



# AMADO-online user's guide

<https://paris-timemachine.huma-num.fr/amado/>

English, Français, Español, Русский, Українська, Tiếng Việt

AMADO-online was designed by **Nguyen-Khang PHAM** (University of Can Tho) from the code of **Alban Risson**

This manual was written by **Jean-Hugues Chauchat** (Université Lyon 2)

Version of 13 Nov 2020

To start: Choose the language on the home page. Go on.

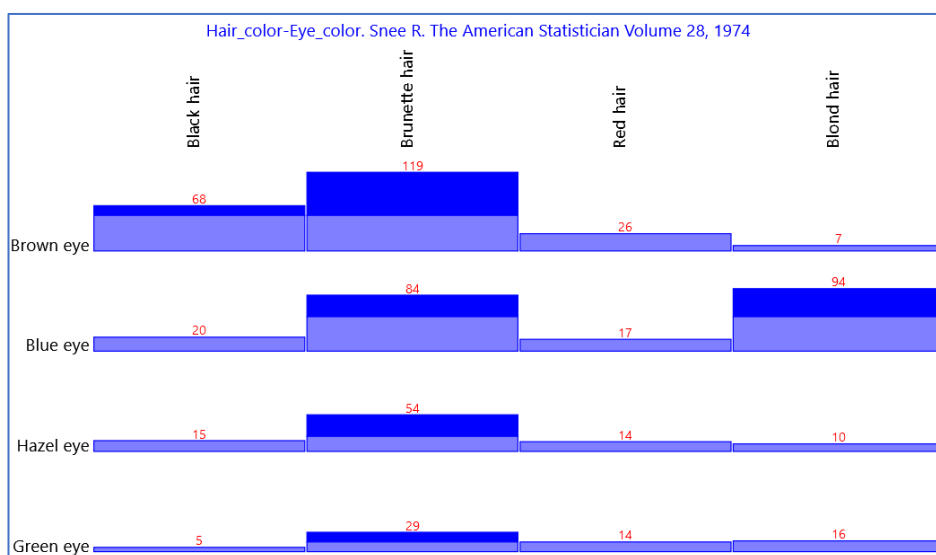
## File: open a data file

**File / Open** a file (in UNICODE format, or UTF-8 if there are accents or special characters), with "tab separators".



**Open / Sample / EN\_Hair\_color-Eye\_color.TXT** <= This file can be opened by File / Samples

Or **Copy** the table area into a spreadsheet, then "Edit / Paste" in AMADO online <sup>1</sup>. If the cell at the top left of the table contains text, it appears as the title of the chart.

	A	B	C	D	E
	Hair_color-Eye_color. Snee R. The American Statistician				
1	Volume 28, 1974	<b>Black hair</b>	<b>Brunette hair</b>	<b>Red hair</b>	<b>Blond hair</b>
2	<b>Brown eye</b>	68	119	26	7
3	<b>Blue eye</b>	20	84	17	94
4	<b>Hazel eye</b>	15	54	14	10
5	<b>Green eye</b>	5	29	14	16

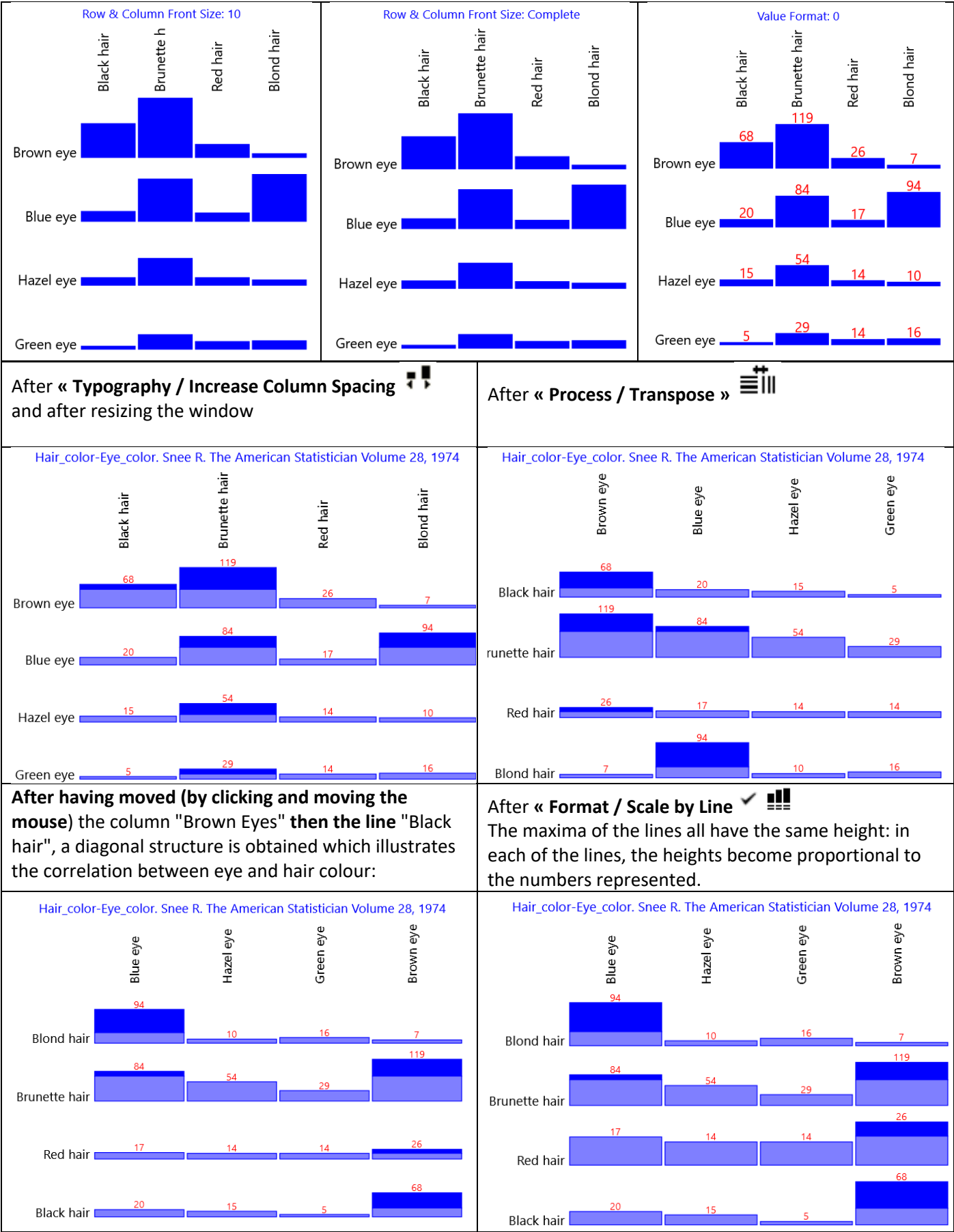


The numbers in the table are represented by the heights (and areas) of the rectangles.


<sup>1</sup> If you are using the Firefox browser, go to the menu at the top right of Firefox Customize / Customize Toolbar / Move the "Edit Control" commands   to the toolbar. You will then be able to copy a table.

# Format: Row Legends; Column Legends; Value Format

By default, labels are displayed with 10 characters. To display the full labels "Format / Row Legend / Complete", and "Format / Column Legend / Complete".



# The 6 Display Modes

« Format / Mode 1, etc. » 

allow, in different ways, to visually distinguish values below or above the average value of each line.


Modes 1 & 2	<div>Hair_color-Eye_color. Snee R. The American Statistician Volume 28</div> <table><tr><th></th><th>Blue eye</th><th>Hazel eye</th><th>Green eye</th><th>Brown eye</th></tr><tr><td>Blond hair</td><td>94</td><td>10</td><td>16</td><td>7</td></tr><tr><td>Brunette hair</td><td>84</td><td>54</td><td>29</td><td>119</td></tr><tr><td>Red hair</td><td>17</td><td>14</td><td>14</td><td>26</td></tr><tr><td>Black hair</td><td>20</td><td>15</td><td>5</td><td>68</td></tr></table>		Blue eye	Hazel eye	Green eye	Brown eye	Blond hair	94	10	16	7	Brunette hair	84	54	29	119	Red hair	17	14	14	26	Black hair	20	15	5	68	<div>Hair_color-Eye_color. Snee R. The American Statistician Volume 28</div> <table><tr><th></th><th>Blue eye</th><th>Hazel eye</th><th>Green eye</th><th>Brown eye</th></tr><tr><td>Blond hair</td><td>94</td><td>10</td><td>16</td><td>7</td></tr><tr><td>Brunette hair</td><td>84</td><td>54</td><td>29</td><td>119</td></tr><tr><td>Red hair</td><td>17</td><td>14</td><td>14</td><td>26</td></tr><tr><td>Black hair</td><td>20</td><td>15</td><td>5</td><td>68</td></tr></table>		Blue eye	Hazel eye	Green eye	Brown eye	Blond hair	94	10	16	7	Brunette hair	84	54	29	119	Red hair	17	14	14	26	Black hair	20	15	5	68
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## Edit: Cut, Copy table, Paste table.

**Undo** (Ctrl Z) allows you to go back. **Redo** (Ctrl Y) to restore

**Copy table:** The current table can then be pasted into a Text, Excel or Word file.

**Paste:** An extract from a text, Excel or Word file can be pasted into AMADO online to become a graph; this is an alternative to File / Open.


**Edit**  **Delete** / First select a row or column by clicking on the name of the row or column; then Edit / Delete. By "Ctrl + Click", you can also select several rows or columns to be deleted.

**Set Title** ... to compose, modify or delete the title of the chart


**Export chart to SVG (or PNG) format:** "File / Export to SVG" copies the chart to the "Downloads" folder on the computer; see the appendix on how to crop an SVG chart that has been pasted into Word, Excel or PowerPoint.

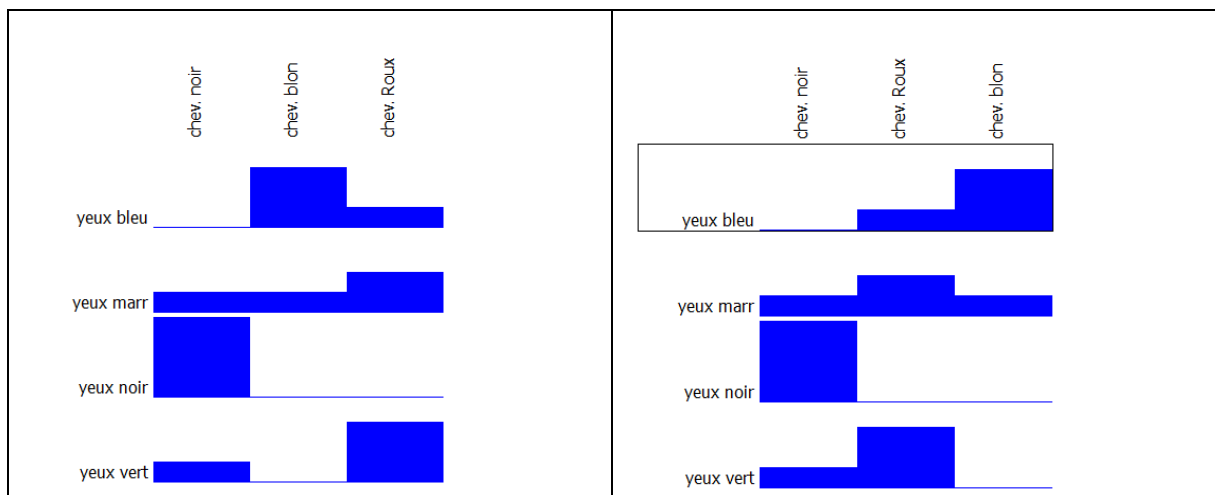
## Process:

**Sort, Frequency Data..., Homogeneous Numerical Data..., Heterogeneous Numerical Data..., Remove Tree, Compute Row Percentages, Compute Column Percentages, Normalize Rows, Normalise Columns, Insert Separators, Remove Separator**


**Process / Sort A to Z**  First, select a row by clicking on its label. Then, execute the command to reorder all the columns according to the increasing order of the values in that row.

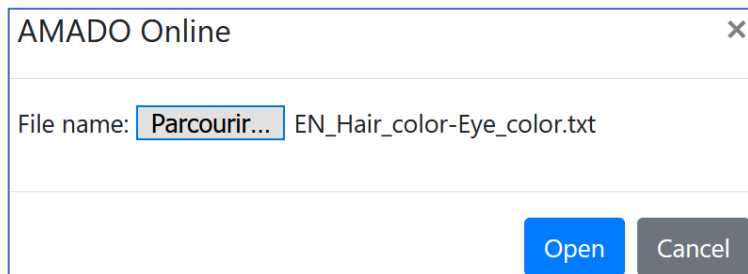
Or select a column by clicking on its label. Then, execute the command to reorder all the rows according to the values in this column.

**Process / Sort Z to A**  The same to reorder the rows (columns or lines) in descending order



## **File: Open, Samples..., Export to SVG, Export to PNG**

**File / Open**  allows you to open a .TXT format file from your computer. The fields must be separated by "Tab" characters. If the title or the line or column labels contain accented characters, the file must have been saved in UTF or UNICODE format.



**File / Sample:** Some ".TXT" files are available, including those used in this Guide. The English file names begin with EN (Example: EN\_Hair\_color-Eye\_color.TXT). If the cell at the top left of the .TXT table contains a text, this appears as the title of the graph.

**Edit / Set Title** allows you to create or change the title of the chart.

### **Export the Chart**

## **Moving a row or column**

To show the data structure, rows and/or columns can be reordered.

Moves can be made "by hand": select a row by clicking on it and move it while keeping the mouse button pressed. You can also move a block of contiguous rows by clicking on one row and then on another using the Ctrl key. The same applies to one column or a block of contiguous columns.

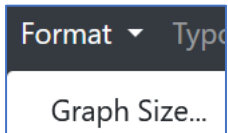
Automatic diagonalization (by Factorial Correspondent Analysis) and classification methods will be discussed later.

## **Sort the rows according to the values of a column (or sort the columns according to the values of a row)**

Select a column by clicking on its label, then **Process / Sort ascending (or descending)**.

Same when you select a line.

## **How to change the size, and the height/width ratio, of the graphic**



Opens the window:

A screenshot of a window titled 'AMADO Online'. It contains two sliders for 'Graph width' and 'Graph height'. The 'Graph width' slider is set to 612, and the 'Graph height' slider is set to 699. There is an 'Auto resize' checkbox which is currently unchecked. An 'Ok' button is located at the bottom right of the window.

Uncheck: ☒ Auto resize → ☐ Auto resize

Then choose the desired width and height for the graphic. At the end, validate by clicking on:



# Frequency Data Processing: diagonalisation & classification

**Frequency Data...** These commands are suitable for frequency cross-tabulation:

- in a population described by two qualitative variables,  $N_{ij}$  is the number of individuals with the character " $i$ " of the variable "rows" and the character " $j$ " of the variable "columns" (examples: number of inhabitants of district " $i$ " with the occupation " $j$ ". Number of people according to the colours " $i$ " of their eyes and " $j$ " of their hair),
- tables of 0/1.  $N_{ij}=1$  if the character " $j$ " of the variable "column" is present in the individual " $i$ ",  $N_{ij}=0$  if not (example: the pottery found in the archaeological site " $i$ " has, or does not have, the shape or design " $j$ "),
- square co-occurrence tables:  $N_{ij}$  is the number of times characters " $i$ " and " $j$ " have been matched together.

For **Frequency Data / Processing by CA** (Factorial Correspondence Analysis) and **Hierarchical Clustering**.

## Example-1: eye and hair colours of 592 people

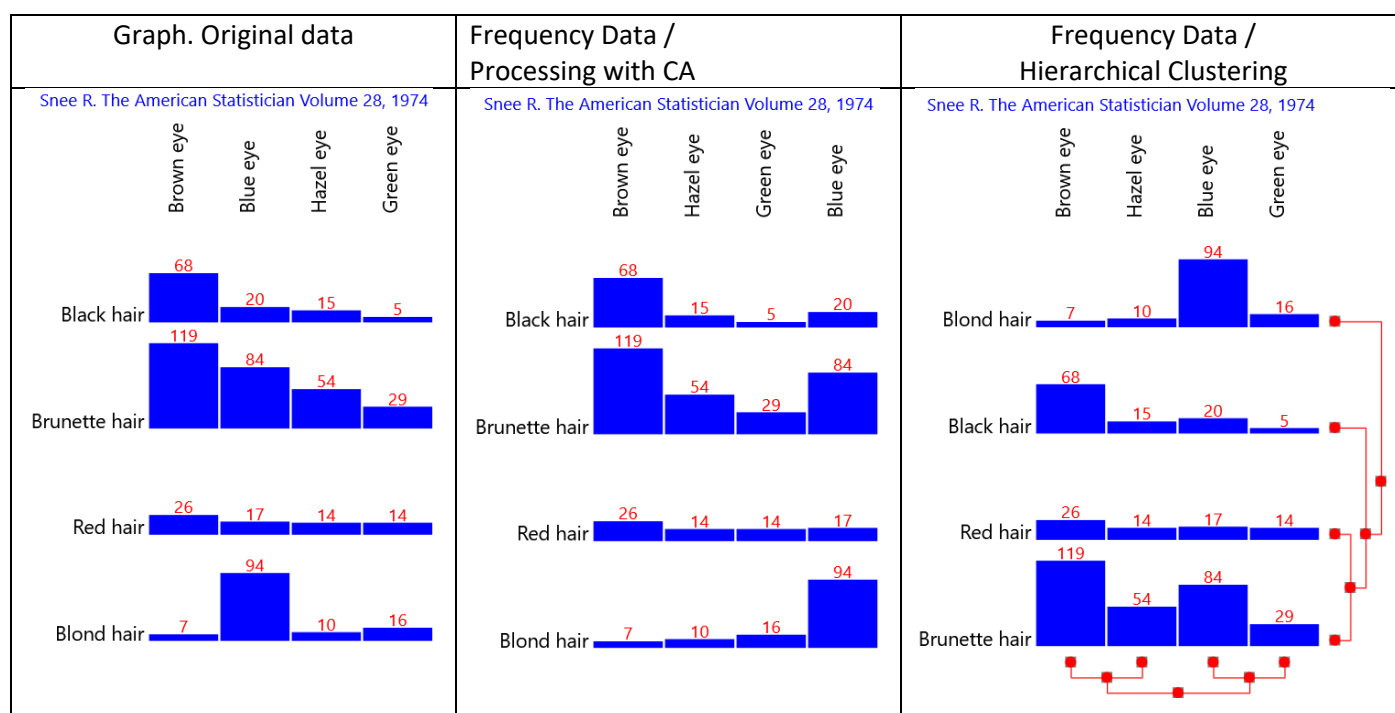
**Open / Sample / EN\_Hair\_color-Eye\_color.TXT**

<= This file can be opened by File / Samples

Hair_color-Eye_color. Snee R. The American Statistician Volume 28, 1974	Black hair	Brunette hair	Red hair	Blond hair
Brown eye	68	119	26	7
Blue eye	20	84	17	94
Hazel eye	15	54	14	10
Green eye	5	29	14	16

By default, labels are displayed with 10 characters.

To display the full labels "**Format / Row Legend / Complete**", and "**Format / Column Legend / Complete**".



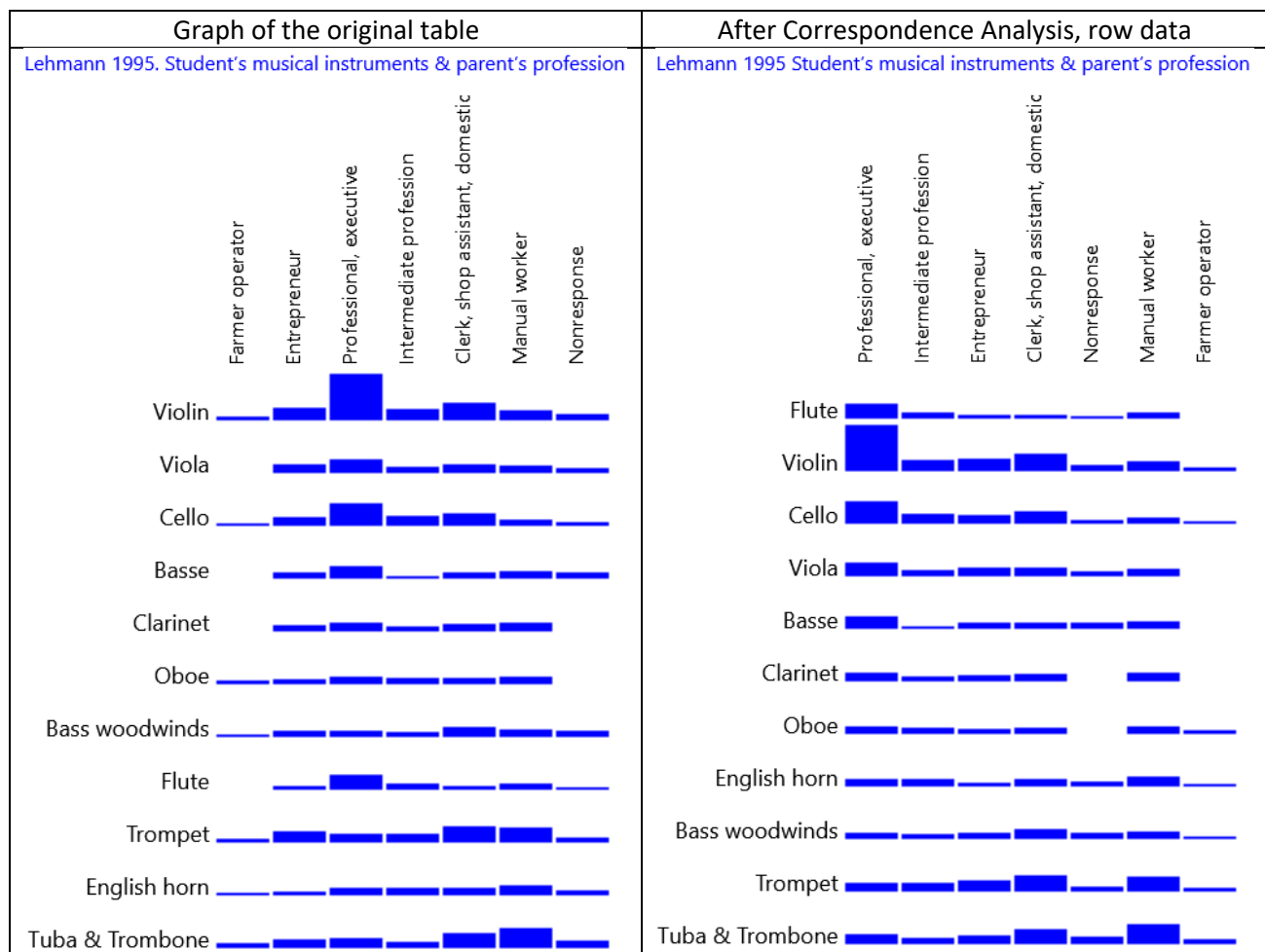
## Example-2: Instruments played by students of the Paris National Conservatory of Music and Dance (CNSM) and their parents' professions and socio-professional categories (PCS)

*L'orchestre dans tous ses éclats : sociologie de la profession de musicien*, by B. Lehmann. Doctoral thesis in Sociology defended in 1995 in Paris, EHESS.

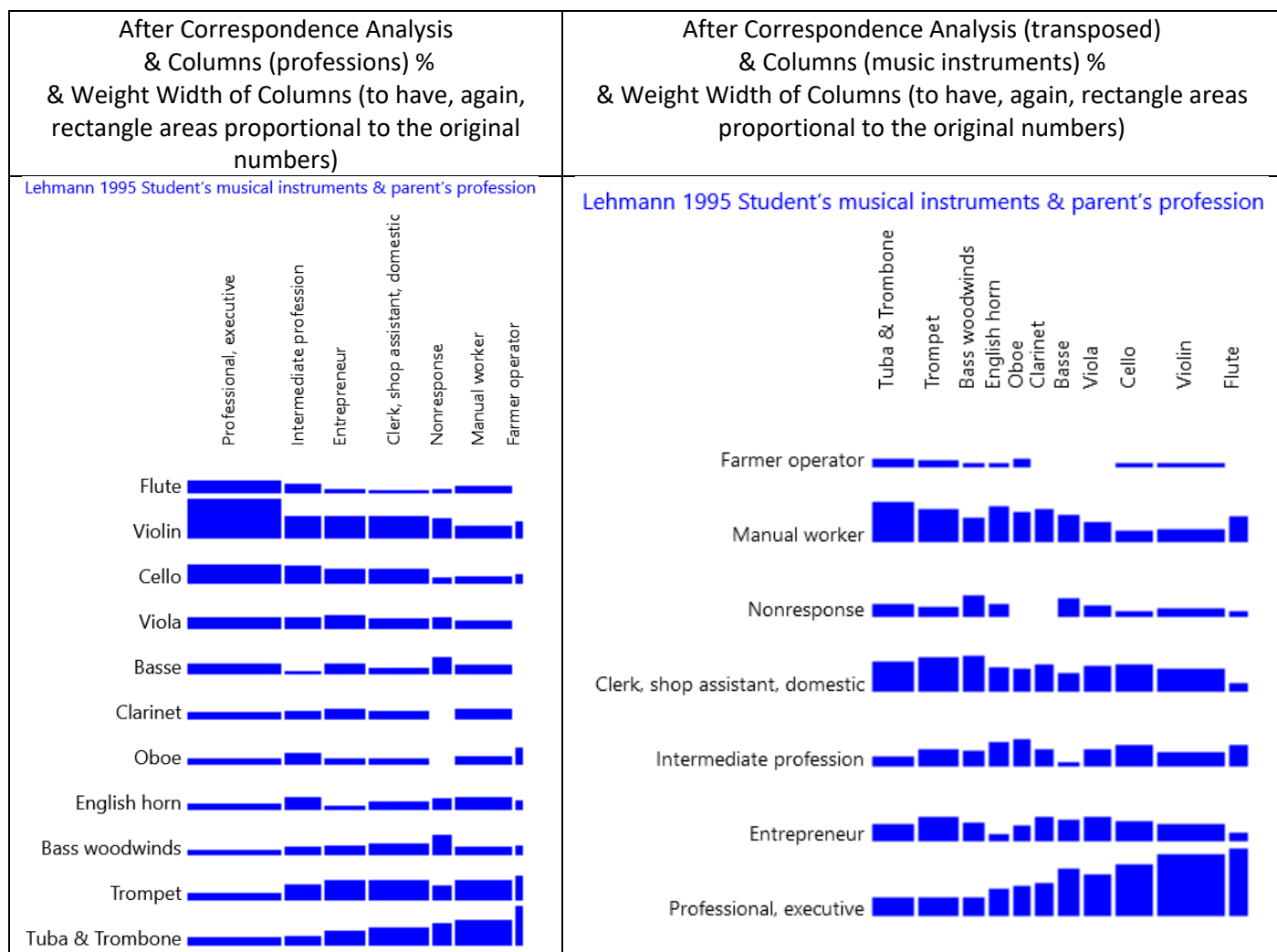
File: EN\_musical\_instruments-parents\_professions.TXT

<= This file can be opened by File / Samples

Sociology of the music profession. Lehmann 1995. Student's musical instruments & parent's profession	Farmer operator	Craftsman, shopkeeper, entrepreneur	Professional, executive, higher intellectual profession	Intermediate profession	Clerk, shop assistant, domestic worker	Manual worker	Nonresponse
Violin	2	17	69	15	24	12	7
Viola	0	10	18	7	11	8	4
Cello	1	11	32	12	16	6	2
Basse	0	7	16	1	6	9	6
Clarinet	0	7	10	5	8	10	0
Oboe	2	4	8	7	6	8	0
Bass woodwinds	1	6	6	5	12	8	7
Flute	0	2	20	6	2	7	1
Trumpet	3	15	11	10	22	21	5
English horn	1	2	9	8	8	12	4
Tuba & Trombone	5	11	12	6	20	27	8







The graph on the right shows that the flute and stringed instruments are chosen more by children from the well-to-do and "cultured" categories. On the other hand, brass and woodwind instruments are played more by the children of employees and workers (these instruments are played in the harmonies and brass bands thanks to which they often began their musical education); the children of farmers are few in number at the CSNS and their share of flute or string players is nil or very low.

### Example-3: Chronological "seriation" of archaeological objects.

Example of data inspired by those used by the archaeologist Sir Flinders PETRIE to date tombs excavated at Diospolis Parva in Egypt at the end of the 19th century. He had hypothesised that the type of objects and decorative elements characterised their period and that, consequently, their variations reflected the chronology.

In their book *Archaeology: Theories Methods and Practice*, 1991, Renfrew, C., & Bahn, P. G. give the following pedagogical example. [https://en.wikipedia.org/wiki/Seriation\\_\(archaeology\)](https://en.wikipedia.org/wiki/Seriation_(archaeology))

**File:** Egyptian\_pottery\_example.TXT    <= This file can be opened by File / Samples

Raw matrix of presence/absence of decorative elements on pottery according to Tombs A, B, C ...	Matrix becomes diagonal by changing the rows and columns ranks (according Correspondence Analysis first factor): the chronology appears clearly.
<p>The raw matrix shows the presence (1) or absence (0) of decorative elements (columns: A, B, C, D, E, F, G) for different pottery types (rows: beaker, blackrim, bottle, flatpot, handle, pointed, spirals). The matrix is not diagonal, indicating that the current ordering does not reflect the chronological sequence.</p>	<p>The matrix is reordered based on the first factor of Correspondence Analysis. The rows and columns are now ordered chronologically, resulting in a diagonal matrix where each pottery type is associated with a single decorative element, clearly showing the chronological sequence.</p>

The 2nd graphic is obtained, in one click, by the commands:

#### Process / Frequency Data or 0/1 / Processing with Correspondence Analysis

It shows the pottery (C, B, D, G, A, E and F) reordered along an axis of presence-absence of the decorative elements identified by the archaeologist; this rank probably corresponds to the chronological order (direct or inverse) of invention, then of abandonment, of these artistic creations.

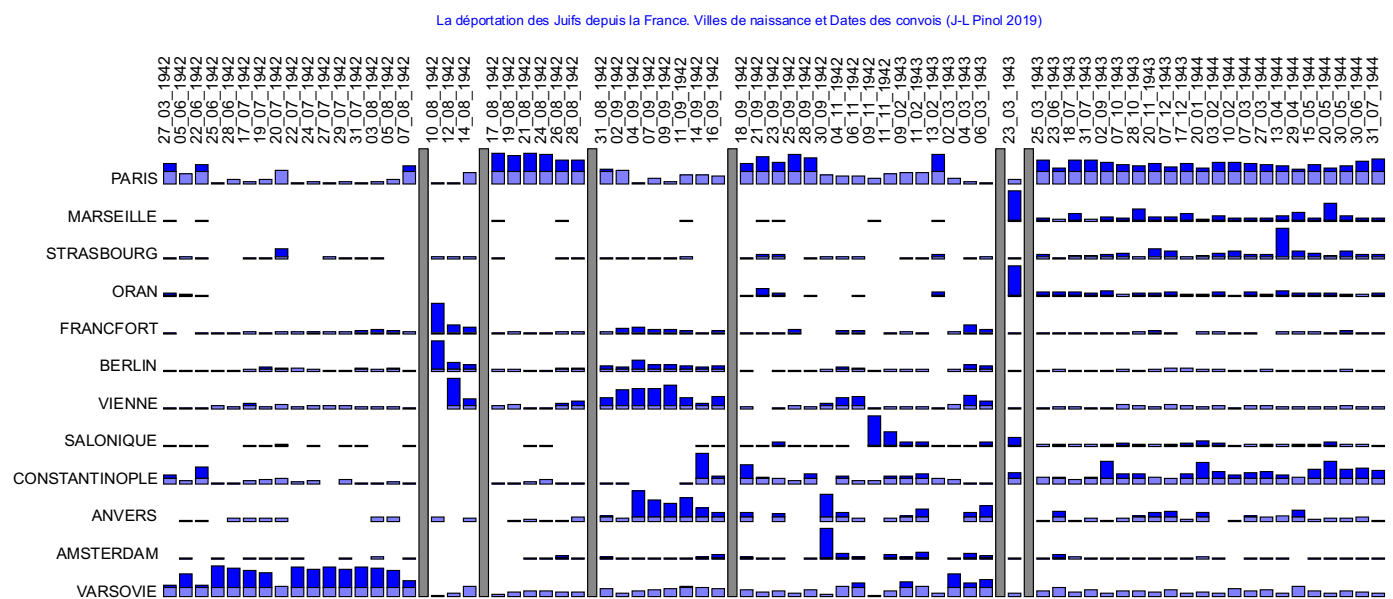
## Example-4: Chronological data: distribution of Jews deported from France according to convoys and cities of birth

In this example, we do not change the chronological order; the graph produced by AMADO online visualises the data table and supports the historian's commentary.

The graph represents the distribution of deportees to the Nazi death camps, born in a representative subset of cities, according to the convoys (% in columns) that left France. See Jean-Luc Pinol, *Convois, La déportation des Juifs de France*, Paris, Éditions du Détour, 2019.

**File / Samples:** Deportation\_Villes-naissance\_Convois.TXT

<= This file can be opened by File / Samples



On this graph, it is clear that the first 19 convoys (from March to August 7th 1942) included mostly Jews refugees in France, born in Warsaw (*Varsovie*); then from Germany (Berlin, Frankfurt) and Austria (Vienna) on August 10th, 12th and 14th 1942; after the *Rafle du Vel d'Hiv* (more than 13,000 French Jews were rounded up in Paris and herded into Paris velodrome), the deportees of the convoys from August 17th to 28th were mostly born in Paris.

From 31 August 1942 until 16 September, eight convoys transported people arrested during the great round-up of 26 August in the *unoccupied zone* where many Jews from Germany (Frankfurt, Berlin) and Austria (Vienna) and Belgium (Antwerp) had taken refuge.

The convoy that left on March 23<sup>rd</sup>, 1943 deported mostly Jews born in Marseille or Algeria, arrested after the destruction of the *Vieux Port* district of Marseille in January 1943.

## Example-5. The working population of the Paris districts (25 to 54 years old) in 2015

**File: EN\_Paris2015\_Districts-Professions.TXT** <= This file can be opened by File / Samples

Paris labour force (2015) 25 to 54 y. old	entrepreneur	Professional, executive	Intermediate profession	Clerk, shop assistant, domestic	Manual worker
Paris 01	601	3651	1491	991	325
Paris 02	647	5969	2239	1404	599
Paris 03	1161	9005	3811	2206	713
Paris 04	871	5908	2621	1738	418
Paris 05	1145	12188	4699	2627	849
Paris 06	1062	7971	2842	1813	487
Paris 07	1532	10642	3417	2836	638
Paris 08	1203	7546	2461	2236	633
Paris 09	1880	15821	6028	3534	1247
Paris 10	2322	21477	9936	7228	2937
Paris 11	3211	35521	17426	10837	4143
Paris 12	2172	29285	14779	10556	3550
Paris 13	2604	28770	16884	15580	5503
Paris 14	2116	26809	11685	9988	2832
Paris 15	4066	50880	21436	15601	4676
Paris 16	4730	27917	10677	8916	2382
Paris 17	4095	37101	15304	11636	4051
Paris 18	4299	37529	21749	17266	8808
Paris 19	3213	25364	18532	17815	7803
Paris 20	3096	30256	21563	18382	7829

**File / Open / Parcourir / EN\_Paris2015\_Arrondissements.TXT**

**Process / Transpose**

**Format / Row Legends / Complete**

**Typography / Increase Column Spacing (2 times)**

**Format / Graph Size...** Graph width = 950 Graph height = 400 (Uncheck: ☒ Auto resize → ☐ Auto resize )

**Format / Mode 3**

**Process / Frequency Data / Hierarchical Clustering**

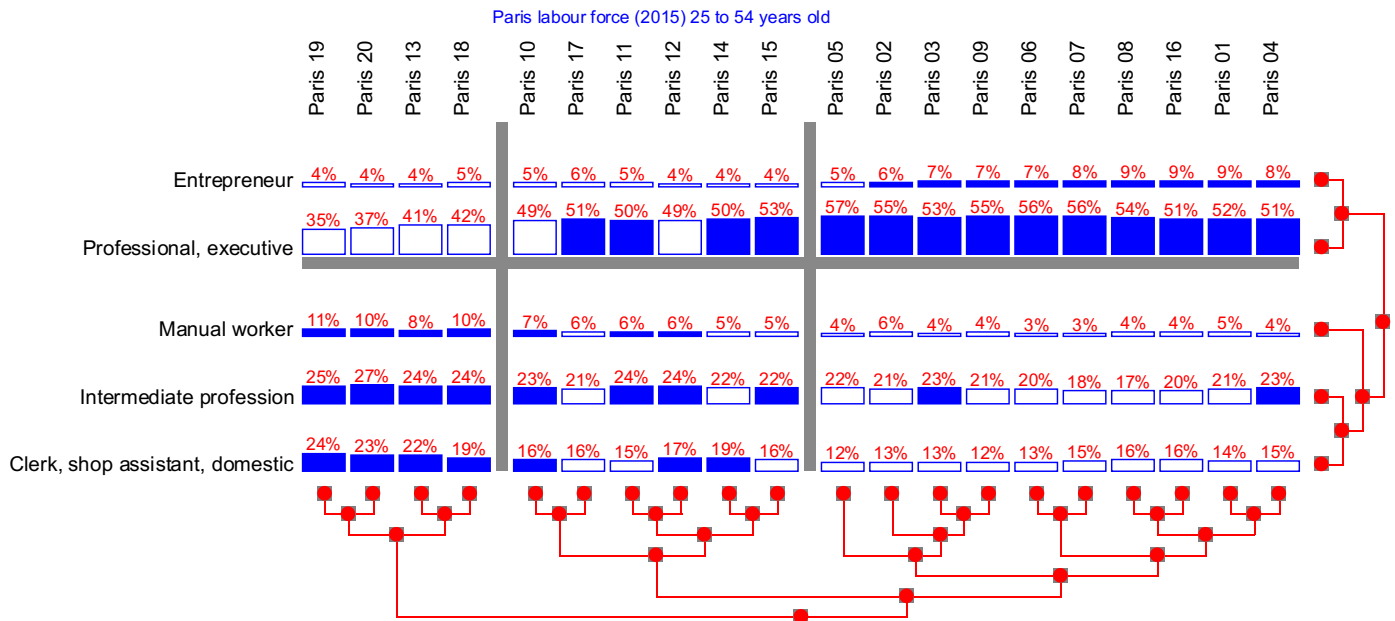
**Process / Compute Column Percentage**

**Format / Value Format / 0%**

Click on the line "Manual Worker", then **Process / Insert separator** (the insertion is done before the selected column or above the selected line).

Click on the column "Paris\_10", then **Process / Insert separator**

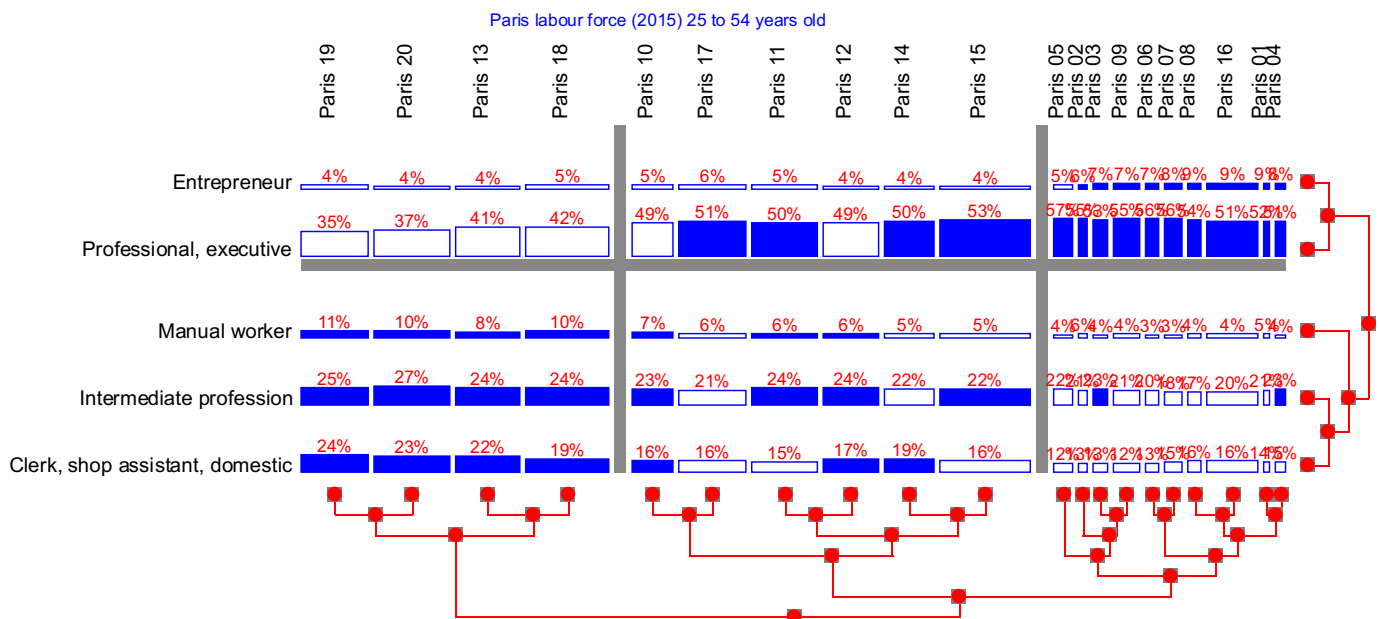
Click on the "Paris\_05" column, then **Process / Insert separator**



On this graph, we can see the separation between - on the one hand, the eastern districts of Paris (19°, 20°, 13° and 18°) where relatively more manual workers, middle-class people and employees live; - on the other hand, the arrondissements of the Centre of Paris (5°, 2°, 3°, 9°, 6°, 16°, 1° and 4°) where more Managers and Senior Executives live; - and, in the middle of the graph, the intermediate arrondissements from the sociological point of view (10°, 17°, 11°, 12°, 14° and 15°). Here the numbers and heights represent the column %, i.e. the distribution of the working population aged 25 to 54 in each district.

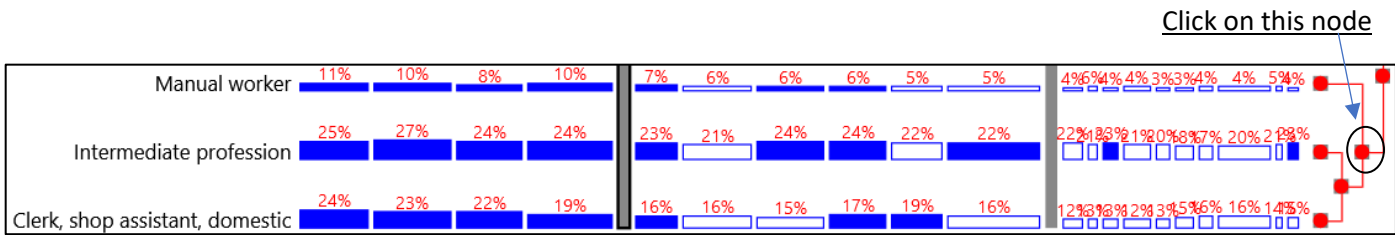
The graph can be enriched by introducing additional information: by making the column widths proportional to the sum of each column in the initial table (i.e. to the total population of 25-54 year olds in the district), the heights of the rectangles remain proportional to the % of each PCS in the district, but the surface area of the rectangles becomes proportional to the size of the sub-population concerned.

### Format / Weight Width of columns

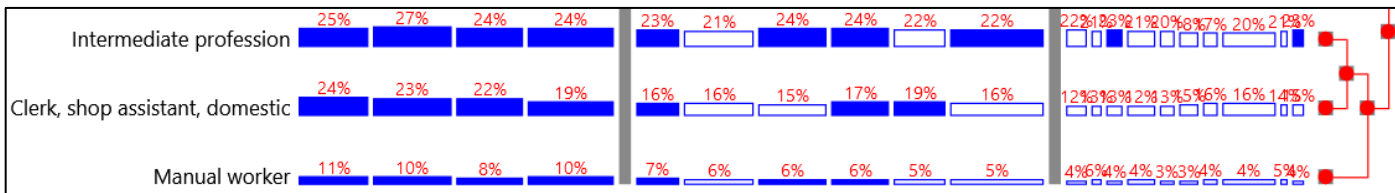


For example, in Paris\_19, there are 3213 entrepreneurs, more than in Paris\_09 where there are 1880. But, in proportion, there are aa% in Paris\_19, less than the bb% in Paris\_09. But, proportionally, there are 4% in Paris-19, less than the 7% in Paris-09.

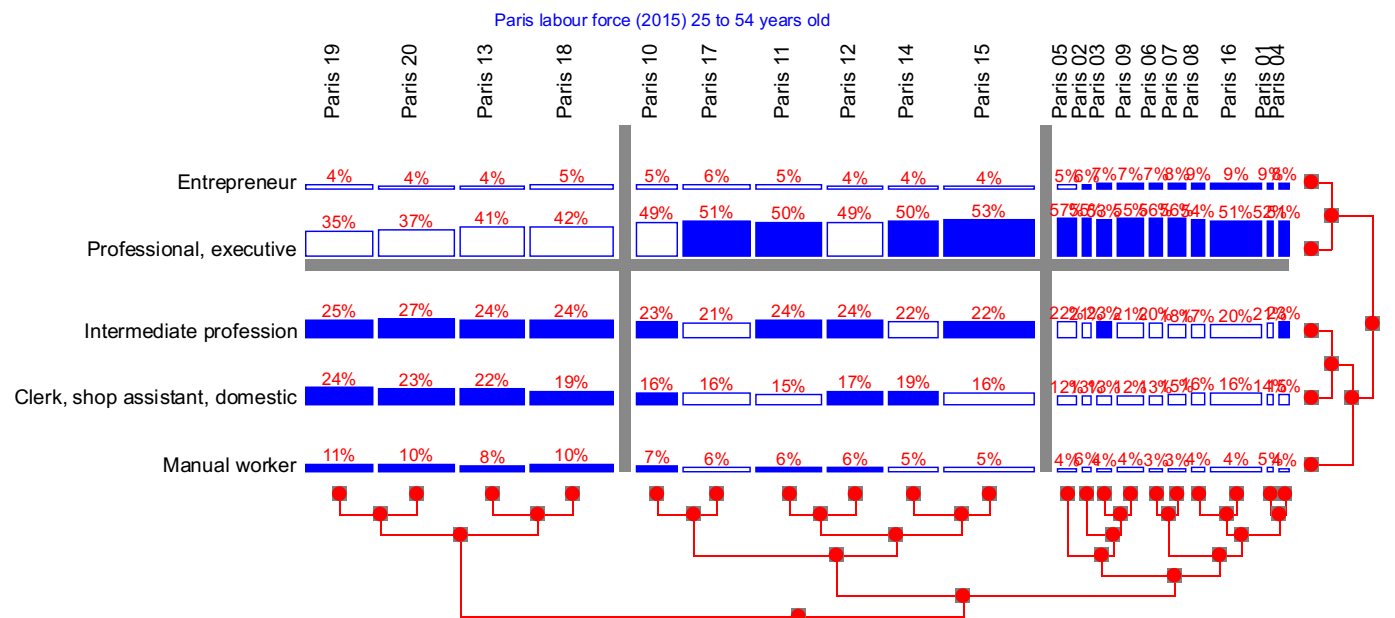
Since, at each node of the clustering tree, the order of the two classes is arbitrary, this order can be reversed by simply clicking on the small red square representing the node.



Below, the line "Manual worker" is moved to the very bottom of the graph, as opposed to "Contractors".



Finally, we get:



# Example-6. Searching for blocks in a square co-occurrence matrix. A study in territory marketing

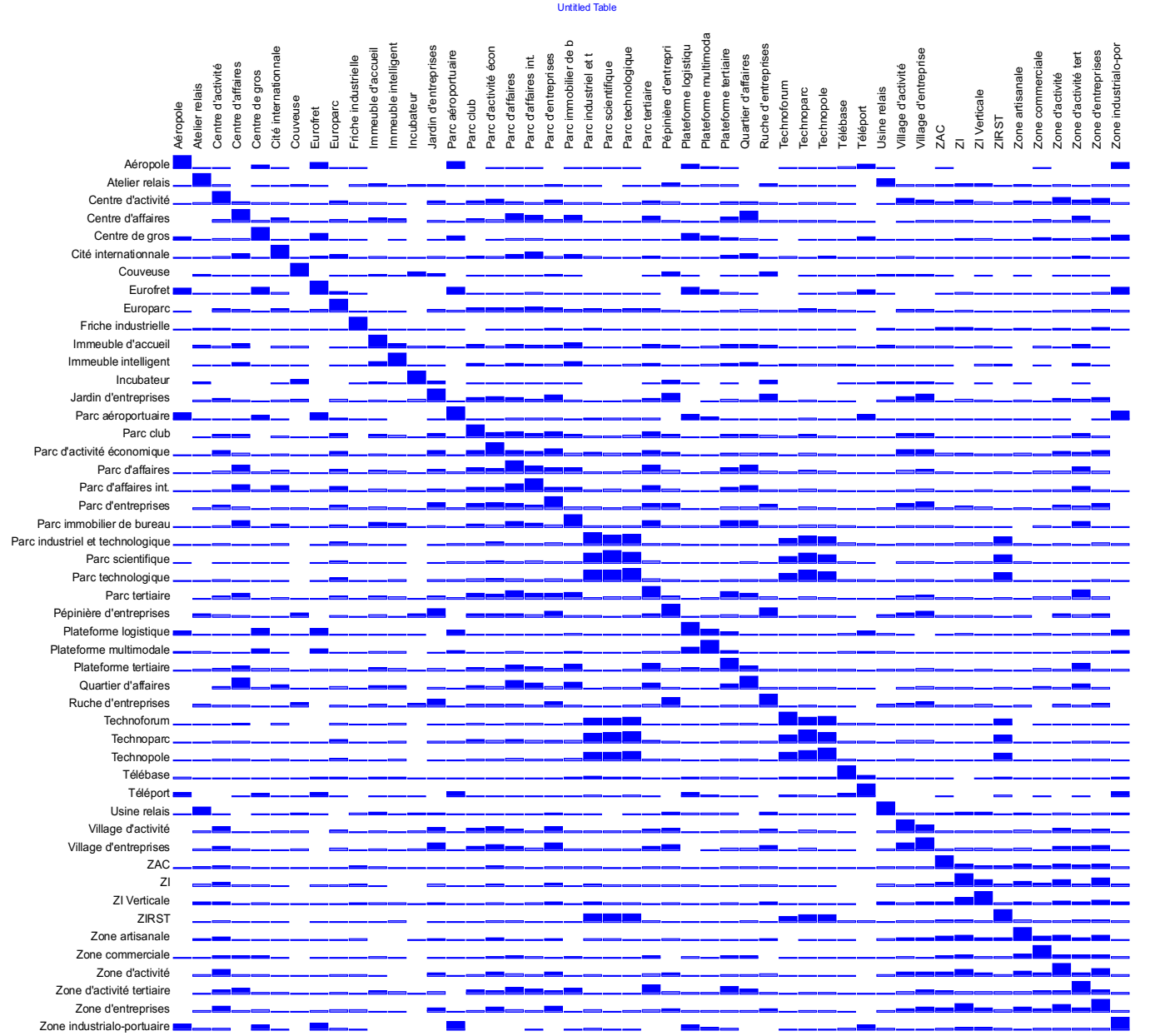
In order to attract new businesses to their territories, many towns and cities are marketing possible business location sites. These sites (brands) have various names (industrial zone, techno-park, etc.). To help reduce the "range" of possible location names offered to businesses by local authorities, 72 business leaders were asked to group 49 cards on which were written the names of sites proposed by different French cities, with each group gathering the names that seemed synonymous to them. There were no constraints on the number and size of groups a respondent could form. Each interviewee also had the option of omitting any card bearing a site name that was unknown to him or her. The matrix gives the number of times two names have been put together<sup>2</sup>. It can be seen as a proximity type similarity matrix.

File / Open / Parcourir / MARKETING-Territorial.TXT <= This file can be opened by File / Samples

Ctrl + - => to decrease the menu font and access the last lines of the sub-menus.

Format / Value Format / None                      Format / Row Legends / Complete

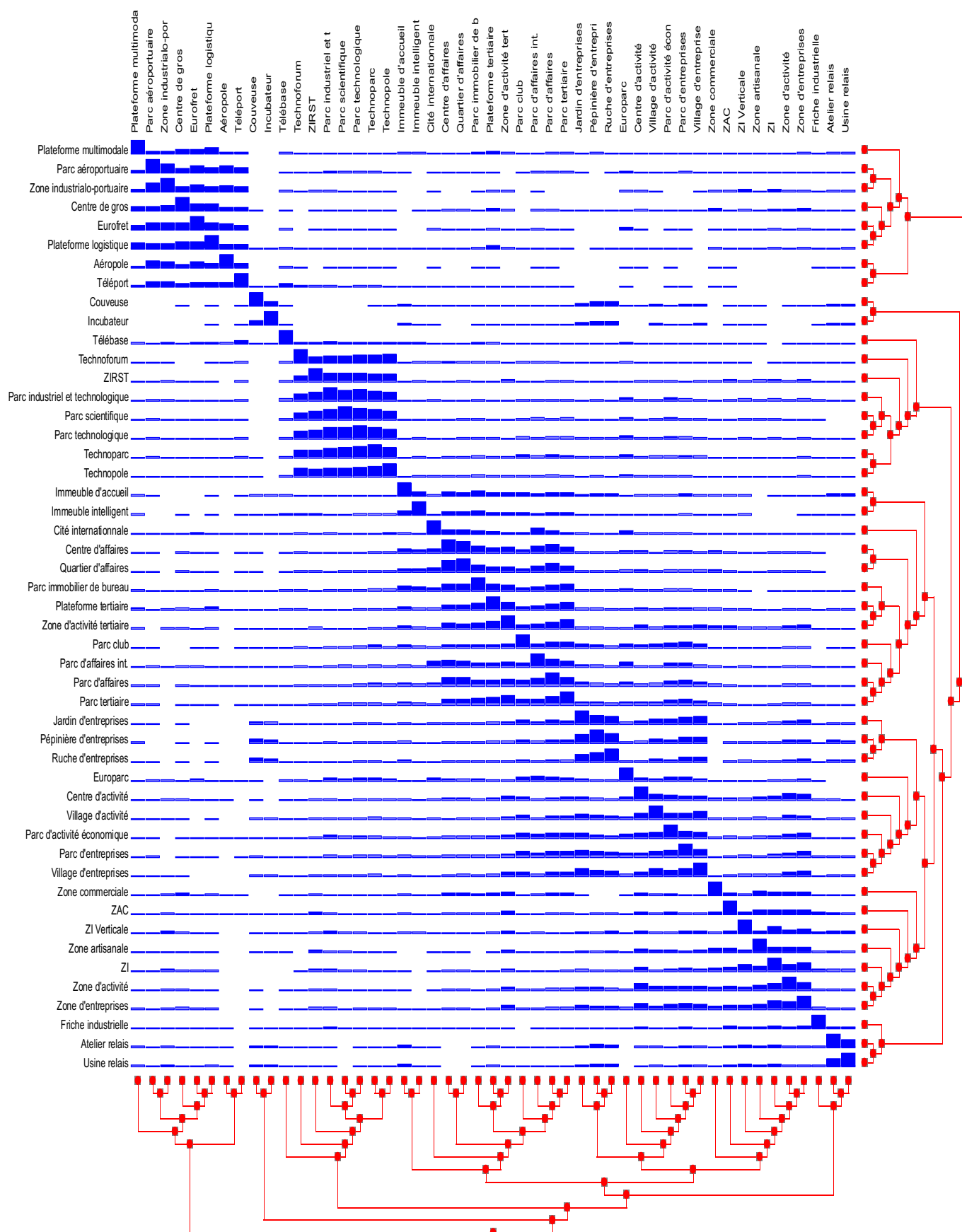
Format / Column Legends / 20                      Format / Graph Size / 1438 et 1278



<sup>2</sup> TEXIER Laurence. 1999, « Une clarification de l'offre d'implantation en marketing territorial : produit de ville et offre de territoire », RERU Revue d'économie régionale et urbaine, no 5, p. 1021-1036

To find blocks of names that are often classified together as synonyms, the classification (hierarchical ascending clustering) integrated in AMADO online is used: **Process / Frequency Data / Hierarchical Clustering**

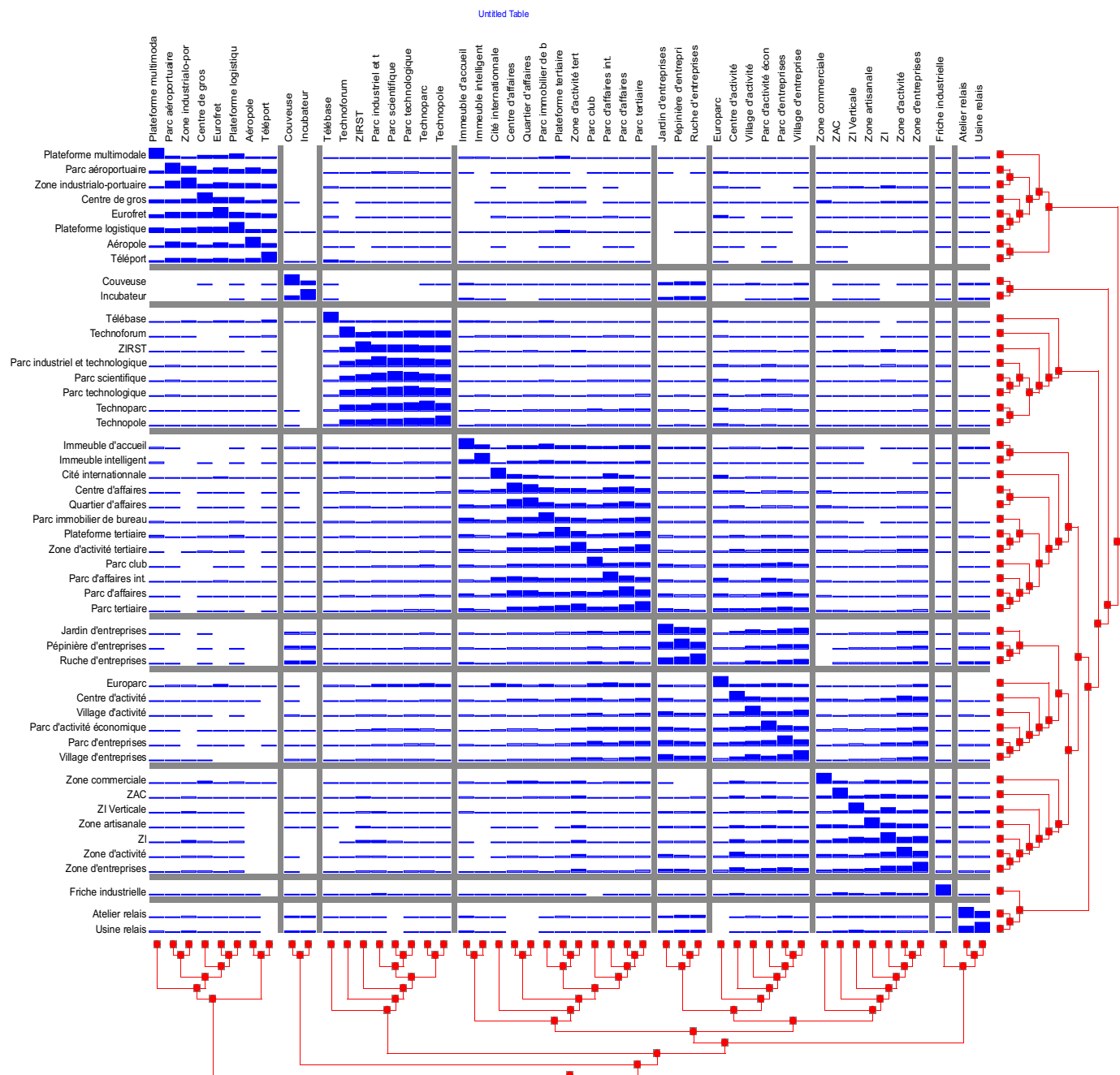
Untitled Table





Classes are best seen by isolating them with separators:

Click on a column (or a row) to select it and **Process / insert a separator** between it and the previous one:



On this graph, we can see that certain groups of names are almost synonymous for the heads of companies:

- *Plateforme multimodale, Parc aéroportuaire, Zone industrialo-portuaire, Centre de gros, Eurofret, Plateforme logistique*; then slightly separated: *Aéropole, Téléport*.
- *Couveuse* (hatchery), *Incubateur*.
- *Technoforum, ZIRST* (Zones d'Innovation et de Recherche Scientifique et Technique), *Parc industriel et technologique, Parc scientifique, Parc technologique, Technoparc, Technopole*. It can be observed that the names *Parc Scientifique* et *Parc Technologique* are almost confused in the minds of business leaders.
- *Jardin d'entreprises, Pépinière d'entreprises* (Business Nursery), *Ruche d'entreprises* (Business Beehive),
- *Atelier relais* (Bridging Plant) et *Usine Relais* (Bridging Factory).

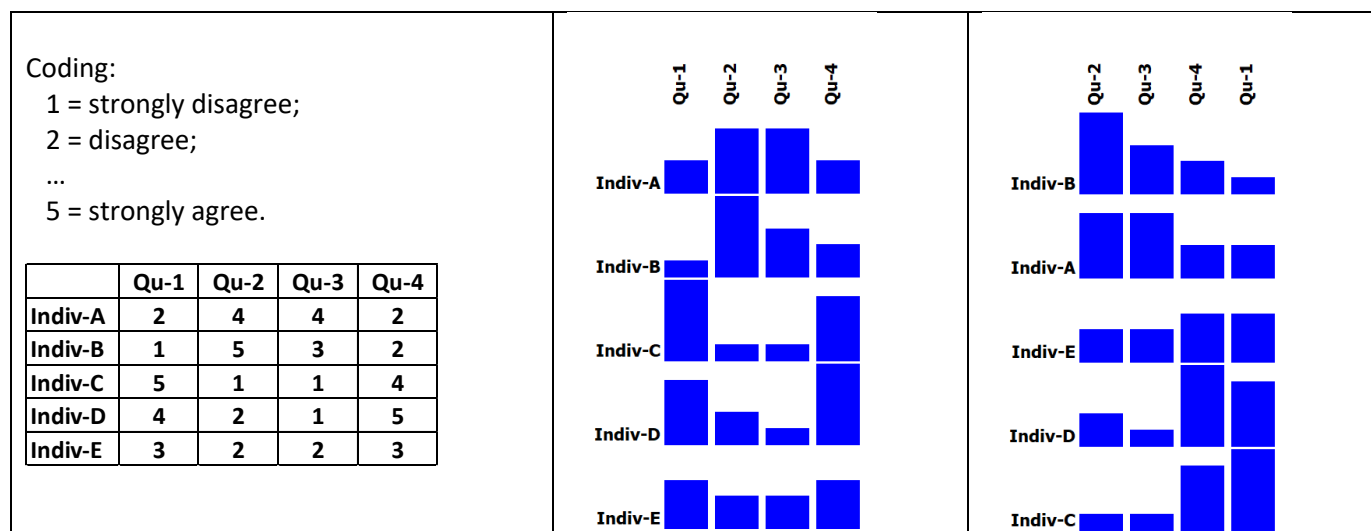
Those responsible for a territory's marketing campaign will have to reduce the range of activity sites they offer and use only one name per group, while being aware that other territories use synonyms.

# Homogeneous Numerical data processing: diagonalisation & clustering

These statistical methods are suitable for tables where the columns represent variables with homogeneous units, e.g. the responses of a set of individuals to questions all using the same scale (for instance: strongly disagree=1; disagree=2; ... strongly agree=5), or unit prices, or temperatures, etc.

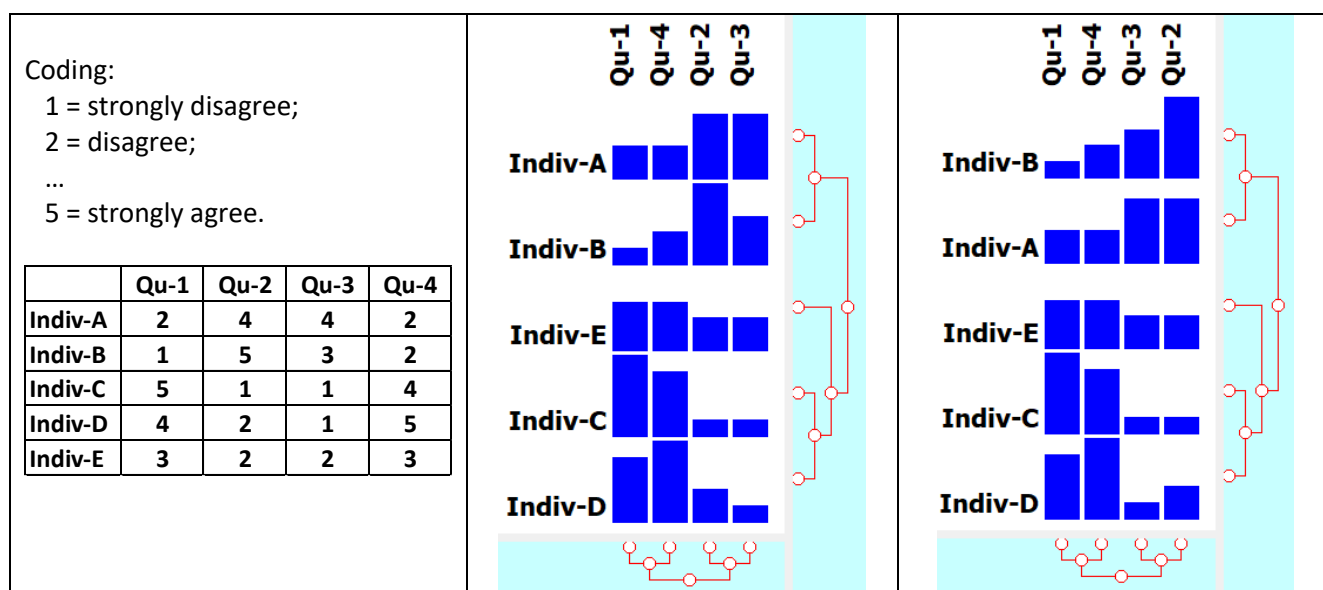
With "**Process / Homogeneous numerical data / Processing by PCA** (Principal Component Analysis)", the rows-individuals are reordered according to their coordinates on the first factor (i.e. the first principal component), and the columns-variables according to their correlations with this first factor.

## Principal Component Analysis.



With « **Process / Homogeneous numerical data / Hierarchical Clustering** », the lines are permuted as the nodes of the Hierarchical Ascending Classification tree and this tree is drawn to the right of the graph. As the columns are swapped as the nodes of the Hierarchical Ascending Classification tree and this tree is drawn at the bottom of the graph.

**Note:** since at each node of the tree the order of the two classes is arbitrary, **this order can be reversed by simply clicking on the small red square representing the node.** Below, the columns Qu-2 and Qu-3, and the rows Indiv-A and Indiv-B have been swapped.



# Heterogeneous Numerical data processing: diagonalisation & clustering: 24 car models according to 6 characteristics

These treatments are suitable for tables with columns representing variables of different units. Example for cars: Engine capacity in cm<sup>3</sup>, Power (horsepower), Speed in Km/h, Weight in Kg, Width and Length in cm.

In order to avoid the choice of units, and to make them homogeneous for the calculations, each variable is "normalized".

File: EN\_Cars\_2004\_Tenenhaus.TXT <= This file can be opened by File / Samples

Format / Row Legends / Complete & Format / Column Legends / Complete

Format / Value Format / None

Typography / Increase Column Spacing (2 times)

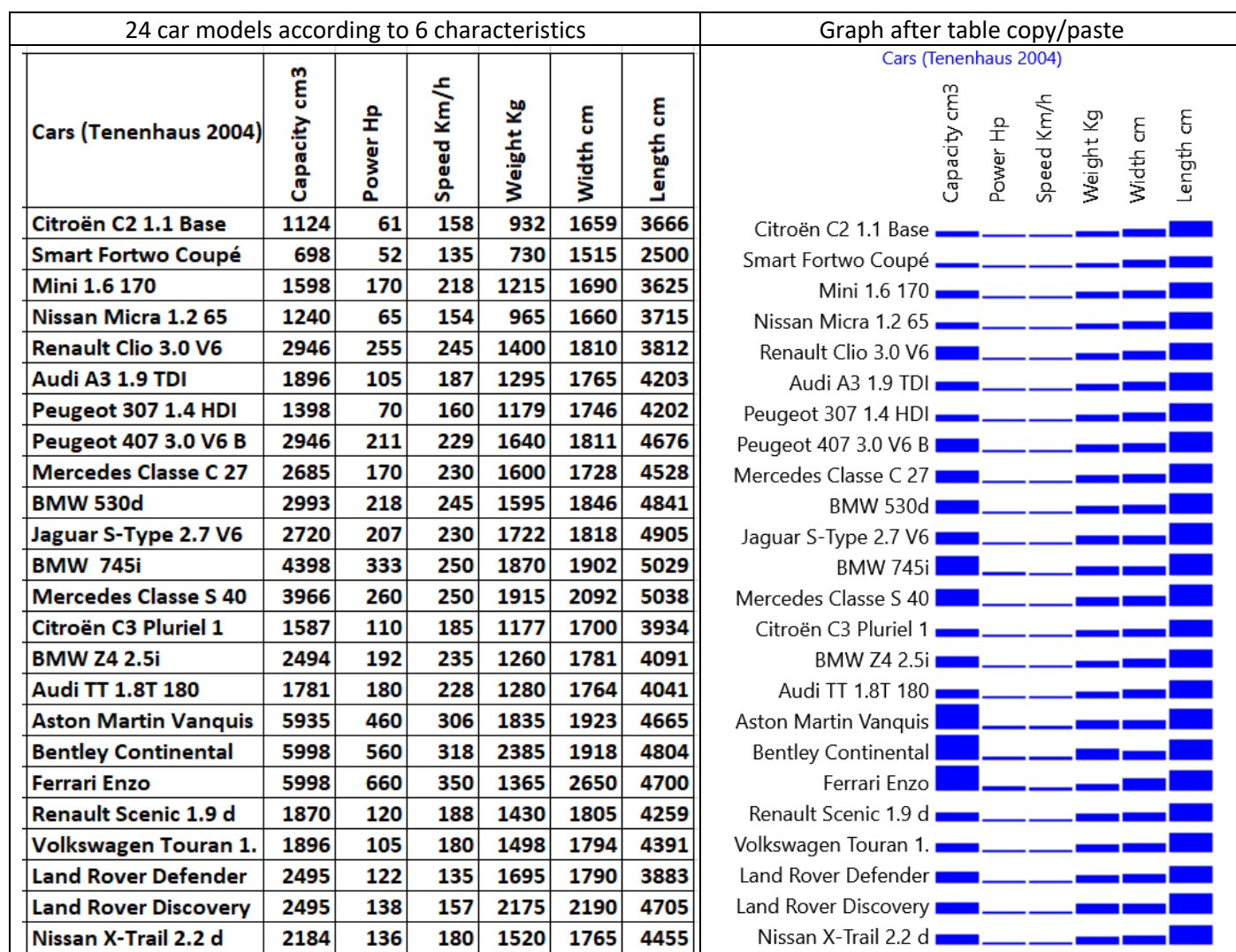
Format / Graph Size... Graph width = 480 Graph height = 690 (Uncheck: ☒ Auto resize → ☐ Auto resize )

Format / Mode 3

Process / Frequency Data / Hierarchical Clustering

Process / Compute Column Percentage

Format / Value Format / 0%



In the graph, the heights of the rectangles are proportional to the numbers in the table, which makes no sense here; as these numbers are in different units (cm<sup>3</sup>, Hp, Km/h, cm...) they are not comparable.

For all subsequent calculations, it will therefore be necessary to normalise them (i.e. each value in the table is centred on its column mean and then divided by the column standard deviation.; we then obtain pure numbers, i.e. "without dimension")  $X_{ij} \rightarrow [(X_{ij} - m_j) / \sigma_j]$  In this case of "heterogeneous numerical data", the calculation procedures, Principal Component Analysis and Clustering, are performed on these "pure numbers".

Because *AMADO online* can only represent positive numbers, we add to these "normalised" numbers their minimum in the column; the smallest value becomes zero; in our example, the "*Smart Fortwo Coupé*" is the smallest car out of the 6 variables, the 6 values become zero for it in the following graphs.

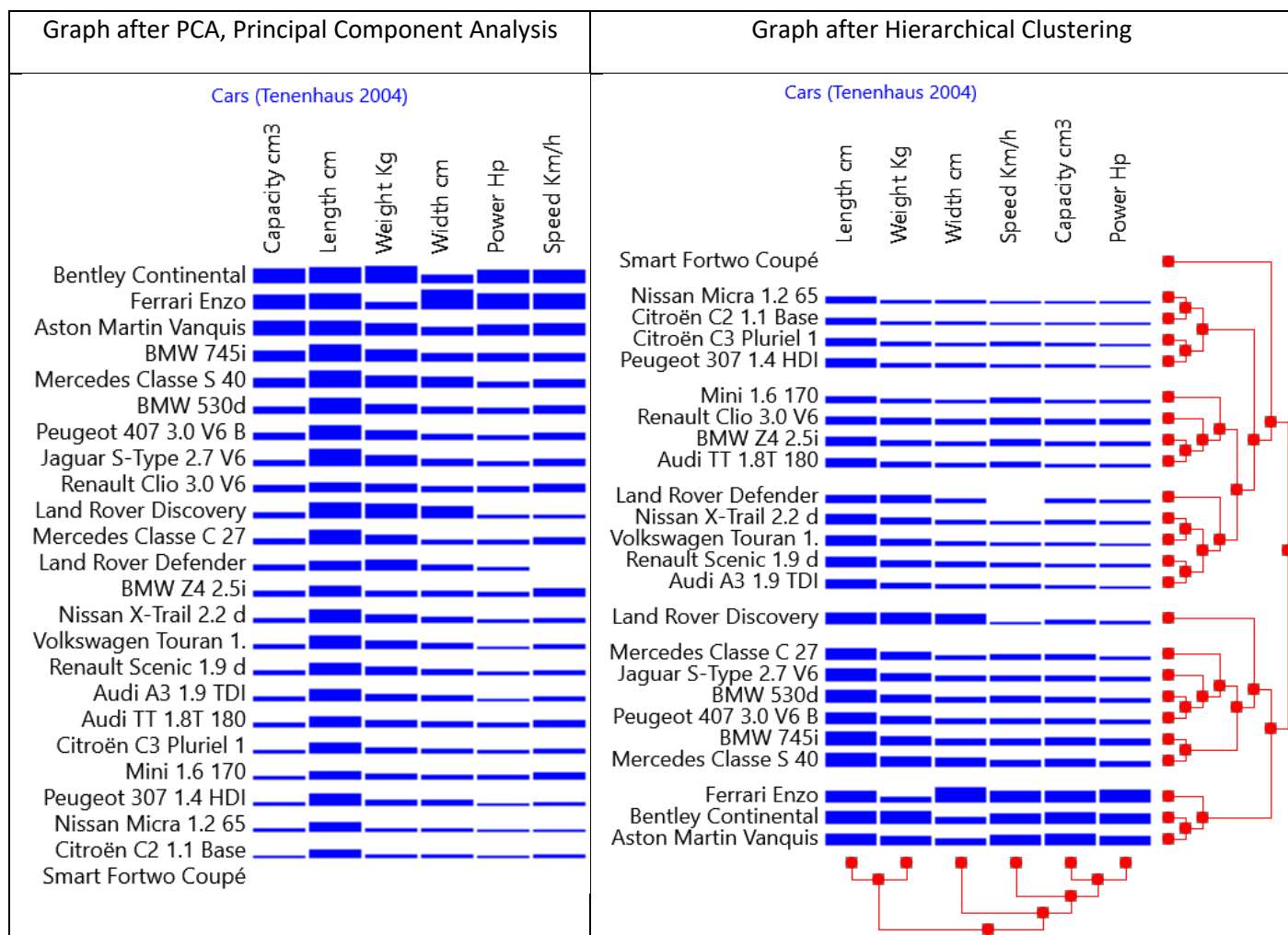
### Process / Heterogeneous numerical data / Processing with normalized PCA

#### Process / Normalize Columns

#### Process / Heterogeneous numerical data / Hierarchical Clustering

#### Format / Separators / 10

#### Format / Separators / Invisible



On the classification tree, you can see car classes: - The *Smart Fortwo Coupé* is alone, clearly the smallest for all variables; - Then *Citroën C2 1.1 Base*, *Nissan Micra 1.2 65*, *Citroën C3 Pluriel 1*, and *Peugeot 307 1.4 HDI* form a homogeneous group of 4 small cars; - As are (but more sporty) *Mini 1.6 170*, *Renault Clio 3.0 V6*, *BMW Z4 2.5i* and *Audi TT 1.8T 180*; - Next comes a group of 4 large family cars *Land Rover Defender*, *Nissan X-Trail 2.2 d*; *Volkswagen Touran 1*; *Renault Scenic 1.9 d* and *Audi A3 1.9 TDI*; - The *Land Rover Discovery* is specific, being long, wide and heavy, relatively unpowerful for its size and rather slow; - Next comes a group of 6 luxury sedans, large, nervous and fast: *Mercedes Classe C 27*; *Jaguar S-Type 2.7 V6*; *BMW 530d*; *Peugeot 407 3.0 V6 B*; *BMW 745i*; *Mercedes Classe S 40*; - Ultimately, cars, both large, very powerful and extremely expensive, form the last group: *Ferrari Enzo*, *Bentley Continental* and *Aston Martin Vanquis*.

As for the variables, we can see that *weight* and *size* are strongly correlated, as are *capacity* and *power* and, a little less so, *speed*.

# BERTIN's Graphic

AMADO-online allows you to graphically represent a numerical cross-table and then to permute the rows (and columns) to reveal the data structure: - either a diagonal structure (seriation) if it exists, - or a class structure of the rows and columns, or even blocks.

This user's guide presents several types of tables with, for each one, the source data and the sequence of commands in the AMADO-online menus that allow the reproduced graphics to be obtained.

AMADO-online is a tool adapted to small or medium sized tables (up to fifty rows and columns)<sup>3</sup> such as those constructed in the Social and Human Sciences where each element has been precisely defined and must be clearly positioned in the overall picture.

The graphs produced by AMADO online are faithful to the data and simple to understand; they give the reader direct access to the result: each piece of information - each number in the data table - is restored in its original form, the numbers are represented by rectangles whose heights are proportional to the values in the original table, either in absolute numbers or in percentages.

The idea of permuting the rows and columns of a matrix in order to reveal a hidden structure in a data matrix is an old one: Sir W. M. Flinders Petrie (1899) presented a century ago a "sequence in prehistoric remains", i.e. a chronological "seriation" of the shapes and decorative elements of objects found during archaeological excavations in Egypt. As Phipps Arabia, Scott Boorman & Paul Levitt (1978), Giles Caraux (1984) and Jean-François Marcotorchino (1987) have pointed out, this idea is increasingly influential in applied mathematics and the cognitive sciences.

Jacques Bertin (1967, 1977) came up with the idea of putting histograms side by side, using an appropriate scale, and permuted the elements to reveal the underlying structures in the data. Since then, this approach has gained considerable momentum (Bord 1997, Palsky 2017, Harvey 2019). Originally, Bertin and his team worked with sets of wooden cubes that they moved several times by hand, first the rows, then the columns, then the rows, etc. Then, the spread of multidimensional data analysis methods (Cordier 1965, Benzécri 1973, Arabie & al. 1978, Greenacre 1984, Caraux 1984, Tenenhaus & Young 1985, Hoffman DeLeeuw 1992) somewhat overshadowed this empirical approach.

Of course, the numerical techniques of data analysis make it possible to quickly discover the main features of the structure of the table. This saves a considerable amount of time in the search for the best pair of permutations of the  $n$  rows and  $p$  columns of the table among the  $n! p!$  possible solutions. However, in factor analysis, lists of coordinates and other "*numerical aids to interpretation*" are useful to the statistician but often incomprehensible to the social scientist; the same applies to *factorial graphs*, *cloud of individuals*, *circle of correlations*, *simultaneous representation*, etc. Their interpretation requires a trained eye, and they may owe part of their success with the general public to their very esotericism ... For their part, classification trees give a useful but distorted ("*ultrametric*")<sup>4</sup> representation of the original table, and almost always for only one side of the table, either the rows or the columns. But many lists of *averages*, *marginal and conditional means*, *standard deviations*, *contributions*, etc., are necessary to clarify the meaning of such a tree.

On the contrary, as will be seen in the examples presented here, AMADO online uses factor analysis or classification and then gives the reader direct access to the result: each piece of information - each number in the data table - is restored in its original form, either as an absolute number or as a percentage. It is only the order of the rows and columns that has changed, but it is all there.

---

<sup>3</sup> The method of graphic representation proposed by Bertin has been adapted to the very large data tables by Jean Daniel Fekete and his collaborators (2015, 2016).

<sup>4</sup> A distance is ultra-metric if all the triangles are isosceles, the 3<sup>rd</sup> side being smaller than the two equal sides. This is the case when the distance of two elements is measured by the height of the smallest node that joins them together in a hierarchical classification tree. This type of distance is very special; for example, it is impossible to place more than 3 points in a plane such that their distances (in the usual geometric sense) meet this ultrametric condition.

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# Appendix

## Appendix 1: PNG or SVG graphics format?

**File / Export to SVG copies** the chart, in SVG (*Scalable Vector Graphic*) format, to the "Downloads" folder on the computer. See the appendix on how to crop an SVG chart that has been pasted into Word, Excel or PowerPoint.

**File / Export to PNG copies** the chart in PNG (*Portable Network Graphics*) format, to the "Downloads" folder on the computer, so that it can be pasted into Word, Excel, or PowerPoint.

SVG and PNG both are a type of image format to store images. SVG is a vector-based image format where an image is represented by set of mathematical figures and PNG is a binary image format and it uses lossless compression algorithm to represent image as pixels.

Following are the important differences between SVG and PNG.

Sr. No.	Key	SVG	PNG
1	Stands for	SVG stands for <i>Scalable Vector Graphics</i> .	PNG stands for <i>Portable Network Graphics</i> .
2	Image type	SVG image is vector based.	PNG image is pixel based.
3	On Zoom	SVG image quality remains same while zooming.	PNG image quality degrades while zooming.
4	Basis	SVG images is made up of paths and shapes.	PNG images is made up of pixels.
5	Editable	SVG images are editable.	PNG images are not editable.
6	Extensions	SVG images use .svg extension.	PNG images use .png extension.
7	Usage	SVG images are used in devices using high resolution images.	PNG images are generally used in image creation.

<https://www.tutorialspoint.com/difference-between-svg-and-png>


## Appendix 2: How do I crop an SVG graphic that has been pasted into Word, Excel or PowerPoint?

When the graphic has been pasted in Word, Excel, PowerPoint, etc., **click on its border** to select it, then **right-click** to

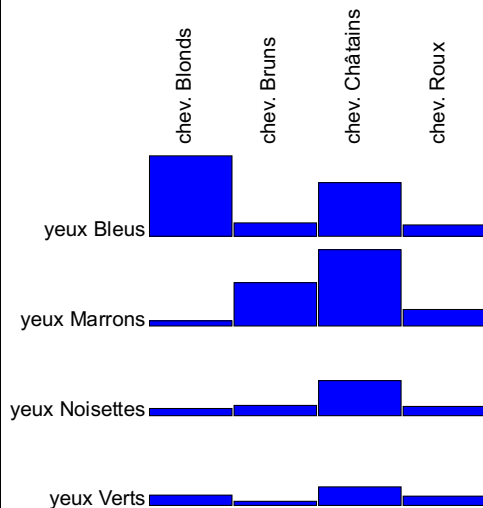
Format de l'image

open the dialogue box and **click at the bottom** on **Image Format**; you get



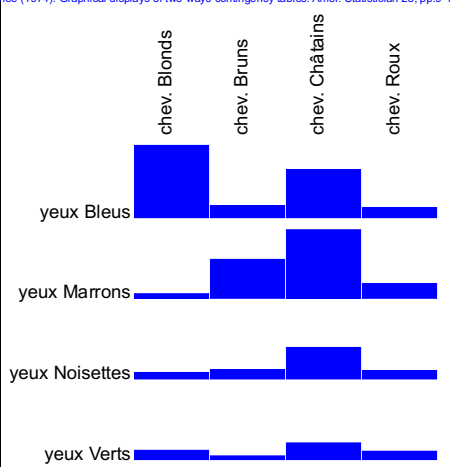
**Click on the icon on the right** , then on the "Crop" line; you can then modify the widths of the right and bottom margins by changing the values of Crop Position, Width, Height which are at the bottom of the dialogue box.

Lee (1974). Graphical displays of two-ways contingency tables. Amer. Statistician 28, pp.9-12



The following graph is obtained. The size of this image can then be changed by clicking on the edge and moving the mouse.

Lee (1974). Graphical displays of two-ways contingency tables. Amer. Statistician 28, pp.9-12





# Appendix 3: Correspondence Analysis = Optimal Coding of Rows and Columns

## Why is Correspondence Analysis an effective tool for reordering rows and columns in a table?

Michel Tenenhaus and M., Young, F.W. showed in their 1985 article (*An analysis and synthesis of multiple correspondence analysis, optimal scaling, dual scaling, homogeneity analysis and other methods for quantifying categorical multivariate data. Psychometrika* 50, 91–119) that there are multiple ways of understanding Factorial Correspondence Analysis; identical, but differently named, methods have been proposed during the development of science in different countries: *Optimal Scaling, Optimal Scoring & Appropriate Scoring methods* in the USA; *Dual Scaling* in Canada; *Homogeneity Analysis* in the Netherlands; *Scalogram Analysis* in Israel; *Quantification Method* in Japan; etc.

**Example.** Let us start with a matrix that crosses the eye and hair colours of 16 people.

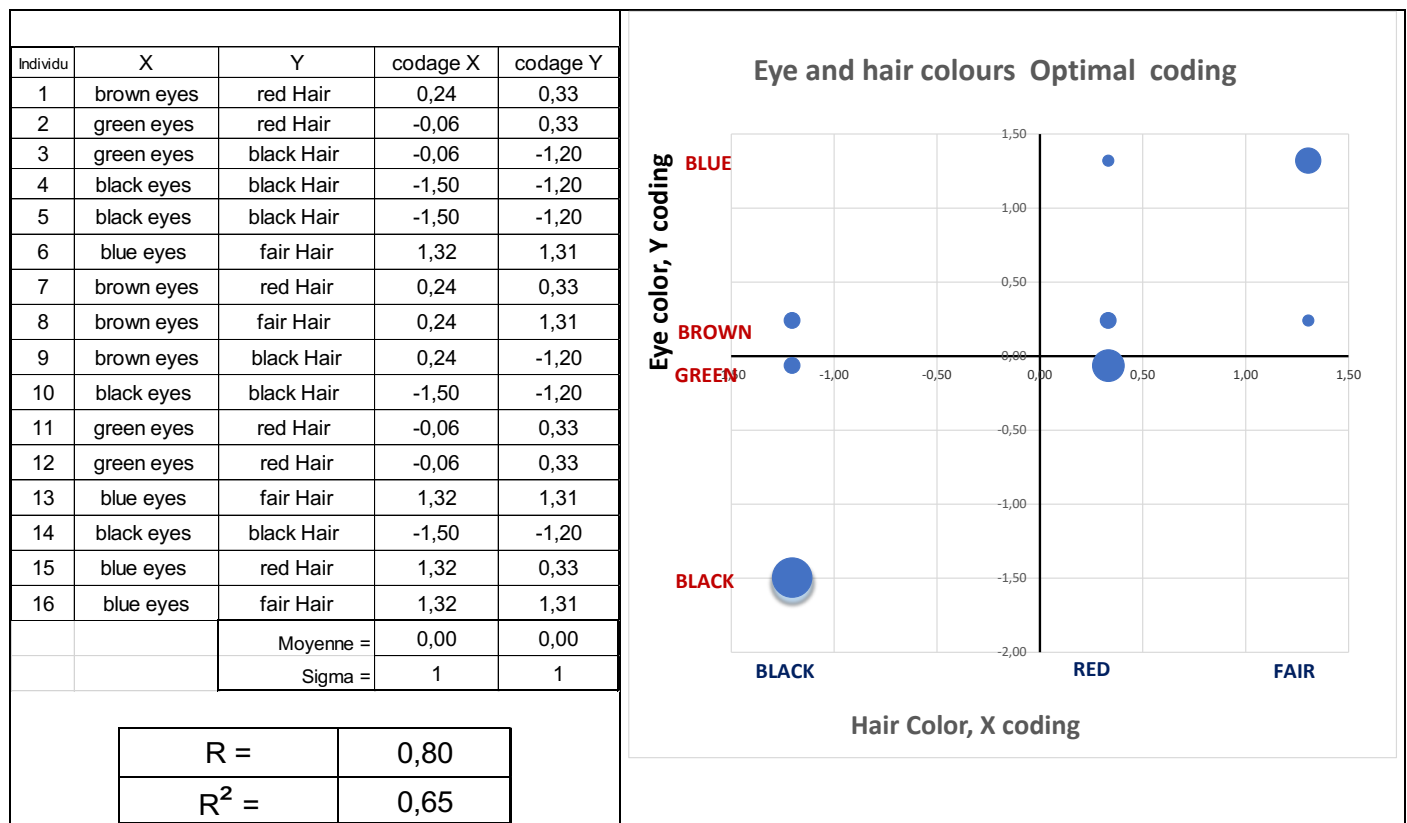
This data can also be in the form of a "database" with the identifier of individuals and two qualitative fields: eye colour and hair colour.

								identifier	X	Y
								1	brown eyes	red Hair
								2	green eyes	red Hair
								3	green eyes	black Hair
								4	black eyes	black Hair
								5	black eyes	black Hair
								6	blue eyes	fair Hair
								7	brown eyes	red Hair
								8	brown eyes	fair Hair
								9	brown eyes	black Hair
								10	black eyes	black Hair
								11	green eyes	red Hair
								12	green eyes	red Hair
								13	blue eyes	fair Hair
								14	black eyes	black Hair
								15	blue eyes	red Hair
								16	blue eyes	fair Hair

	fair Hair	black Hair	red Hair
blue eyes	3	0	1
brown eyes	1	1	2
black eyes	0	4	0
green eyes	0	1	3

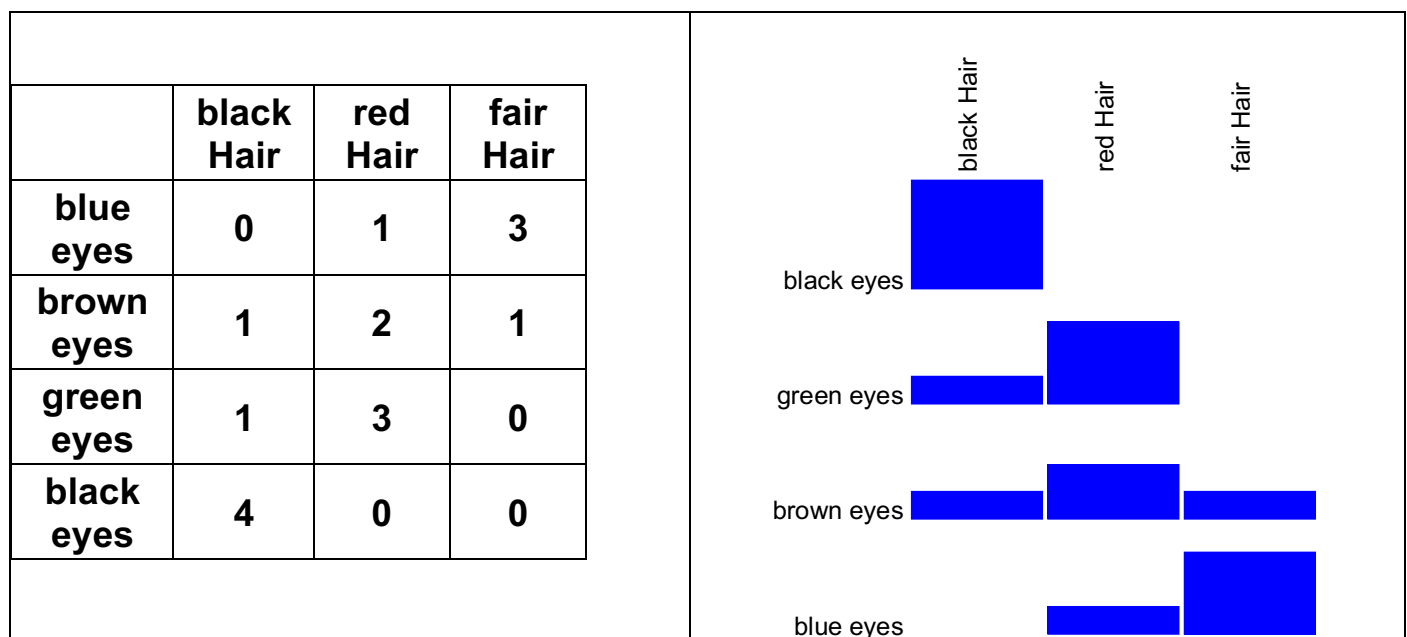
The numerical coding of the two qualitative variables is a set of numerical values associated with the modalities of each of the two qualitative variables. (« X coding » and « Y coding » in the table below).

Optimal coding is that which maximises the "R" correlation between the two numerical variables thus created.



The numerical values of the optimal coding are identical to the coordinates of the rows and columns of the table on the Correspondence Analysis 1st factor.

By reordering the rows and columns of the table according to the values of their numerical coding, we obtain the graph that best shows the structure of the data, i.e. the links between the two qualitative variables, rows and columns (the rows of the rows are reversed here) :



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