Formative Assessment 3

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Question 2

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:
   Given when event:
   0 is received = R_0 = 0.95
   1 is received = R_1 = 0.75
   0 is transmitted = T_0 = 0.7
   1 is transmitted = T_1 = 0.3

*(a) a 1 was received;
$P(R_1) = P(T_0)\ P(R_1|T_0) + P(T_1)\ P(R_1|T_1)$

$P(T_0) = 0.7$
$P(T_1) = 0.3$
$P(R_1|T_0) = 1 - 0.95 = 0.05$
$P(R_1|T_1) = 0.75$

```
# 0 is received = reZ = 0.95
# 1 is received = reO = 0.75
# 0 is transmitted = trZ = 0.7
# 1 is transmitted = trO = 0.3

reZ <- 0.95
reO <- 0.75
trZ <- 0.7
trO <- 0.3

prob1 <- (trZ*(1-reZ))+(trO*reO)
cat("Probability of receiving 1 (P(R1)):", prob1, "\n")
```

```
## Probability of receiving 1 (P(R1)): 0.26
```

*(b) a 1 was transmitted given than a 1 was received. $P(T_1|R_1) = \frac{P(T1)P(R1|T1)}{P(R1)}$

$P(T_1) = 0.3$
$P(R_1) = 0.26$
$P(R_1|T_1) = 0.75$

```
prob2 <- (trO*reO)/(prob1)
cat("Probability of receiving 1 when 1 was transmitted: ", prob2, "\n")
```

```
## Probability of receiving 1 when 1 was transmitted:  0.8653846
```

Question 7

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. What is the overall percentage of error? If a program is found with an error, who is the most likely person to have written it?

   Given:
   work of Jane = W_J = 0.1
   work of Amy = W_{Am} = 0.3
   work of Ava = W_{Av} = 0.6
   Error:
   error of Jane = E_J = 0.08
   error of Amy = E_{Am} = 0.05
   error of Ava = E_{Av} = 0.01

   *(a) overall percentage of error
   $E = (J \cap E) \cup (Am \cap E) \cup (Av \cap E)$
   $P(E) = P(J)P(E|J) + P(Am)P(E|Am) + P(Av)P(E|Av)$

   $P(J) = 0.1$
   $P(E|J) = 0.08$
   $P(Am) = 0.3$
   $P(E|Am) = 0.05$
   $P(Av) = 0.6$
   $P(E|Av) = 0.01$

```
# work of Jane = WJ = 0.1
# work of Amy = WAm = 0.3
# work of Ava = WAv = 0.6
# error of Jane = EJ = 0.08
# error of Amy = EAm = 0.05
# error of Ava = EAv = 0.01
# E = overall error

WJ = 0.1
WAm = 0.3
WAv = 0.6
EJ = 0.08
EAm = 0.05
EAv = 0.01

E <- (WJ*EJ) + (WAm*EAm) + (WAv*EAv)
E <- E*100
cat("The overall percentage of error:", E, "%\n")
```

```
## The overall percentage of error: 2.9 %
```

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

Percentage error of Jane:
$P(J|E) = \frac{P(WJ)P(E|WJ)}{P(E)}$
$P(W_J) = 0.1$
$P(E|W_J) = 0.08$
$P(E) = 0.029$

```
E <- E/100
prob3 <- (WJ*EJ)/E
prob3 <- prob3*100
cat("The percentage of error:", prob3,"%\n")
```

```
## The percentage of error: 27.58621 %
```

Percentage error of Amy:
$P(Am|E) = \frac{P(WAm)P(E|WAm)}{P(E)}$
$P(W_{Am}) = 0.3$
$P(E|W_{JAm}) = 0.05$
$P(E) = 0.029$

```
prob4 <- (WAm*EAm)/E
prob4 <- prob4*100
cat("The percentage of error:", prob4,"%\n")
```

```
## The percentage of error: 51.72414 %
```

Percentage error of Ava:
$P(Av|E) = \frac{P(WAv)P(E|WAv)}{P(E)}$
$P(W_{Av}) = 0.6$
$P(E|W_{JAv}) = 0.01$
$P(E) = 0.029$

```
prob5 <- (WAv*EAv)/E
prob5 <- prob5*100
cat("The percentage of error:", prob5,"%\n")
```

```
## The percentage of error: 20.68966 %
```

Since the highest percentage of error is 51.72%, the most likely person to have written it is Amy.