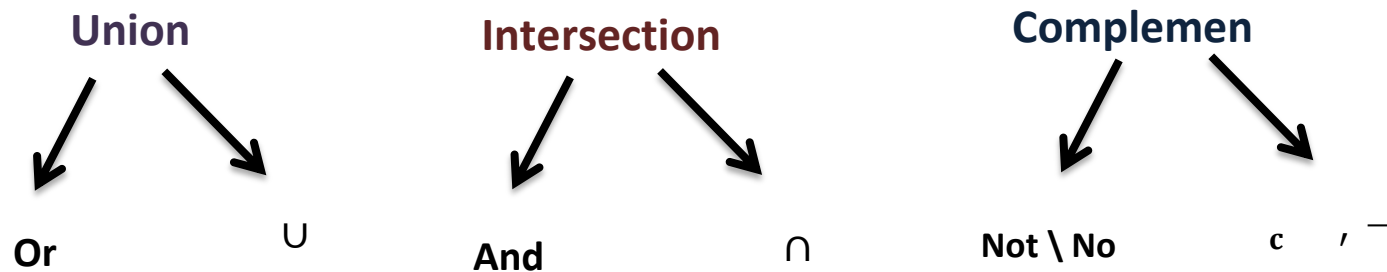


Chapter 3: Probability The Basis of Statistical Inference

Probability:

$$P(E) = \frac{n(E)}{n(\Omega)} \quad , \quad 0 \leq P \leq 1$$

Some Operations on Events:



Rules of Probability :

<p><u>Addition Rule:</u></p> $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ <p style="text-align: center;"> $=$ احتمال الاول $+$ احتمال الثاني $-$ احتمال التقاطع </p>	<p><u>Conditional Probability:</u></p> <p>Known - Given</p> $P(A B) = \frac{P(A \cap B)}{P(B)}$ <p style="text-align: center;"> $=$ احتمال التقاطع / احتمال ما بعد الشرط </p>	<p><u>Complement Probability:</u></p> $P(\bar{A}) = 1 - P(A)$ <p style="text-align: center;"> $=$ 1 - الاحتمال الاساسي </p>
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Table of **number of** elements in each event:

العدد للتقاطعات

	B_1	B_2	B_3	Total
A_1	50	30	70	150
A_2	20	70	10	100
A_3	30	100	120	250
Total	100	200	200	500

$n(A_1)$
 $n(A_2)$
 $n(A_3)$
 $n(B_1)$ $n(B_2)$ $n(B_3)$ $n(\Omega)$

calculating the probability by using the probability rule

$$P(E) = \frac{n(E)}{n(\Omega)}$$

Table of **probabilities** of each event:

احتمال التقاطع

	B_1	B_2	B_3	Marginal Probability
A_1	0.1	0.06	0.14	0.3
A_2	0.04	0.14	0.02	0.2
A_3	0.06	0.2	0.24	0.5
Marginal Probability	0.2	0.4	0.4	1

$P(A_1)$
 $P(A_2)$
 $P(A_3)$
 $P(\Omega)$
 $P(B_1)$ $P(B_2)$ $P(B_3)$

Calculating the probability directly from the table

mutually exclusive
(disjoint)



$$A \cap B = \emptyset$$

$$P(A \cap B) = 0$$

exhaustive



$$A \cup B = \Omega$$

$$P(A \cup B) = 1$$

Independent



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

$$P(A|B) = P(A)$$

$$P(B|A) = P(B)$$

3.5 Bayes Theorem

		True status of the disease		
		Has the disease (D)	Dose not have the disease (\bar{D})	Total
The result of the test	Positive (T)	Correct decision Sensitivity $P(T D) = \frac{n(T \cap D)}{n(D)}$	False decision false positive + $P(T \bar{D}) = \frac{n(T \cap \bar{D})}{n(\bar{D})}$	n(T)
	Negative (\bar{T})	False decision false negative - $P(\bar{T} D) = \frac{n(\bar{T} \cap D)}{n(D)}$	Correct decision Specificity $P(\bar{T} \bar{D}) = \frac{n(\bar{T} \cap \bar{D})}{n(\bar{D})}$	n(\bar{T})
Total		n(D)	n(\bar{D})	n(Ω)

Predictive value Positive :

$$P(D|T) = \frac{\text{Sensitivity} * P(D)}{\text{same numerator} + (1 - \text{Specificity}) * P(\bar{D})}$$

Predictive value Negative :

$$P(\bar{D}|\bar{T}) = \frac{\text{Specificity} * P(\bar{D})}{\text{same numerator} + (1 - \text{Sensitivity}) * P(D)}$$

$P(D)$ = probability of the relevant disease in the general population (معطاه بالسؤال)