الدرس الأول

"Basic Concepts"

* population: is the largest collection of entities (elements or individuals) in which we are interested at particular time and about which we want to draw some conclusions (N = population size).
* sample: is a part of population (n = sample size).
* variable: characteristic to be measured (number or words) on the elements (in population or in sample).
* types of variables
  - quantitative (by numbers)
    - Discrete (jumps or gaps or specific)
    - Continuous (no gaps or within interval)
  - qualitative (by words)
    - Nominal (not order)
    - Ordinal (order)

* data: raw material of statistics.
* statistics: field of study concerned with.
* descriptive statistics: collection, organization, summarization, describe, and analysis of data.
* inferential statistics: reach decisions, inference, and conclusions about a large body of data (population) by only part of the data (sample) is observed.

الدرس الثاني

الجزء الأول

"Frequency Distribution"

* Ordered array or set: listing of values in order from the smallest to the largest values with frequency.

class interval	true class interval	mid point or mid interval
[lower① - upper①]	[true lower① - true upper①)	$mid① = \frac{lower① + upper①}{2} = \frac{true\ lower① + true\ upper①}{2}$
[lower② - upper②]	[true lower② - true upper②)	$mid② = \frac{lower② + upper②}{2} = \frac{true\ lower② + true\ upper②}{2}$
[lower③ - upper③]	[true lower③ - true upper③)	$mid③ = \frac{lower③ + upper③}{2} = \frac{true\ lower③ + true\ upper③}{2}$

The method to find the following:

* Class interval ⇒ true class interval:

$d = lower② - upper① = lower③ - upper②$ (gaps) ;

$true\ lower① = lower① - \frac{d}{2}$;

$true\ upper① = upper① + \frac{d}{2}$;

$true\ lower② = lower② - \frac{d}{2}$;

$true\ upper② = upper② + \frac{d}{2}$;

$true\ lower③ = lower③ - \frac{d}{2}$;

$true\ upper③ = upper③ + \frac{d}{2}$.

* true class interval $\Rightarrow$ class interval (where d or $\frac{d}{2}$ is known) :

$$\begin{cases} \text{lower}① = \text{true lower}① + \frac{d}{2} \\ \text{upper}① = \text{true upper}① - \frac{d}{2} \end{cases}$$

$$\begin{cases} \text{lower}② = \text{true lower}② + \frac{d}{2} \\ \text{upper}② = \text{true upper}② - \frac{d}{2} \end{cases}$$

$$\begin{cases} \text{lower}③ = \text{true lower}③ + \frac{d}{2} \\ \text{upper}③ = \text{true upper}③ - \frac{d}{2} \end{cases}$$

* midpoint $\Rightarrow$ true class interval :

w = width = lower② − lower① = lower③ − lower②
= upper② − upper① = upper③ − upper② → by using the class interval

= true upper① − true lower①
= true upper② − true lower②
= true upper③ − true lower③ → by using the true class interval

= mid② − mid① = mid③ − mid② → by using the mid point

$$\begin{cases} \text{true lower}① = \text{mid}① - \frac{w}{2} \\ \text{true upper}① = \text{mid}① + \frac{w}{2} \end{cases}$$

$$\begin{cases} \text{true lower}② = \text{mid}② - \frac{w}{2} \\ \text{true upper}② = \text{mid}② + \frac{w}{2} \end{cases}$$

$$\begin{cases} \text{true lower}③ = \text{mid}③ - \frac{w}{2} \\ \text{true upper}③ = \text{mid}③ + \frac{w}{2} \end{cases}$$

true upper① = true lower②

true upper② = true lower③

الجزء الثاني

* Frequency ≅ freq.
* Relative ≅ r. (relative ≅ propotion)
* Percentage ≅ per. (percentage ≅ percent)
* Cumulative ≅ cum.

freq.	cum. freq.	r. freq.	cum. r. freq.	per. freq.	cum. per. freq.
	n		1		100%
Total = n		Total = 1		Total = 100%	

we have another Method to find the following :

* Cumulative frequency :

cum. freq. of 1st class interval = freq.

cum. freq. of any class interval = freq. + cum. freq. of preceding class interval

* Cumulative relative frequency :

cum. r. freq. of 1st class interval = r. freq.

cum. r. freq. of any class interval = r. freq. + cum. r. freq. of preceding class interval

* cumulative percentage frequancy :

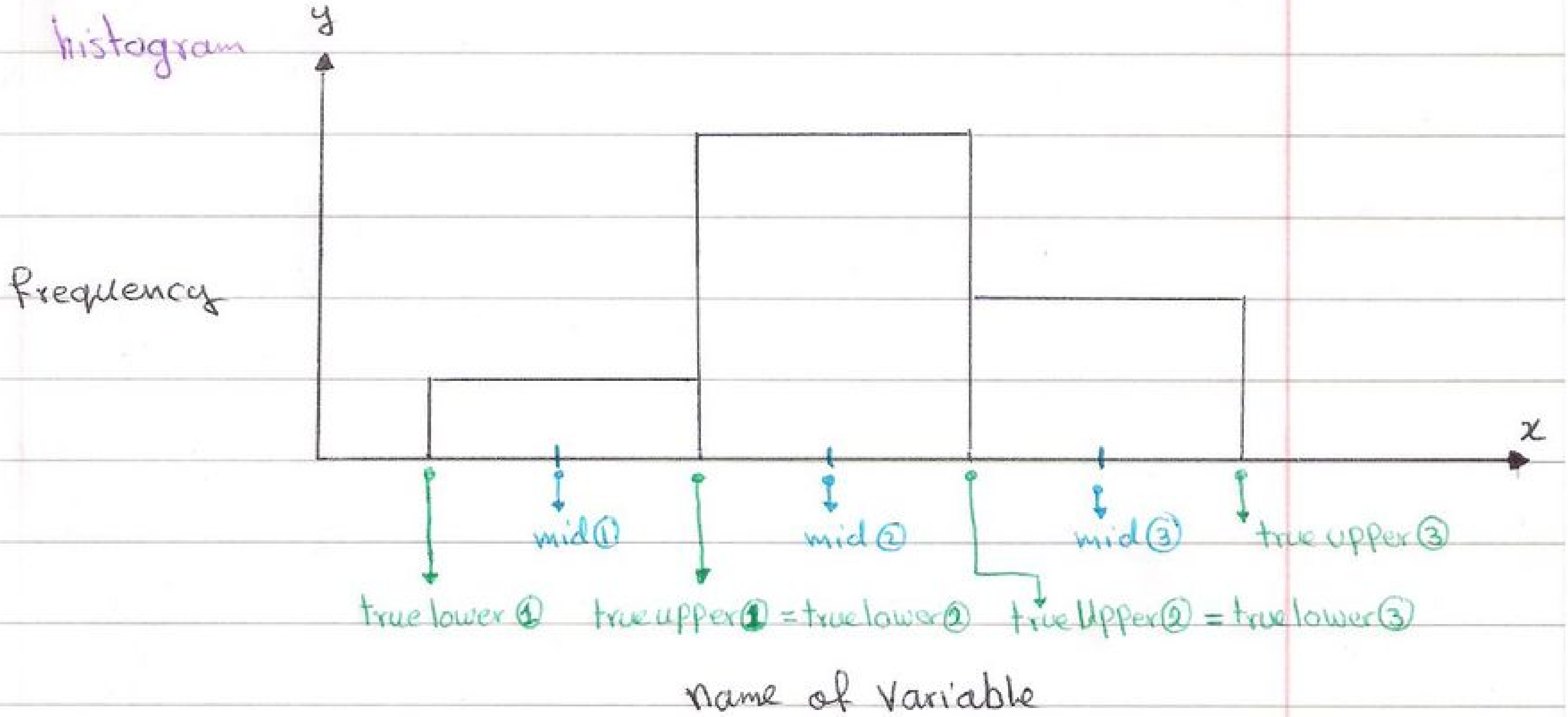
cum. per. freq. of 1st class interval = per. freq.

cum. per. freq. of any class interval = per. freq. + cum. per. freq. of preceding class interval

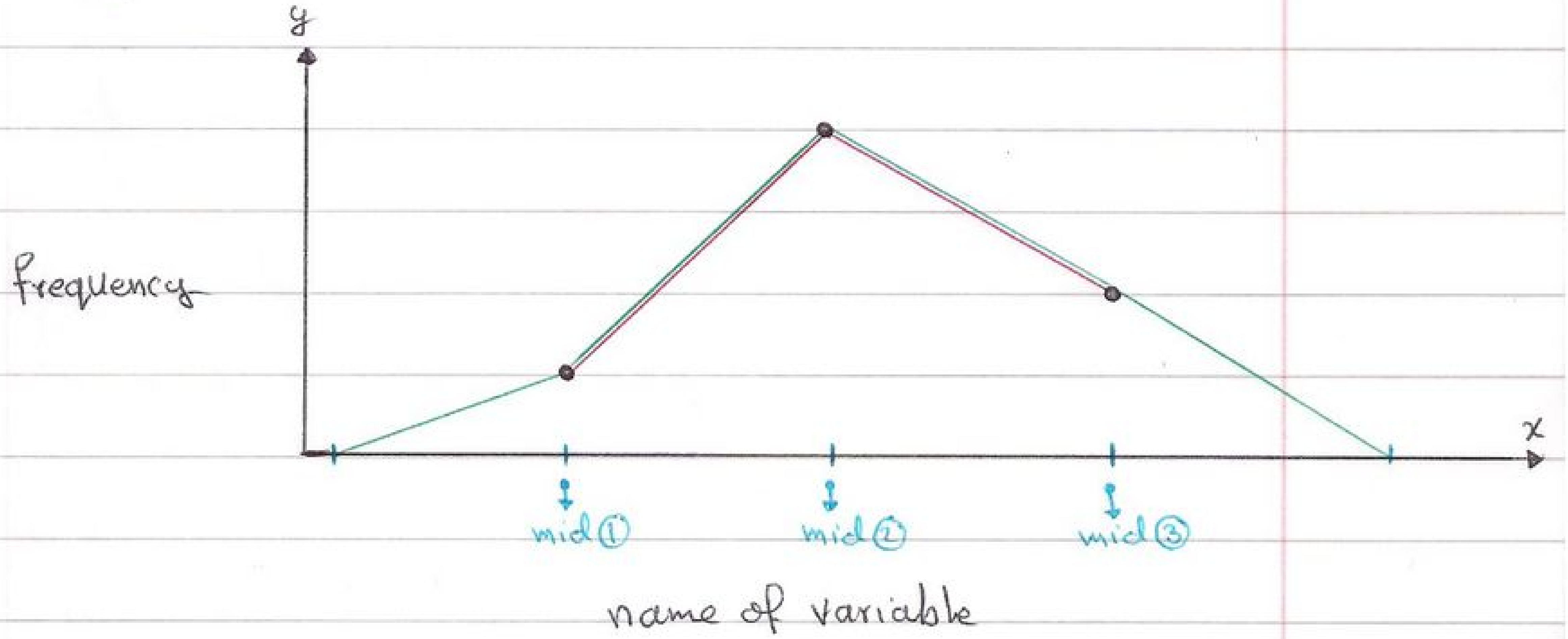
جزء الثالث

* displaying the frequency distribution :

histogram



polgon



polgon closed

polgon open

الدرس الثاني

الجزء الأول

"Descriptive Statistics"

measures of

Central Tendency (Location) ← → Dispersion (Variation)

* mean (unit)
* median (unit)
* mode (unit)

* range (unit)
* Variance = (standard deviation)^2 (unit)^2
* standard deviation = $\sqrt{\text{variance}}$ (unit)
* coefficient of variation (unit-less) C.V.

Population

* $X_1, X_2, \ldots, X_N$
* any measure here it called "parameter"

→

sample

* $x_1, x_2, \ldots, x_n$
* any measure here it called "statistic"

	Population	sample
mean	$\mu = \frac{\sum_{i=1}^{N} X_i}{N}$	$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$
Variance	$\sigma^2 = \frac{\sum_{i=1}^{N}(X_i-\mu)^2}{N}$; $\sigma^2 \geq 0$	$s^2 = \frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n-1}$; $s^2 \geq 0$
standard deviation	$\sigma = \sqrt{\sigma^2}$; $\sigma \geq 0$	$s = \sqrt{s^2}$; $s \geq 0$
size	N	n

الدرس الرابع
جزء الأول

"Probability"

* Experiment: some procedure or process that we do.
* Sample Space (Ω): set of all possible outcomes of experiment; where $n(\Omega)$ is the number of outcomes (elements) in Ω.
* Event (E): any subset of Ω; where $n(E)$ is the number of outcomes in E.

  $E \subseteq \Omega$

  $\emptyset \subseteq \Omega$ (impossible event)

  $\Omega \subseteq \Omega$ (sure event)

* Equally likely outcomes of experiment: if the outcomes have the same chance of occurrence.
* Probability: measure used to measure the chance of occurrence of event; which is between 0 and 1.
* Probability of event E: $0 \leq P(E) = \frac{n(E)}{n(\Omega)} \leq 1$

  $P(\emptyset) = 0$

  $P(\Omega) = 1$

* Operations on events:

  (1) Union:

  - $A \cup B \cong A \text{ or } B \cong A + B$
  - $n(A \cup B) = n(A) + n(B) - n(A \cap B) \iff P(A \cup B) = P(A) + P(B) - P(A \cap B)$
  - $A \cup B = \Omega$ or $P(A \cup B) = 1 \iff A$ and B are exhaustive
  - $A \cup A' = \Omega$ (exhaustive)
  - $P(A \cup B) = \frac{n(A \cup B)}{n(\Omega)}$

② intersection:

- $A \cap B \cong A$ and B
- $P(A \cap B) = \frac{n(A \cap B)}{n(\Omega)}$
- $A \cap B = \emptyset$ or $P(A \cap B) = 0 \iff A$ and B are disjoint (mutually exclusive)
- $A \cap A' = \emptyset$ (disjoint or mutually exclusive)

③ Complement:

- $\overline{A} \cong A^c \cong A' \cong$ not A
- $n(A) + n(A') = n(\Omega) \iff P(A) + P(A') = 1$

* Marginal probability:

① table 2x2:

	B	B^c	
A	$n(A \cap B)$ +	$n(A \cap B^c)$ =	$n(A)$
	+	+	+
A^c	$n(A^c \cap B)$ +	$n(A^c \cap B^c)$ =	$n(A^c)$
	=	=	=
	$n(B)$ +	$n(B^c)$ =	$n(\Omega)$

$\iff$

	B	B^c	
A	$P(A \cap B)$ +	$P(A \cap B^c)$ =	$P(A)$
	+	+	+
A^c	$P(A^c \cap B)$ +	$P(A^c \cap B^c)$ =	$P(A^c)$
	=	=	=
	$P(B)$ +	$P(B^c)$ =	1

الجمع عاموديا أو عرضياً للتقاطع يساوي الأطراف عاموديا أو عرضياً على التوالي ...

② tables of 2×3 ; 3×3 ; 2×4 ; 3×4 , 4×4 , ... : for example if we take

	B_1	B_2	B_3	
A_1	$n(A_1\cap B_1)$ +	$n(A_1\cap B_2)$ +	$n(A_1\cap B_3)$	$= n(A_1)$
	+	+	+	+
A_2	$n(A_2\cap B_1)$ +	$n(A_2\cap B_2)$ +	$n(A_2\cap B_3)$	$= n(A_2)$
	+	+	+	+
A_3	$n(A_3\cap B_1)$ +	$n(A_3\cap B_2)$ +	$n(A_3\cap B_3)$	$= n(A_3)$
	$\parallel$	$\parallel$	$\parallel$	$\parallel$
	$n(B_1)$ +	$n(B_2)$ +	$n(B_3)$	$= n(\Omega)$

$\Longleftrightarrow$

	B_1	B_2	B_3	
A_1	$P(A_1\cap B_1)$ +	$P(A_1\cap B_2)$ +	$P(A_1\cap B_3)$	$= P(A_1)$
	+	+	+	+
A_2	$P(A_2\cap B_1)$ +	$P(A_2\cap B_2)$ +	$P(A_2\cap B_3)$	$= P(A_2)$
	+	+	+	+
A_3	$P(A_3\cap B_1)$ +	$P(A_3\cap B_2)$ +	$P(A_3\cap B_3)$	$= P(A_3)$
	$\parallel$	$\parallel$	$\parallel$	$\parallel$
	$P(B_1)$ +	$P(B_2)$ +	$P(B_3)$	$= 1$

الجمع عامودياً أو عرضياً للتقاطع يساوي الأطراف عامودياً أو عرضياً على التوالي . . . .

- $A_1\cap A_2 = A_1\cap A_3 = A_2\cap A_3 = A_1\cap A_2\cap A_3 = \emptyset$;

  $B_1\cap B_2 = B_1\cap B_3 = B_2\cap B_3 = B_1\cap B_2\cap B_3 = \emptyset$.
- $A_1' = A_2\cup A_3$; $A_2' = A_1\cup A_3$; $A_3' = A_1\cup A_2$; $B_1' = B_2\cup B_3$; $B_2' = B_1\cup B_3$; $B_3' = B_1\cup B_2$.
- $A_1^c\cap B_1 = (A_2\cup A_3)\cap B_1 = (A_2\cap B_1)\cup(A_3\cap B_1) \Leftrightarrow P(A_1^c\cap B_1) = P(A_2\cap B_1) + P(A_3\cap B_1)$

  $A_1\cap B_1^c = A_1\cap(B_2\cup B_3) = (A_1\cap B_2)\cup(A_1\cap B_3) \Leftrightarrow P(A_1\cap B_1^c) = P(A_1\cap B_2) + P(A_1\cap B_3)$

وعلى هذا يقاس الأمر لأي حادثتين . . . .

* conditional probability:

- $A|B \cong A$ given $B \cong A$ knowing B
- $P(A|B) = \dfrac{P(A\cap B)}{P(B)} = \dfrac{n(A\cap B)}{n(B)}$

$$P(B|A) = \frac{P(A\cap B)}{P(A)} = \frac{n(A\cap B)}{n(A)}$$

- A and B independent $\iff P(A\cap B) = P(A)\,P(B)$

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

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