Statistics for Data Analytics

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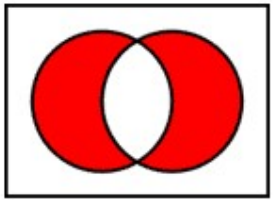
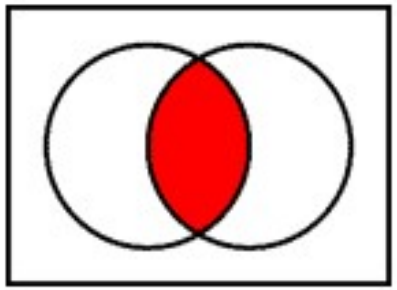
Probabilities: Problems solved

$$P(A\ XOR\ B) = P(A) + P(B) - 2 \times P(A \cap B)$$



$$P(A \cap B) = P(A) \times P(B)$$



$$\frac{1}{6} \times \frac{1}{6} = 0.0278$$

Exercise 1

T = The order arrives on time
S = The order meets the specifications

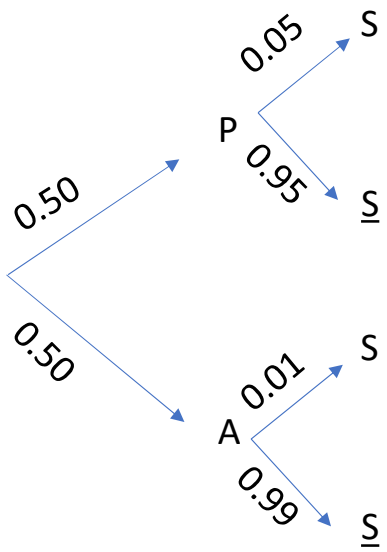
	T	$\underline{T}$	TOTAL
S	60 (80% of 75)	15 (60% of 25)	75
$\underline{S}$	15	10	25
TOTAL	75	25	100

a) P(S) = 75/100 = 0.75

b) $P(T/\underline{S})$ = 15/25 = 0.60

Exercise 2

P = He uses the phone (even number)
A = He uses the alarm (odd number)
S = He keeps sleeping



a) $P(S) = P(P \cap S) + P(A \cap S)$
$P(S) = 0.50 * 0.05 + 0.5 * 0.01 = 0.025 + 0.005$
$P(S) = 0.03$

b) $P(P/\underline{S}) = 0.475/0.97 = 0.4896$

Auxiliar calculations
$P(\underline{S}) = 1 - 0.03 = 0.97$
$P(P \cap \underline{S}) = 0.5 * 0.95 = 0.475$

Exercise 3

T = it comes up a tale (3 coins)

T	T	T = ½ * ½ * ½ = 1/8
T	T	T = ½ * ½ * ½ = 1/8
T	T	T = ½ * ½ * ½ = 1/8

P(Two Tails) = 1/8 + 1/8 + 1/8 = 0.375

Exercise 4

X = number that shows up rolling the dice

X	P(X)
1	1/6
2	1/6
3	1/6
4	1/6
5	1/6
6	1/6

a) Even number = 1/6 + 1/6 + 1/6 = 0.50
b) Getting a multiple of 6 = 1/6 = 0.1666
c) Greater than 4 = 1/6 + 1/6 = 0.3333

Exercise 5

8 red balls
5 yellow balls
7 green balls
20 total

a) P(R) = 8/20 = 0.40
b) P(G) = 7/20 = 0.35
c) P(Y) = 5/20 = 0.25
d) P($\underline{R}$) = 1 – 8/20 = 0.60
e) P($\underline{Y}$) = 1 – 0.25 = 0.75
f) P(G /$\underline{R}$) =0.35/0.6 = 0.5833

Probabilities: Exercise 6

Being P(A) = 0.50, P($\underline{B}$) = 0.30 and P(A U $\underline{B}$) = 0.70, Calculate P(A ∩ B).

Information that we can get from the given data:

P($\underline{A}$) = 0.50 → Complementary probability

P(B) = 0.70 → Complementary probability

P(A U $\underline{B}$) = 0.70 → What if we use the complementary probability here?

$\overline{P(A \cup \underline{B})}$ = 1 - P(A U $\underline{B}$)

↳ P($\underline{A}$ ∩ B) = 0.30 → This is because if we go to the opposite values, A would be $\underline{A}$, Union would be intersection and $\underline{B}$ would be B

But then, what do we do at this stage?

Probabilities: Exercise 6

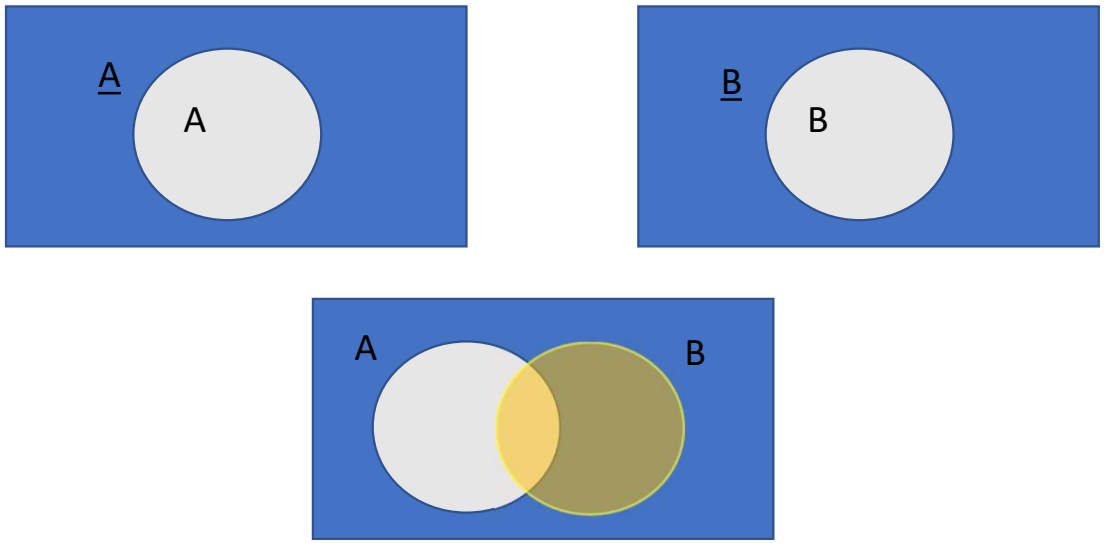
Why not to try a table?

Total	A	$\underline{A}$	Total
B	0.40	0.30	0.70
$\underline{B}$	0.10	0.20	0.30
Total	0.50	0.50	1

Answer: $P(A \cap B) = 0.40$

Probabilities: Exercise 6

Another way to look at it would be with the circles diagram (Venn diagram if you want to look for it)



Probabilities: Exercise 6

$\underline{B}$ = everything that we have in the universe, but B.

$\underline{A}$ = everything that we have in the universe, but A.

If $P(A \cup \underline{B})$ is the union of A and B minus the intersection, it means that there is a part that we are discarding from this union.

If $P(\underline{A} \cap B)$ is the intersection of $\underline{A}$ and B and it is the opposite of $P(A \cup \underline{B})$, the difference between one and another one will give me the overlap that we are missing.

$P(A \cup \underline{B}) = 0.70$ $P(\underline{A} \cap B) = 0.30$

Then → $P(A \cap B) = 0.70 - 0.30 = 0.40$

Some observations:

- P(A U B) is not P(A) + P(B), there is an axiom that help us to calculate this.
- P(A ∩ B) is not always P(A) * P(B), we can only do this calculations if we are sure that the evets are independent.
- Complementary probabilities assume that the entire universe is 1 and we remove a probability to see what is left. It is very useful when we want to clear something, as it happened with the exercise 6.
- If you are interested in learn more about probabilities, the use, the relation to Mathematics and deepen your knowledge, you can search for the following topics: De Morgan's Laws, Bayesian Theorem (we covered this 'hidden' in the exercises, so reading it you will have a better understanding of our practice), Venn Diagram.

Exercise 7

B = The student is a boy
G = The student is a girl
S = The student speaks another language

	B	G	TOTAL
S	3	15	18
$\underline{S}$	7	15	22
TOTAL	10	30	40

a) P(G) = 30/40 = 0.75
b) P(S) = 18/40 = 0.45
c) P(B/ $\underline{S}$)= 7 / 22 = 0.3181

THAT'S ALL FOR TODAY

THANK YOU