



p_e <- (j * j_e) + (am * am_e) + (av * av_e)
p_e_percentage <- p_e * 100
```

ANSWER

```
print(paste0("The overall percentage of error is ", p_e_percentage, "%."))
```

```
## [1] "The overall percentage of error is 2.9%."
```

(b) If a program is found with an error, who is the most likely person to have written it?

In this problem, we'll use all the data provided in Section 7.a. Additionally, we'll include the 'p_e_percentage', which represents the overall percentage of error, as part of our given information.

Let's find out first the percentage of each employee's error given that an error has occurred.

```
# Jane
p_je_oe <- (j * j_e) / p_e
p_je_oe_rounded <- round(p_je_oe, 3)
p_je_oe_rounded_percentage <- p_je_oe_rounded * 100

print(paste0("Jane's error given that an error occurred: ", p_je_oe_rounded,
" or ", p_je_oe_rounded_percentage, "%"))
```

```
## [1] "Jane's error given that an error occurred: 0.276 or 27.6%"
```

```
# Amy
p_ame_oe <- (am * am_e) / p_e
p_ame_oe_rounded <- round(p_ame_oe, 3)
p_ame_oe_rounded_percentage <- p_ame_oe_rounded * 100
print(paste0("Amy's error given that an error occurred: ", p_ame_oe_rounded,
" or ", p_ame_oe_rounded_percentage, "%"))
```

```
## [1] "Amy's error given that an error occurred: 0.517 or 51.7%"

# Ava
p_ave_oe <- (av * av_e) / p_e
p_ave_oe_rounded <- round(p_ave_oe, 3)
p_ave_oe_rounded_percentage <- p_ave_oe_rounded * 100
print(paste0("Ava's error given that an error occurred: ", p_ave_oe_rounded,
" or ", p_ave_oe_rounded_percentage, "%"))

## [1] "Ava's error given that an error occurred: 0.207 or 20.7%"
```

ANSWER

```
# Compare probabilities and print the most likely person
if (p_je_oe_rounded_percentage > p_ame_oe_rounded_percentage &&
p_je_oe_rounded_percentage > p_ave_oe_rounded_percentage) {
  print(paste0("The most likely person to have written a program with an
error, given that a program is found with an error, is Jane with ",
p_je_oe_rounded_percentage, "%."))
} else if (p_ame_oe_rounded_percentage > p_je_oe_rounded_percentage &&
p_ame_oe_rounded_percentage > p_ave_oe_rounded_percentage) {
  print(paste0("The most likely person to have written a program with an
error, given that a program is found with an error, is Amy with ",
p_ame_oe_rounded_percentage, "%."))
} else if (p_ave_oe_rounded_percentage > p_je_oe_rounded_percentage &&
p_ave_oe_rounded_percentage > p_ame_oe_rounded_percentage) {
  print(paste0("The most likely person to have written a program with an
error, given that a program is found with an error, is Ava with ",
p_ave_oe_rounded_percentage, "%."))
} else {
  print(paste0("There is a tie in the error probabilities."))
}

## [1] "The most likely person to have written a program with an error, given
that a program is found with an error, is Amy with 51.7%."
```