

From the package FactoMineR to a project on exploratory multivariate analysis or how to improve the visibility of its R package

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Murcia, 22 de noviembre de 2018 – X Jornadas de usuarios de R

Plan

- 1 Introduction
- 2 Some Basic Tips (or Palisades)
- 3 **FACTOMINE**R
- 4 Supplementary packages
- 5 Dissemination of information
- 6 Teaching

Introduction

The construction of a package allows to:

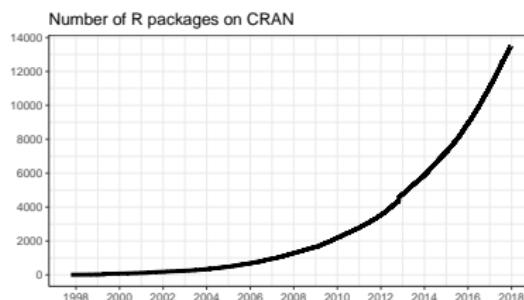
- propose new statistical methods or methodological approaches
- share its work with the entire scientific community
- facilitate the comparison of methods
- make data sets available

The creation of a package is time-consuming: it MUST be beneficial to the package author AND the scientific community

More and more packages

November 16, 2018:

- CRAN : 13 403 packages
- Bioconductor : 2 955 packages
- R-Forge : 2 086 projects
- GitHub: ??? projects



⇒ the visibility of a package is increasingly limited

Many packages are unused... and therefore useless!

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6 Teaching

Before the package submission

- A package to do what?
 - what contribution compared to existing packages?
 - is it possible to propose a function to the authors of another package?

- A package for who?
 - for a few researchers in the field \Rightarrow GitHub or web page
 - for a large audience \Rightarrow CRAN or bioconductor (GitHub)

Before the package submission

The first version of the package may be limited, but what is done must be done well

- the package will evolve and some choices are difficult to modify
 - the name of the package
 - the names of the main functions
 - the default arguments
- users won't use the package if they don't understand how it works
 - properly document his functions
 - choose your examples carefully
 - make a vignette ("first steps guide")

After the package submission

"Make alive" and maintain the package:

- fix the package if there are some errors
- answer users' questions
- include new developments, new options
- improve programming (Rcpp, parallelization, etc.)

Build additional packages

Make the package known

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 in a few words

The package

- allows to explore and visualize data sets
- offers principal component methods and clustering methods
- gives many indicators (quality of representation, contribution, automatic description of dimensions,...)
- possibility to add additional elements
- graphical interface (in French and English)
- missing data management (with the missMDA package)
- user assistance (website, videos)
- course on the methods (books, MOOC)



FACTOMINE R in a few words

Different methods for different data formats:

Data	Methods	Function
Quantitative variables	Principal Component Analysis	PCA
Contingency table	Correspondence Analysis	CA
Qualitative variables	Multiple Correspondence Analysis	MCA
Mixed data	Factor Analysis for Mixed Data	FAMD
Variable groups	Multiple factorial Analysis	MFA
Hierarchy on variables	Hierarchical Multiple Factor An.	HMFA
Groups of individuals	Dual Multiple Factor Analysis	DMFA
Contingency Table and Contextual Variables	Generalized Correspondence Analysis On Generalised Aggregated Lexical Table	CaGalt

Clustering methods and complementary tool methods:

Methods	Function
Hierarchical Ascendant Clustering	HCPC
Description of a qualitative variable (e.g. cluster var.)	catdes
Description of a quantitative variable (e.g. a dimension)	condes, dimdesc

Example on a sensory description of wines

- 10 white wines from Val de Loire: 5 Vouvray - 5 Sauvignon
- sensory descriptor: acidity, bitterness, aroma intensity, etc.



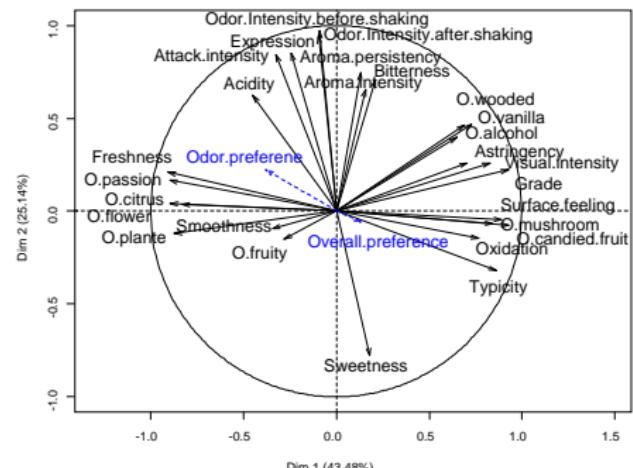
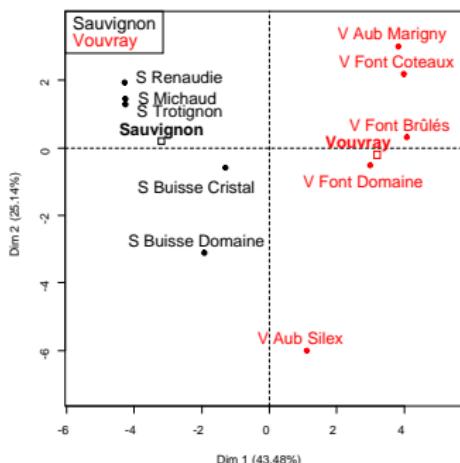
Wine data set

- 10 individuals (rows): white wines from Val de Loire
- 30 variables (columns):
 - 27 continuous variables: sensory descriptors
 - 2 continuous variables: odour and overall preferences
 - 1 categorical variable: label of the wines (Vouvray - Sauvignon)

	O.fruity	O.passion	O.citrus	...	Sweetness	Acidity	Bitterness	Astringency	Aroma.intensity	Aroma.persistency	Visual.intensity	Odor.preference	Overall.preference	Label
S Michaud	4.3	2.4	5.7	...	3.5	5.9	4.1	1.4	7.1	6.7	5.0	6.0	5.0	Sauvignon
S Renaudie	4.4	3.1	5.3	...	3.3	6.8	3.8	2.3	7.2	6.6	3.4	5.4	5.5	Sauvignon
S Trotignon	5.1	4.0	5.3	...	3.0	6.1	4.1	2.4	6.1	6.1	3.0	5.0	5.5	Sauvignon
S Buisse Domaine	4.3	2.4	3.6	...	3.9	5.6	2.5	3.0	4.9	5.1	4.1	5.3	4.6	Sauvignon
S Buisse Cristal	5.6	3.1	3.5	...	3.4	6.6	5.0	3.1	6.1	5.1	3.6	6.1	5.0	Sauvignon
V Aub Silex	3.9	0.7	3.3	...	7.9	4.4	3.0	2.4	5.9	5.6	4.0	5.0	5.5	Vouvray
V Aub Marigny	2.1	0.7	1.0	...	3.5	6.4	5.0	4.0	6.3	6.7	6.0	5.1	4.1	Vouvray
V Font Domaine	5.1	0.5	2.5	...	3.0	5.7	4.0	2.5	6.7	6.3	6.4	4.4	5.1	Vouvray
V Font Brûlés	5.1	0.8	3.8	...	3.9	5.4	4.0	3.1	7.0	6.1	7.4	4.4	6.4	Vouvray
V Font Coteaux	4.1	0.9	2.7	...	3.8	5.1	4.3	4.3	7.3	6.6	6.3	6.0	5.7	Vouvray

Description of the wines by the experts

- PCA performed with supplementary information
`res.pca <- PCA(Expert, quanti.sup=29:30, quali.sup=1)`
- an algorithm optimize the label positions to limit overlap
- individuals can be coloured according to a categorical variable
`plot(res.pca, habillage = 1)`



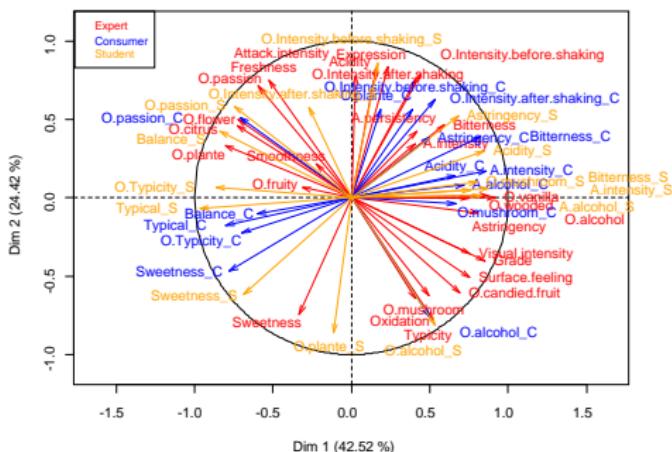
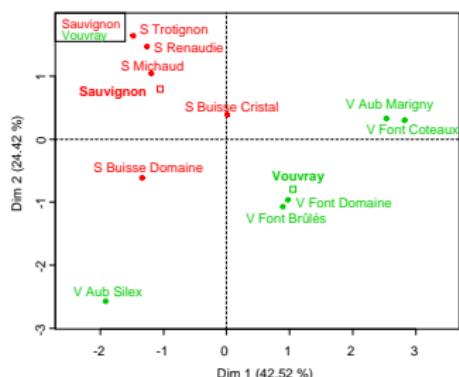
Comparison of sensory panels with MFA

	Continuous variables			Categorical	
	Expert (27)	Consu mer (15)	Student (15)	Preference (60)	Label (1)
wine 1					
wine 2					
...					
wine 10					

Objectives:

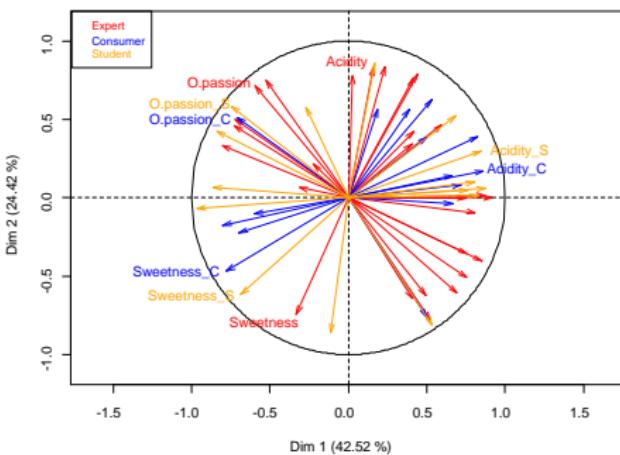
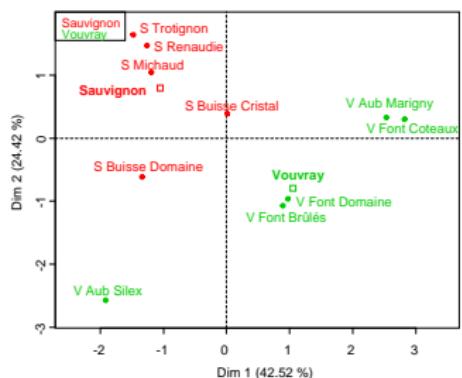
- How are the products described by the panels?
- Do the panels describe the products in a same way? Is there a specific description done by one panel?

Representation of the individuals and of the variables



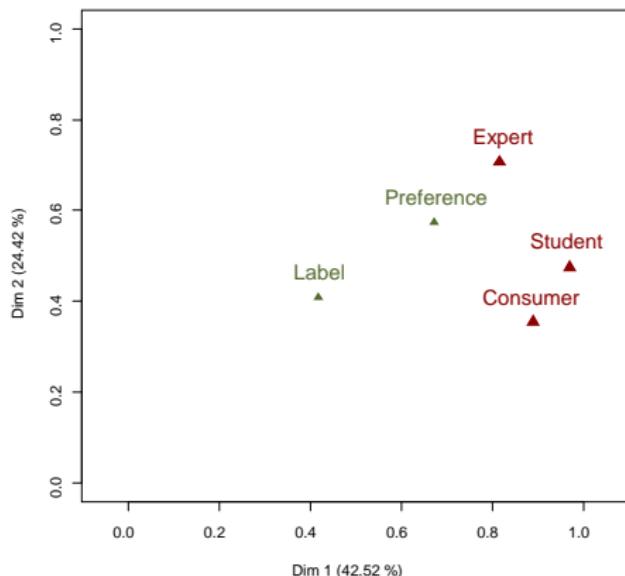
Same interpretation as in PCA

Representation of the individuals and of the variables



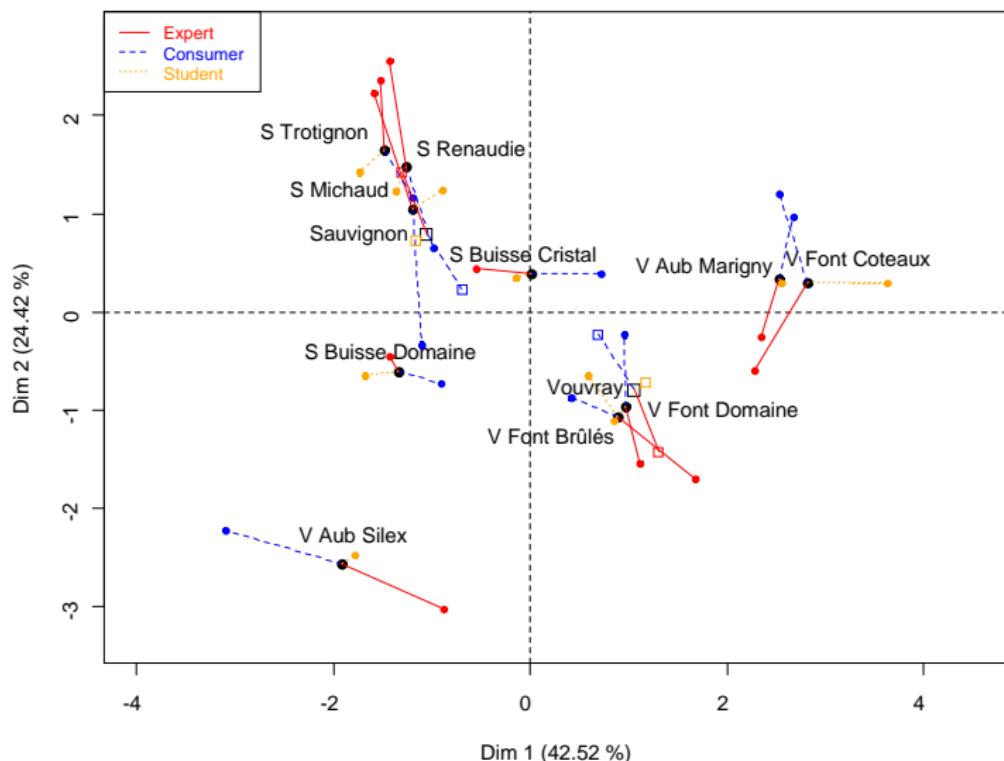
Same interpretation as in PCA

Representation of the groups

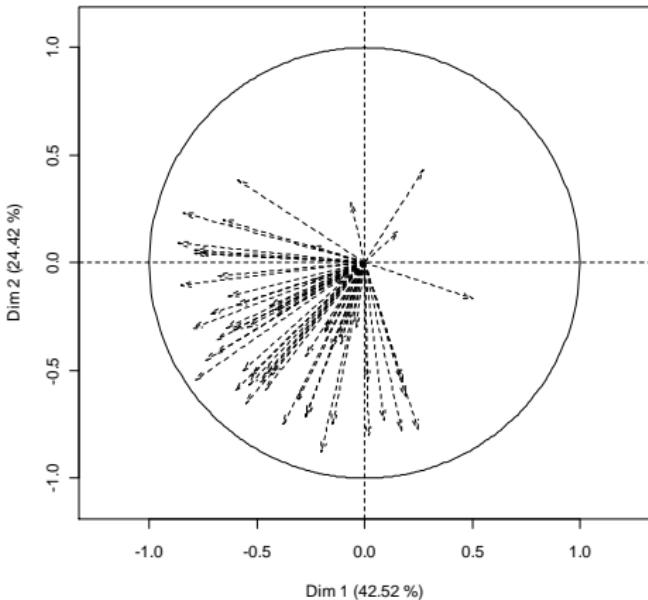
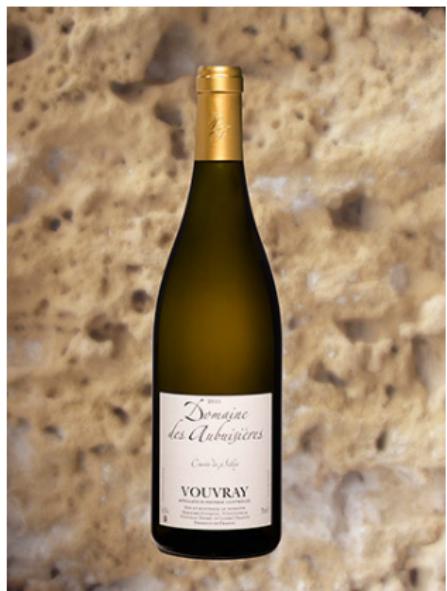


- 2 groups are all the more close that they induce the same structure
- The 1st dimension is common to all the panels
- 2nd dimension mainly due to the experts
- Preference linked to sensory description

Representation of the partial points



Representation of supplementary continuous variables



The favourite wine is
Vouvray Aubussière Silex

Preferences are linked to
sensory description

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Supplementary packages

- `RcmdrPlugin.FactoMineR` : drop-down menu
- `Factoshiny` : GUI and interactive graphs
⇒ make it easier for users to use the packages

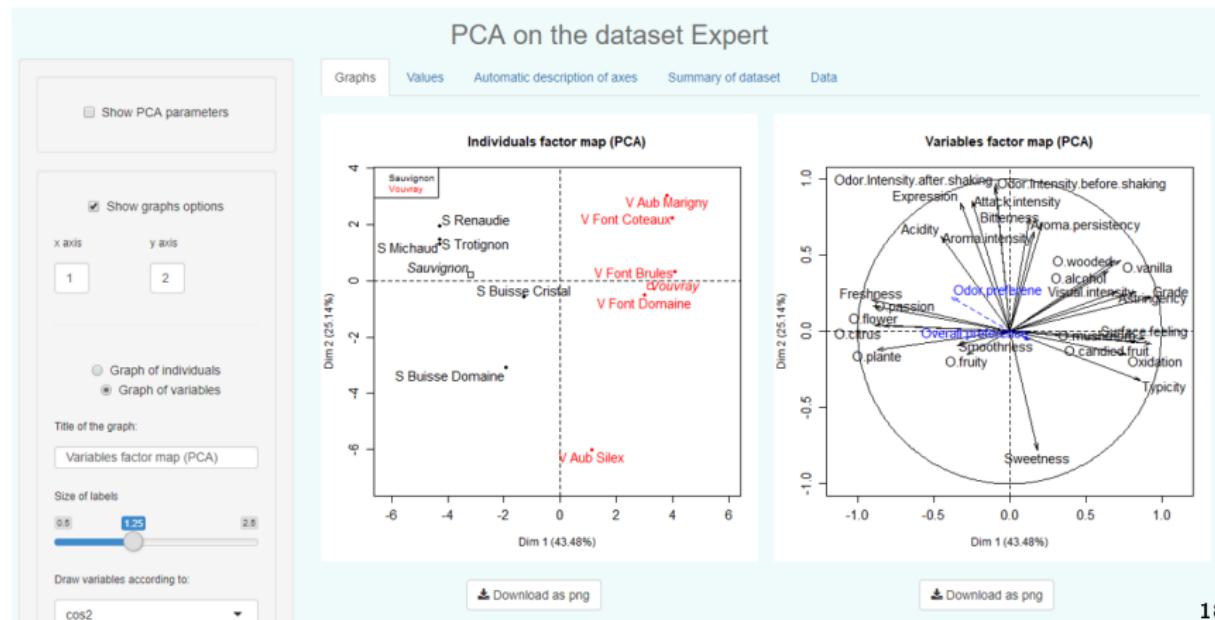
- `FactoInvestigate`: automatic reporting
⇒ propose an interpretation of the results

- `missMDA`: handling missing values
⇒ go further than the standard methods of the package

GUI and interactive graphics with Factoshiny

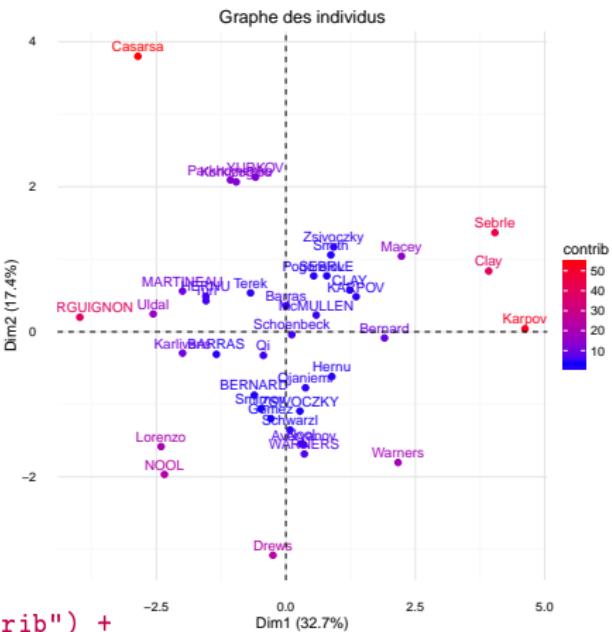
- Perform analyses without the need to master the code
- Real-time visualization of changes made

```
res <- PCAshiny(MyData)      ## principal component analysis on the data
res <- PCAshiny(res.pca)     ## graph on a result object of FactoMineR
res2 <- PCAshiny(res)        ## Factoshiny result object
```



Other graphical packages

- the package **explor**
 - interactive graphics
 - possibility to move the labels
- the package **factoextra**
 - based on **ggplot2**
 - sequential construction of graphs by adding layers



```
> library(factoextra)
> fviz_pca_ind(res.pca, col.ind="contrib") +
  labs(title="Graphe des individus") +
  scale_color_gradient2(mid="blue",high="red") +
  theme_minimal()
```

Automatic reporting with the FactoInvetigate package

Propose an interpretation of the results based on the result object

```
> res.pca <- PCA(MyData, ...)
> library(FactoInvetigate)
> Investigate(res.pca)
```

[http://factominer.free.fr/
reporting](http://factominer.free.fr/reporting)

Principal Component Analysis

Dataset Expert

This dataset contains 10 individuals and 30 variables. 2 quantitative variables are considered as illustrative, 1 qualitative variable is considered as illustrative.

1. Study of the outliers

The analysis of the graphs does not detect any outlier.

2. Inertia distribution

The inertia of the first dimensions shows that there are strong relationships between variables and suggests the number of dimensions that should be studied.

The first two dimensions of PCA express 65.62% of the total dataset inertia. That means that 65.62% of the individuals or variables could total variability is explained by the plane. This percentage is relatively high and thus the first plane well represents the data variability. This value is strongly greater than the reference value that equals 44.91%, the variability explained by this plane is thus highly significant (the reference value is the 0.95-quartile of the inertia percentages distribution obtained by simulating 1983 data tables of equivalent size on the basis of a normal distribution).

From these observations, it should be better to also interpret the dimensions greater or equal to the third one.

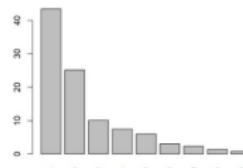


Figure 2 - Decomposition of the total inertia on the components of the PCA

An estimation of the eight number of axis to interpret suggests to restrict the analysis to the description of the first 2 axes. These axes present an amount of inertia greater than those obtained by the 0.95-quartile of random distributions (65.62% against 44.91%). This observation suggests that only these axis are carrying a real information. As a consequence, the description will stand to these axis.

3. Description of the plane 1:2



missMDA: a package to handle the missing values

		Variables	
		<i>j</i>	<i>p</i>
Individus	1	?	?
	<i>i</i>	?	?
	<i>n</i>	?	?
		?	?
		?	?
		?	?
		?	?

Study and implementation of PC methods in the presence of missing data: PCA, MCA, FAMD, MFA

- ① Imputation by iterative principal component method
- ② Analysis of the imputed dataset

Regularized iterative PCA

Principle: impute by values that do not influence the PCA results

- ① initialization $\ell = 0$: X^0 (mean imputation)
- ② iteration ℓ :
 - (a) PCA on the completed data set $\rightarrow (F^\ell, U^\ell)$;
 S dimensions are kept
 - (b) missing values imputed with $F^\ell U^{\ell'}$
 $\Rightarrow X^\ell = W * X + (1 - W) * F^\ell U^{\ell'}$
- ③ steps of estimation and imputation are repeated

\Rightarrow gives the scores and loadings (better than Nipals)
 \Rightarrow gives an imputed data set

Handling missing values: PCA example

```
> library(missMDA)
> data(orange)
> nb <- estim_ncpPCA(orange)          ## Estimate the number of components
> comp <- imputePCA(orange,ncp=nb)    ## Impute the data set
> res.pca <- PCA(comp$completeObs)     ## Perform PCA
```

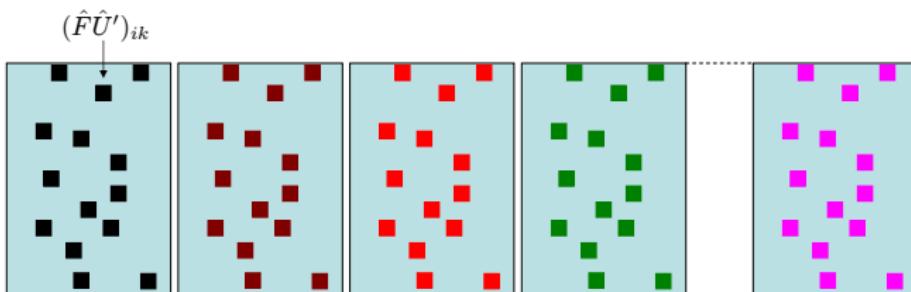
```
> orange
Sweet Acid Bitter Pulp Typicity
NA   NA  2.83  NA   5.21
5.46 4.13 3.54 4.62   4.46
NA   4.29 3.17 6.25   5.17
4.17 6.75  NA  1.42   3.42
...
NA   NA   NA 7.33   5.25
4.88 5.29 4.17 1.50   3.50
```

```
> comp$completeObs
Sweet Acid Bitter Pulp Typicity
5.54 4.13 2.83 5.89   5.21
5.46 4.13 3.54 4.62   4.46
5.45 4.29 3.17 6.25   5.17
4.17 6.75 4.73 1.42   3.42
...
5.71 3.87 2.80 7.33   5.25
4.88 5.29 4.17 1.50   3.50
```

⇒ Use the completed data set as an input for PCA, clustering, ...

Multiple imputation in PCA

⇒ iterative PCA: a single imputation method

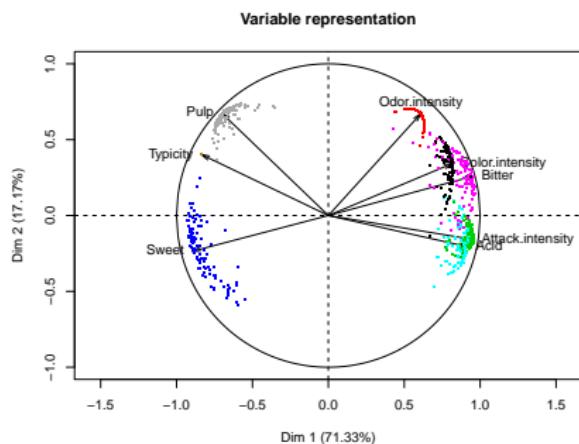
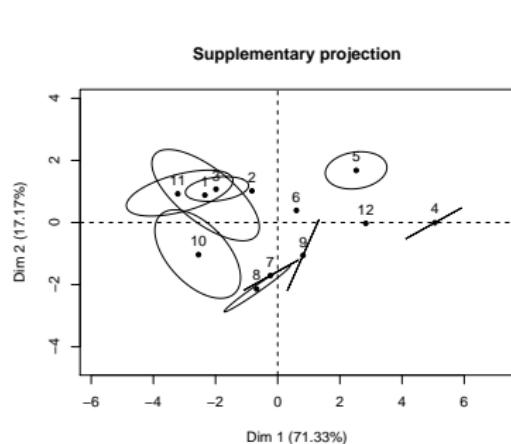


⇒ a single value can't reflect the uncertainty of prediction

⇒ Multiple imputation: generate several plausible values for each missing values

Visualization of the uncertainty due to missing values

```
> mi <- MIPCA(orange, scale = TRUE, ncp=2)
> mi$res.MI          ## output for the imputed data sets
> plot(mi)
```



Avoid that you analyse data sets with too many missing data

For categorical data (MCA):

`estim_ncpMCA, imputeMCA, MIMCA`

For mixed data (FAMD):

`estim_ncpFAMD, imputeFAMD, MIFAMD`

For groups of variables (MFA):

`estim_ncpMFA, imputeMFA`

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User aids: website

- <http://factominer.free.fr> in English and in French
- examples, aids on the functions, course, references, etc.

The screenshot shows the FactoMineR website with a green border. At the top is a black navigation bar with white text and icons. Below it is a large logo for "FACTOMINE R". To the right of the logo are two small flags: the United Kingdom and France. The main content area has several sections: "About FactoMineR", "Why Use FactoMineR?", "Home Menu", "Authors", and "Useful Links". Each section contains descriptive text and links. The "Home Menu" section includes links to "FactoMineR's description", "News", "Install FactoMineR", "How to cite FactoMineR?", and "History of FactoMineR". The "Authors" section lists "François Husson", "Julie Josse", and "Sébastien Lê". The "Useful Links" section features a logo for "AGRO CAMPUS OUEST".

Home | Facto's Methods | Teaching MOOC, books | Graphic enhancements | Missing values missMDA | Automatic Reporting | Google group | More

FACTOMINE R

UK FR

About FactoMineR

FactoMineR is an R package dedicated to multivariate Exploratory Data Analysis. It is developed and maintained by François Husson, Julie Josse, Sébastien Lê, d'Agrocampus Rennes, and J. Mazet.

Why Use FactoMineR?

1. It performs classical principal component methods: Principal Components Analysis (PCA), Correspondence analysis (CA), Multiple Correspondence Analysis (MCA), clustering
2. as well as advanced methods that take into account a **structure on the data** (groups of variables, hierarchy on the variables, groups of individuals).
3. It allows to **add supplementary informations** such as supplementary individuals and/or variables.
4. It provides a geometrical point of view, a lot of graphical outputs, helps to interpret (automatic description of the dimensions, various indicators, ...).
5. Lot of materials (**MOOC, books**, etc.) is available to explain the methods and the way to implement them in FactoMineR.
6. It handles missing values with missMDA (see here).
7. It has a GUI with a Shiny interface that draws interactive graphs with Factoshiny (see here)
8. It gives automatic interpretation of the results with FactoInvestigate (see here).

Home Menu

- FactoMineR's description
- News
- Install FactoMineR
- How to cite FactoMineR?
- History of FactoMineR

Authors

- François Husson
- Julie Josse
- Sébastien Lê

Useful Links

AGRO CAMPUS OUEST

User aids: a Google group

- <https://groups.google.com/group/factominer-users/>
- possibility to ask questions and answer in French or English

The screenshot shows a web browser window displaying the FactoMineR users Google group. The URL in the address bar is <https://groups.google.com/forum/?hl=fr#!forum/factominer-users>. The page header includes the Google logo and a search bar. Below the header, there are buttons for "Groupes" and "Nouveau sujet". A list of messages is displayed, starting with:

Message	Auteur	Date
La 2ème session du MOOC "Analyse de données multidimensionnelles" débute le 1er mars		1 message 19 janv.
Nouveau module graphique		11 messages 17/01/2015
Select the best sample using a reference		1 message 16 mai
salut		1 message 15 mai
PCAshiny scale.unit=F impossible ?		2 messages 12 mai
ACM et questions à choix multiples (plusieurs modalités dans la même question)		6 messages 2 mai
Plot CA neatly (1)		1 message 30 avr.
Interpreting MCA results		11 messages 22 avr.
Installing FactoMineR on Linux (1)		1 message 21 avr.
Estimation of PC for MFA		4 messages 21 avr.
General questions for FAMD		1 message 1 avr.

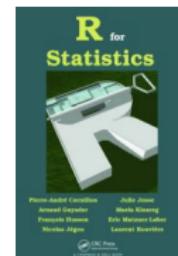
User aids: scientific dissemination

- Suggest the package in CRAN Task views
- Presentations to conferences (useR!, juR, SFdS, etc.)
- 2 papers in *R journal* (CA-galt, MFACT)
- 2 papers in *J. of stat. software* (FactoMineR, missMDA)
- Some books in French, English and Spanish

Análisis de datos con R



R pour la stat. et sc. des données



Plan

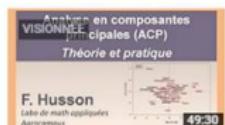
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User aids: some videos

- available from my teaching webpage
- available from the helps of the functions of FactoMineR

Analyse de données avec FactoMineR

L'analyse de données avec R et FactoMineR. Comment faire une ACP, une ACM, une AFM ou encore une classification ? Quelles aides à l'interprétation ? Comment construire des graphiques lisibles ? commen...



Cours d'ACP : théorie et pratique (ancienne version)
de François Husson
38 635 vues • il y a 2 ans
CC



Démarche en analyse des données (ancienne version)
de François Husson
19 348 vues • il y a 3 ans



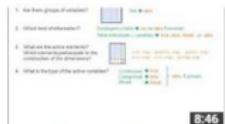
ACP avec le menu déroulant de FactoMineR
de François Husson
7 533 vues • il y a 3 ans



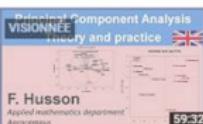
Analyse en Composantes Principales (ACP) avec...
de François Husson
24 748 vues • il y a 3 ans
CC

Exploratory multivariate analysis with R and FactoMineR

This video shows how to perform exploratory multivariate analyses in a French way using R and FactoMineR and how to handle missing values....



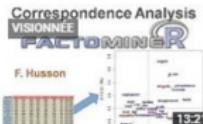
Methodology in multivariate exploratory data analysis
de François Husson
7 973 vues • il y a 3 ans



Course on PCA: theory and practice
de François Husson
20 801 vues • il y a 2 ans
CC



Principal component analysis (PCA) with R
de François Husson
25 377 vues • il y a 3 ans
CC



Correspondence analysis with FactoMineR
de François Husson
6 114 vues • il y a 2 ans

User aids: Youtube channel



- <https://www.youtube.com/HussonFrancois>
- Course videos (27 FR - 24 EN)
- Software tutorials (18 FR - 12 EN)



François Husson
6 147 abonnés

ACCUEIL VIDÉOS PLAYLISTS CHAÎNES DISCUSSION À PROPOS

PERSONNALISER LA CHAÎNE VERSION BÊTA DE YOUTUBE STUDIO

Playlists créées



Vidéos "J'aime"
AFFICHER LA PLAYLIST COMPLÈTE (36 VIDÉOS)



AFFICHER LA PLAYLIST COMPLÈTE (6 VIDÉOS)



AFFICHER LA PLAYLIST COMPLÈTE (5 VIDÉOS)



AFFICHER LA PLAYLIST COMPLÈTE (8 VIDÉOS)

COURS DE STAT À AGROCAMPUZ

LIRE mathAgrocampus
S'ABONNER

CHAÎNES SIMILAIRES

SE PRÉPARER POUR UNE ...
S'ABONNER

PabR67
S'ABONNER

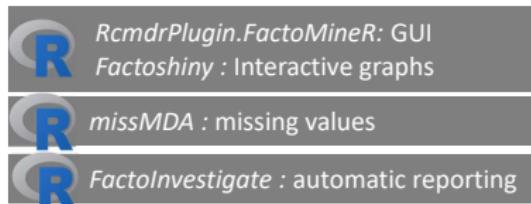
Analyse de données avec FactoMineR

TOUT REGARDER

Carélyse de données avec R et FactoMineR. Comment faire une ACP; une ACM, une AFM ou encore une classification ? Quelles aides à l'interprétation ? Comment construire des graphiques lisibles ?



MOOC “Exploratory Multivariate Data Analysis”



Website

Exploratory Multivariate Data Analysis by Example Using R

About this course
This 2nd edition of the MOOC will run from the 5th of March 2018.
Exploratory multivariate data analysis is studied and taught in a French way since a long time in France. This course focuses on four essential and basic methods: those with the largest potential in terms of applications.

Estimated effort
02:00 h / week

Google group

Videos on Youtube channel

The **R** Journal



Journal of Statistical Software
April 2014, Volume 59, Issue 4

FACTOMINER

MOOC “Exploratory Multivariate Data Analysis”

MOOC = Massive Open Online Courses

Objective: to understand and know how to implement five exploratory multivariate methods

The MOOC has been designed for applications: many examples and software implementation (FactoMineR)

5 sessions in French, 2 in English:

- 2014 on a University platform (Moodle)
- Since 2015 in FR and 2017 in EN on the platform France Université Numérique

NEW SESSION in March 2019 in **French** and in **English**

MOOC “Exploratory Multivariate Data Analysis”

MOOC over 5 weeks: each week focuses on one analysis method
(for example : Principal Component Analysis)

Each week consists of:

- video courses : description of the method
- quizzes
- software implementation
- exercises
- case studies

Moreover, the MOOC has a forum and a wiki

Possibility of obtaining a *successful completion certificate*

MOOC Exploratory Multivariate Data Analysis

Lessons

Cours Info Cours Discussion Wiki Progression

Slides

Video Audio transcription Quiz

1. Data - Practicalities
2. Studying individuals and variables
3. Aids for interpretation

Tutorial FactoMineR

Exercises Exercise Echéance le mai 04, 2018 at 23:30 UTC

To go further: handling missing values

Correspondence Analysis
Multiple Correspondence Analysis
Hierarchical Clustering
Multiple Factor Analysis
To conclude

ADVICES

Once the video is running, you can choose the definition (1080p for HD, 720p for standard definition, and 480p for lower quality). If you have a fast enough connection, we recommend watching in HD.

It is possible to show subtitles by clicking on the speech bubble to the bottom-right of a video, and then on "English".

VIDEO: DATA - PRACTICALITIES

MOOC Exploratory Multivariate Data Analysis

Lessons

Software

The screenshot shows a course interface for 'Exploratory Multivariate Data Analysis'. On the left, there's a sidebar with sections for 'Lessons' and 'Software'. Under 'Lessons', there's a list of topics: 'Principal Component Analysis', 'Data - Practicalities', 'Studying individuals and variables', and 'Aids for interpretation'. Under 'Software', there's a section for 'FactoMineR' with a 'Tutorial' link. Below these are sections for 'Exercises' (with a due date of May 04, 2018 at 23:30 UTC) and 'To go further: handling missing values'. To the right, the main content area has tabs for 'Cours', 'Info Cours', 'Discussion', 'Wiki', 'Progression', 'Slides', 'Video', 'Audio transcription', 'Data', and 'Lines of code'. The 'Video' tab is selected. The main content area displays a list of data sets and their components:

- Wines data set (data used in the course)
 - The data set
 - The script file (lines of code R)
 - The script with the outputs (pdf)
- Decathlon data set (data used in the tutorial of FactoMineR)
 - The data set
 - The script file (lines of code R)
 - The script with the outputs (pdf)

At the bottom right of the content area, there are navigation arrows.

MOOC Exploratory Multivariate Data Analysis

Lessons

Software Exercises

Cours Info Cours Discussion Wiki Progression

Principal Component Analysis

1. Data - Practicalities
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Exercises
Exercise Echéance le mai 04, 2018 at 23:30 UTC

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Tabletop Exercises **Computer Exercises**

EXERCISE 1. INTERPRETING PCA PLOTS (6 points possibles)

In a sensory analysis, a jury assessed six apple sauces based on a list of 11 descriptors such as acidity, bitterness, raw apple flavor, and so on. The scores were gathered in a table with applesauces as rows, and descriptors as columns, with entries the scores for the given product and descriptor. The descriptors are of three kinds: flavor (F), texture (T), and odor (O). For example, F.sweet corresponds to sweetness. In addition, an appreciation score (hedonistic) was given to each applesauce. A PCA was carried out on the data table, with the appreciation score added as a supplementary variable. The plots of individuals and variables are provided below.

Individuals factor map (PCA)

PC1 (28.0%)

PC2 (20.0%)

orange

apple

carrot

peach

strawberry

grapefruit

MOOC Exploratory Multivariate Data Analysis

Lessons

Cours Info Cours Discussion Wiki Progression

- » Principal Component Analysis
 - 1. Data - Practicalities
 - 2. Studying individuals and variables
 - 3. Aids for interpretation

Tutorial FactoMineR

Exercises
Exercise Echéance le mai 04, 2018 at 23:30 UTC

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» Correspondence Analysis

» Multiple Correspondence Analysis

» Hierarchical Clustering

» Multiple Factor Analysis

» To conclude

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Individuals factor map (PCA)

Dim 1 (50.00%)

Dim 2 (28.00%)

apple

orange

carrot

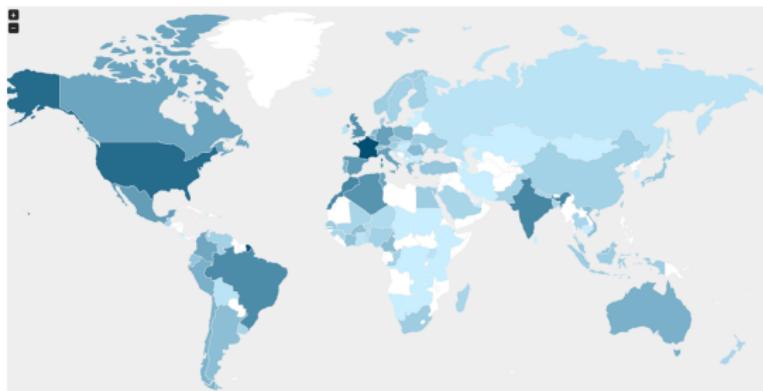
apple

orange

carrot



What was the audience for this MOOC?



Each year:
≈ 5 200 FR students
≈ 1 800 EN students
112 countries
18 to 78 years ($\bar{x} = 35$)
60% Master, 18% pHD

- Learners from industrial and academic world: research institutes, universities, industrial and business companies
- Different fields: economy, biology, genomic, geography, linguistics...

Estimated working time if full reading: 5 hours / week
Diverse audience with different goals and different levels of investment

What interests to use R?

- Free of charge
- Very well known
- Available all over the world (with the same version)
- Same use regardless of the operating system
- Lines of code ⇒ reproducibility of analyses
- Examples with Rmarkdown

MOOC versus course in live

During a MOOC learning, participants can

- manage their time
- learn some parts of the course more than others
- discuss with other participants: a more participative training
- diverse audience and many learners enriches the MOOC
- do not hesitate to ask question via the forum
- come back to the course when they want (they just need to remind that they have seen the method during the MOOC)

But a course in live has also some advantages!

⇒ Using a MOOC in the classroom or during a long-life training session: a complementary approach for the future?

MOOC used with my students

Organisation :

- course on Exploratory multivariate data analysis (25h)
- 192 students in master – 3 teachers (for 10 hours)

Content :

- same videos, quizzes, exercises, forum, wiki
- permanences to discuss the course and their project
- evaluation by an additional quiz and a project on a case study

Positive aspects:

- students are more independent
- students questions-discussions are more interesting
- positive effect of learner discussions and comments
- more time to discuss and exchange on their project

Limitations:

- some students prefer the gentle tranquillity of the classroom
- those who are not working are difficult to motivate

The MOOC in my opinion

What it brings

- Everything I've already talked about but also...
- increased visibility (Youtube channel 800 views/day, MOOC \approx 150 000 views)
- a very complete reference tutorial for a package
- a complete guide for a set of methods
- an opening to new audiences
- an incentive to rethink teaching and pedagogy

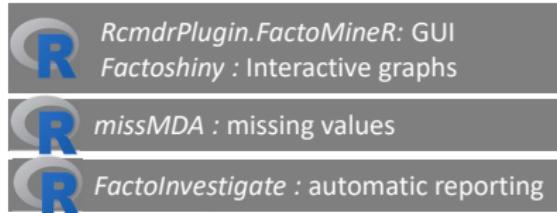
BUT

- It takes a lot of investment: 1 hour of class \approx 20-30h!!!!
- Sequencing, quizzes and exercises are also time-consuming
- Are MOOCs getting old well?

From a package to a project on Exploratory Multivariate Analysis

- Apr 2006 : package FactoMineR (PCA, CA, MCA, MFA, etc.)
- Apr 2007 : paper on FactoMineR (Journal of Statistical Software)
- Apr 2007 : website
- Nov 2007 : package RcmdrPlugin.FactoMineR (GUI)
- Jun 2009 & Feb 2016: book *Analyse de données avec R*
- May 2010 : package missMDA (handling missing values)
- Jan 2011 : Book *Exploratory Multivariate Analysis by Example Using R*
- Apr 2011 : tutorials videos
- Sep 2011 : Google group
- Nov 2012 : Book *Analysing Multidimensional Data with R*
- Mar 2013 : Youtube channel "FactoMineR"
- Jun 2013 : paper on R
- Feb 2014 : online course on Exploratory Data Analysis (in my University)
- Feb 2015: package Factoshiny (interactive graphs)
- Mar 2015 & 2016 & 2017 & 2018 : MOOC analyse de données (French)
- Apr 2015 : package FactoInvestigate (automatic reporting)
- Jun 2015 : paper on CA-Galt (R Journal)
- Apr 2016 : paper on missMDA (Journal of Statistical Software)
- Mar 2017 & 2018 : MOOC Exploratory Multivariate Data Analysis (English)
- Mar 2019 : New session MOOC Exploratory Multivariate Data Analysis (FR or EN)

A project on Exploratory Multivariate Analysis



FACTOMINER

About FactoMineR
Home menu
Learning material
Graphic interfaces
Missing values
Automatic Reporting
Google group
More

Website



The Journal



Journal of Statistical Software

Apr 7 2014, Volume 59, Issue 1.

ABOUT THIS COURSE

This 10th edition of the MOOC will use the 8th version 2014.

