BE601 - Data Analytics I

Seminar 2

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# Test Exercise

# Discussion exercises

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## E6

We define the events:

d1: item being defective

d2: item not being defective

c1: item being classified as defective

c2: item being classified as not\_defective

#5% of the produced items are defective  
p\_d1 <- 0.05  
p\_d2 <- 0.95 #complementary rule  
#items that are free from defects are classified as correct with probability 0.98  
p\_c2\_on\_d2 <- 0.98  
p\_c1\_on\_d2 <- 1 - p\_c2\_on\_d2 #complementary rule  
p\_c2\_intersect\_d2 <- p\_c2\_on\_d2 \* p\_d2 #multiplication rule  
p\_c1\_intersect\_d2 <- p\_c1\_on\_d2 \* p\_d2 #multiplication rule  
#defective items are classified as defective with probability 0.95  
p\_c1\_on\_d1 <- 0.95  
p\_c2\_on\_d1 <- 1 - p\_c1\_on\_d1 #complementary rule  
p\_c1\_intersect\_d1 <- p\_c1\_on\_d1 \* p\_d1 #multiplication rule  
p\_c2\_intersect\_d1 <- p\_c2\_on\_d1 \* p\_d1 #multiplication rule  
# a) proportion of produced items classified as defective: p\_c1  
## Because c(c1,c2) and d(d1,d2) are independent; and each broken into mutually exclusive and collectively exhaustive:  
p\_c1 <- p\_c1\_intersect\_d1 + p\_c1\_intersect\_d2  
p\_c1

## [1] 0.0665

# b) Find the probability that an item classified as defective is defective: p\_d1\_on\_c1  
## Applying Bayes's theorm  
p\_d1\_on\_c1\_nominator <- p\_c1\_on\_d1 \* p\_d1  
p\_d1\_on\_c1\_denominator <- p\_c1\_on\_d1 \* p\_d1 + p\_c1\_on\_d2 \* p\_d2  
p\_d1\_on\_c1 <- p\_d1\_on\_c1\_nominator/p\_d1\_on\_c1\_denominator  
p\_d1\_on\_c1

## [1] 0.7142857

We can calculate the marginal probability of each event by using two-way table:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **D1** | **D2** | **Totals** |
| **C1** | 0.95\*0.05=0.0475 | 0.02\*0.95=0.019 | 0.0475+0.019=0.0665 |
| **C2** | 0.05\*0.05=0.0025 | 0.98\*0.95=0.931 | 0.0025+0.0931=0.9335 |
| **Totals** | 0.0475+0.0025=0.05 | 0.019+0.931=0.95 | 1 |

a <- 0.95\*0.05  
a

## [1] 0.0475

b <- 0.05^2  
b

## [1] 0.0025

c <- 0.02\*0.95  
c

## [1] 0.019

d <- 0.98\*0.95  
d

## [1] 0.931

a+b

## [1] 0.05

c+d

## [1] 0.95

a+c

## [1] 0.0665

b+d

## [1] 0.9335

n <- a  
d <- a + c  
n/d

## [1] 0.7142857