

Probability FA4

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5. Relevant Images

First, we can create a data frame for visual purposes. In here, we can already mention the given vectors.

```
sensor_table <- data.frame(  
  Sensor = 1:4,  
  PImages_Supplied = c(15, 20, 25, 40),  
  PRelevant_Images = c(50, 60, 80, 85)  
)  
knitr::kable(sensor_table)
```

Sensor	PImages_Supplied	PRelevant_Images
1	15	50
2	20	60
3	25	80
4	40	85

Now, we can compute for the overall percentage of relevant images using the Law of Total Probability. We have to use \$ to access variables from our data frame.

```
Poverall_relevant_images <- sum((sensor_table$PImages_Supplied / 100) * (sensor_table$PRelevant_Images  
print(Poverall_relevant_images)
```

```
## [1] 73.5
```

Therefore, the overall percentage of relevant images is 73.5%.

6. Pairwise Independent but not Mutually Independent

We start by first defining our sample space and inputting the givens.

```
SS <- c("HH", "HT", "TH", "TT")  
E1 <- c("HH", "TT")  
E2 <- c("HH", "HT")  
E3 <- c("HH", "TH")
```

Now, we can compute their probabilities. Let's use length to count the number of elements in our vector.

```
PE1 <- length(E1) / length(SS)
PE2 <- length(E2) / length(SS)
PE3 <- length(E3) / length(SS)
```

Next, we compute the joint probabilities. To ensure that there will be no redundancy, note that this accounts for the intersection of events. Therefore, PE1_E2 will be the same as PE2_E1, etc.

```
PE1_E2 <- length(intersect(E1, E2)) / length(SS)
PE1_E3 <- length(intersect(E1, E3)) / length(SS)
PE2_E3 <- length(intersect(E2, E3)) / length(SS)
PE1_E2_E3 <- length(intersect(intersect(E1, E2), E3)) / length(SS)
```

To check if they are pairwise independent:

```
pairwise_independent <- list(
  E1_E2 = PE1_E2 == PE1 * PE2,
  E1_E3 = PE1_E3 == PE1 * PE3,
  E2_E3 = PE2_E3 == PE2 * PE3
)
print(pairwise_independent)
```

```
## $E1_E2
## [1] TRUE
##
## $E1_E3
## [1] TRUE
##
## $E2_E3
## [1] TRUE
```

To check if they are mutually independent:

```
mutually_independent <- PE1_E2_E3 == PE1 * PE2 * PE3
print(mutually_independent)
```

```
## [1] FALSE
```

From here, we can see that E1, E2, E3 are pairwise independent but not mutually independent.