Unfolding Models for Preference data

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- ✓ **Unfolding**
- ✓ **Models for Preference data**
- ✓ **A simulation**
- ✓ **Application to a preference study**

Preference mapping

- ✓ MdPref: internal preference mapping

- ✓ Ideal point interpretation (EDIPM)

Meullenet J.-F. et al. (2008)

- ✓ Unfolding

  - Probabilistic Unfolding (LSA)

Rousseau B. et al. (2012)
Ennis D.M. & Ennis J.M. (2013)

  - Deterministic Unfolding (Prefscal)

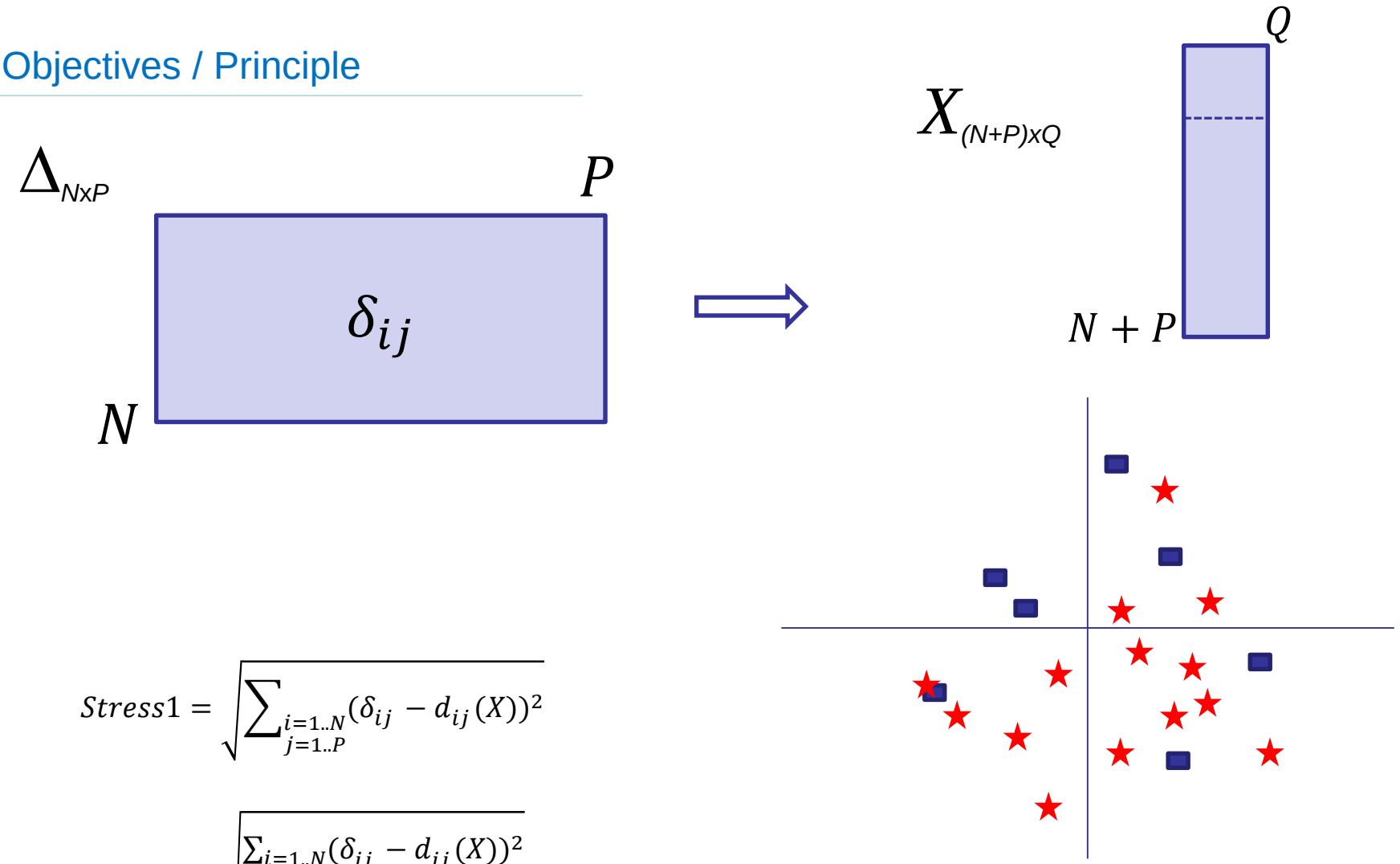
Busing F.M.T.A. et al. (2010)
Van De Velden M.,et al. (2013)

Few comparisons between different techniques

Cleaver G. (2010) and **MacFie H. et al. (2010)** Sensometrics 2010 (Vlaardingen, NL).

Unfolding

Objectives / Principle



$$Stress1 = \sqrt{\sum_{\substack{i=1..N \\ j=1..P}} (\delta_{ij} - d_{ij}(X))^2}$$

$$Stress\ Kruskal = \sqrt{\frac{\sum_{\substack{i=1..N \\ j=1..P}} (\delta_{ij} - d_{ij}(X))^2}{\sum_{\substack{i=1..N \\ j=1..P}} d_{ij}^2(X)}}$$

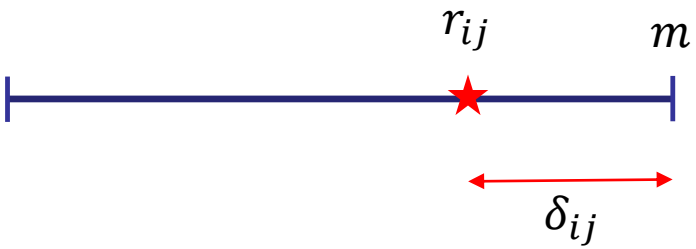
Internal Preference Mapping with ideal point interpretation

Dissimilarities

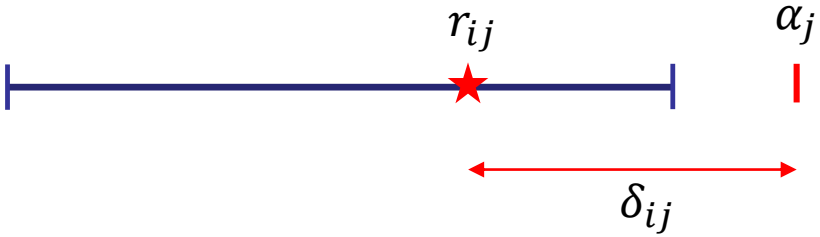
δ_{ij} fonction of r_{ij} (preference rating of subject *j* for product *i*)

1. $$\delta_{ij} = m - r_{ij}$$

m : max of the rating scale



2. $$\delta_{ij} = \alpha_j - r_{ij}$$

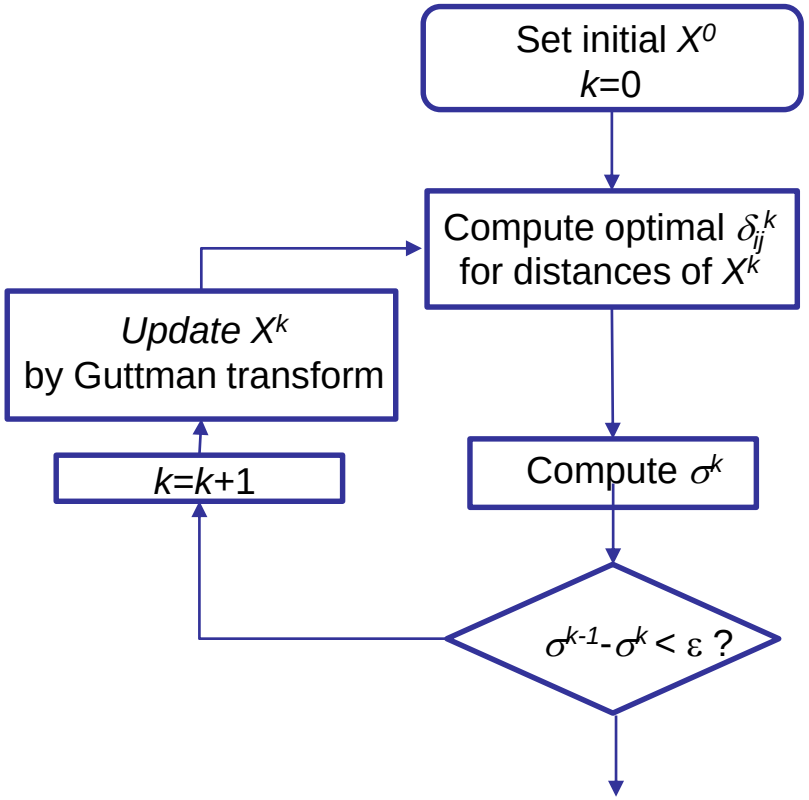


α_j : «rating» (to be estimated) of the ideal point of subject *j*

3. δ_{ij} monotone transformation of $m - r_{ij}$

Algorithm

Smacof algorithm
Borg & Groenen, 2005

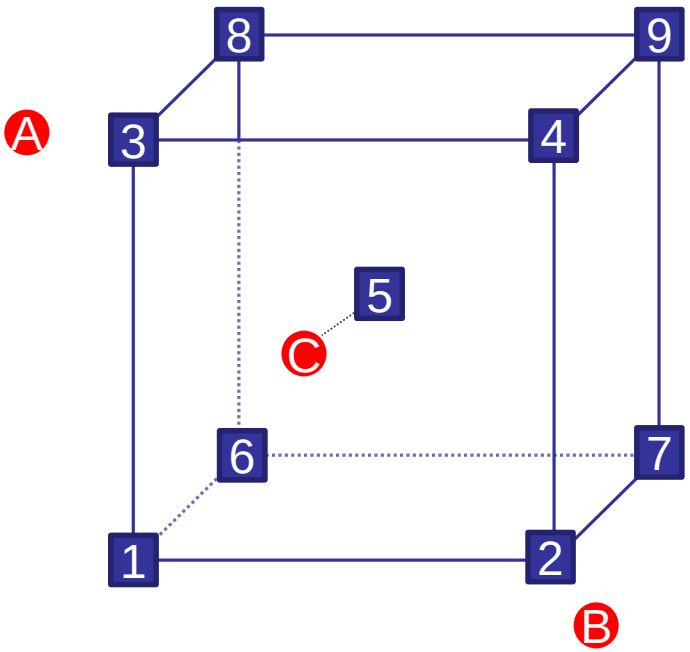


- ✓ Initial solution
  (Schoneman, 1970)
- ✓ Incomplete data supported
- ✓ "Restricted" unfolding
- ✓ Optimal scaling of preference
  Non metric transformations allowed (Busing et al., 2005)

Simulated data

Design

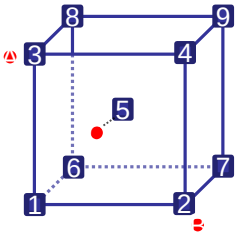
- ✓ 9 products :
  2^3 Factorial design + central point
- ✓ Factor 3 : weak vectorial effect
- ✓ 3 classes of consumers:
  A and B with opposite vectorial effects
  C with ideal point effect

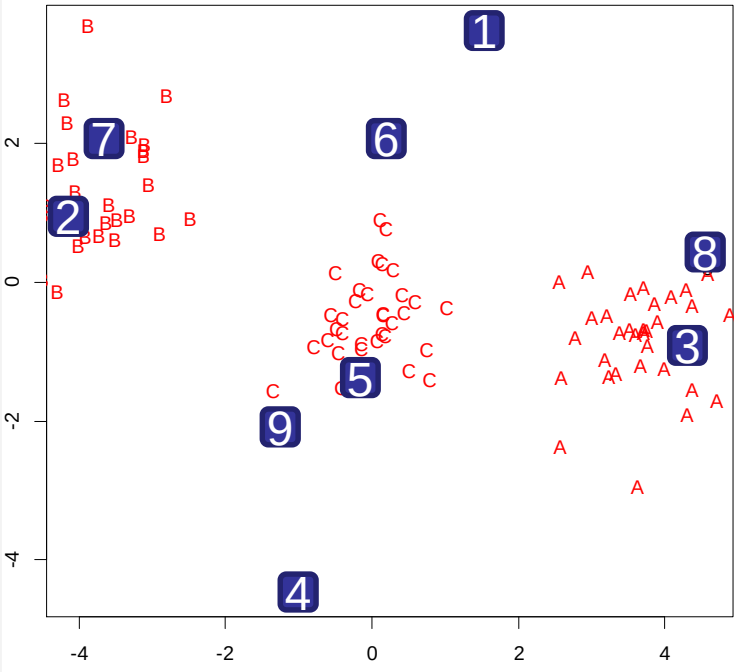


100 consumers are simulated : each one belonging to one of the 3 classes
and adding - a random noise $\mathcal{N}(0,1)$ to each rating
- an additive effect (uniform [-1;1]) to each subject

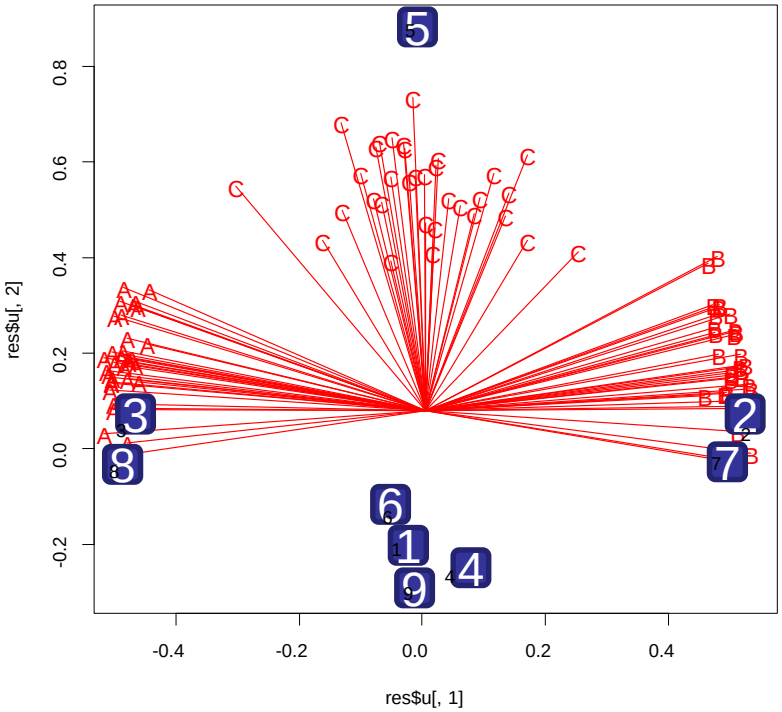
Simulated data

Proportions of the 3 classes : 33%, 33%%, 33%.





Unfolding



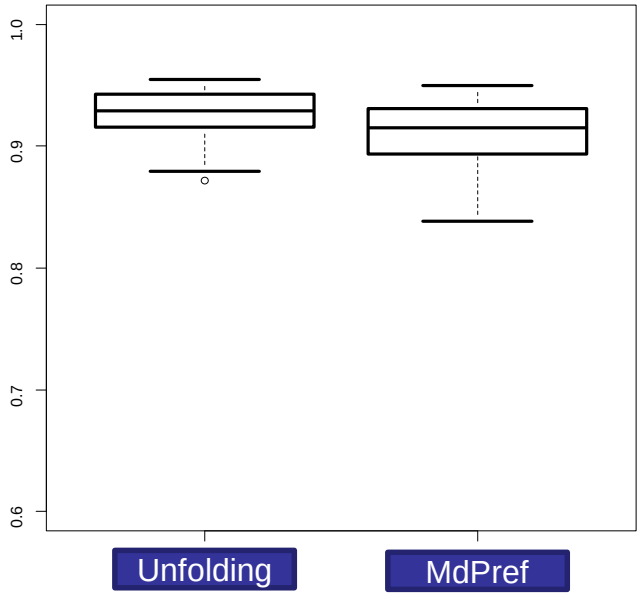
MdPref

Simulated data

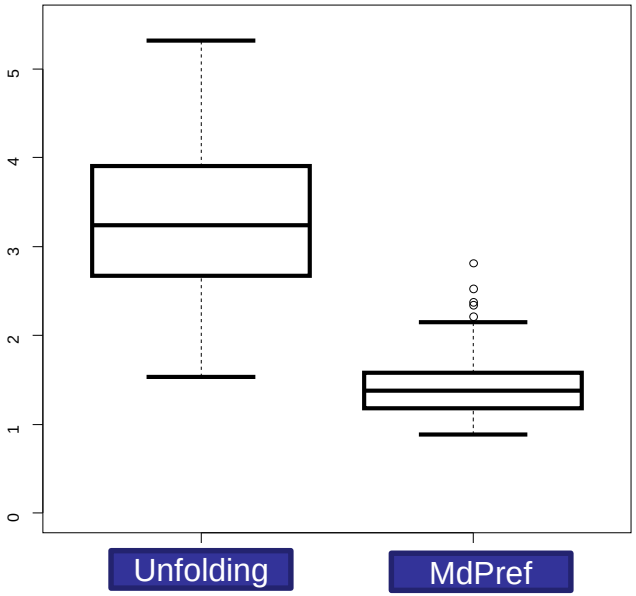
Mixture of classes

120 simulations : proportions of the 3 classes varying between 10% and 80%

Mean R^2 between reconstituted and original ratings

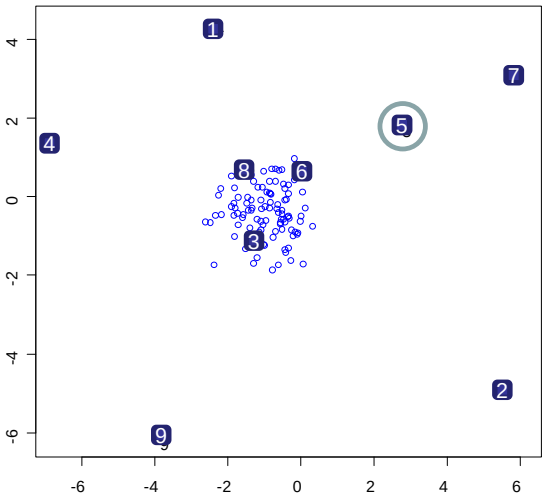


RV stand. between final and original configurations

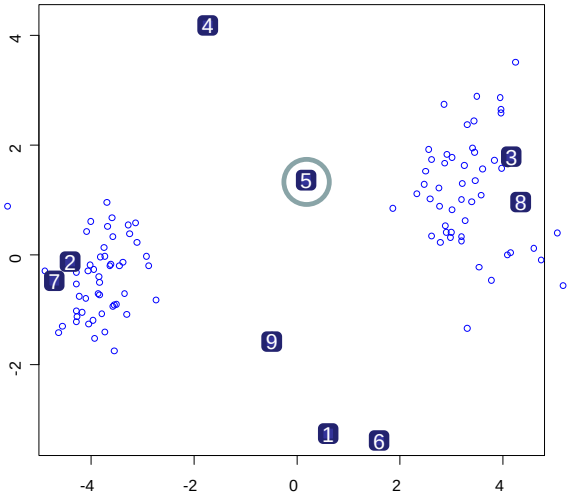


- ✓ Good reconstitution of the original ratings for both techniques
- ✓ Best recovery of the initial configuration for unfolding

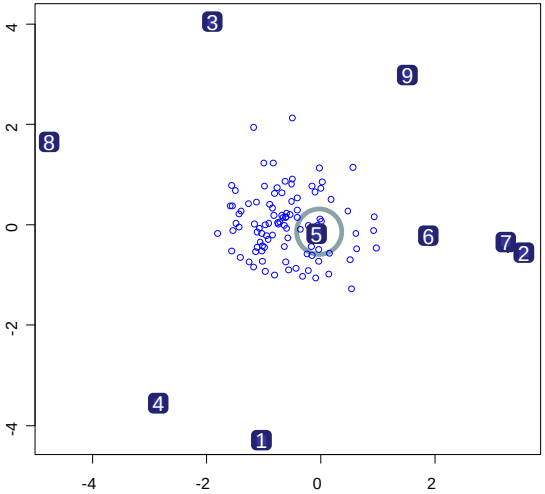
3 opposite situations



1
A single vectorial segment



2
Two opposite vectorial segments



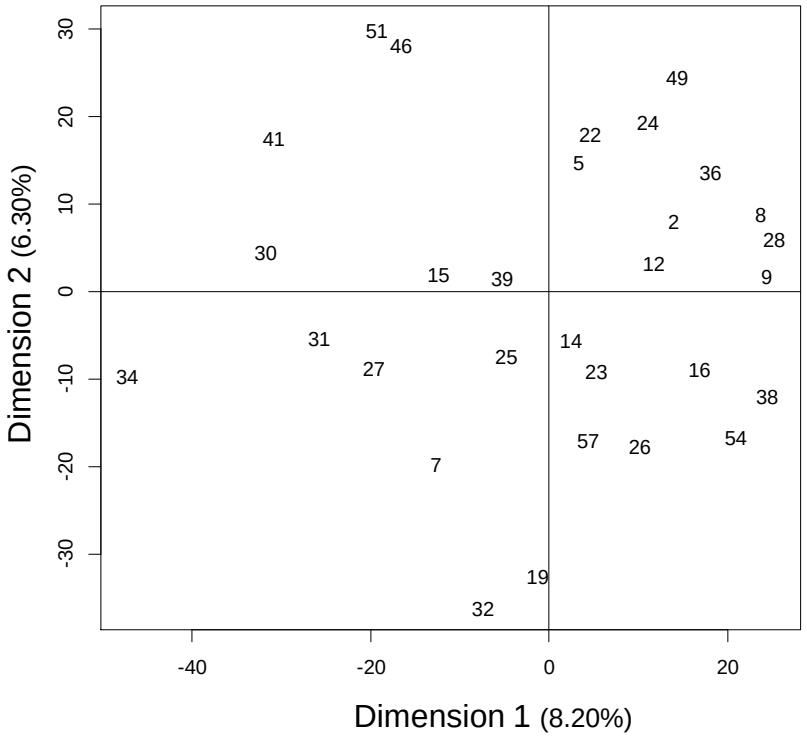
3
A single ideal point segment

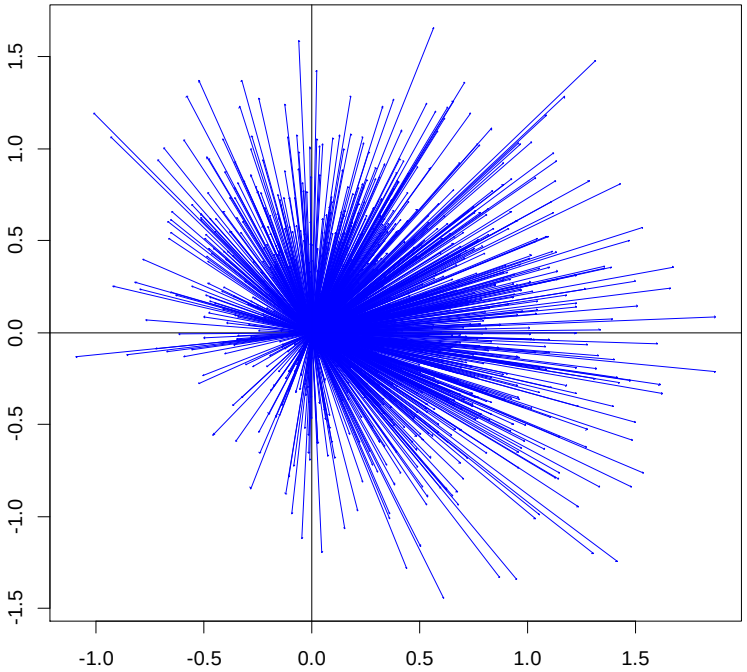
	1	2	3
Unfolding	RVs=1.09 (p=0.13)	RVs=3.76 (p=0.00)	RVs=2.22 (p=0.02)
MdPref	RVs=1.62 (p=0.06)	RVs=2.31 (p=0.01)	RVs=1.63 (p=0.06)

EuroSalmon data

30 commercial smoked salmons
1037 consumers from 5 european countries
(5 sessions ; preference rating on a 9-points scale)

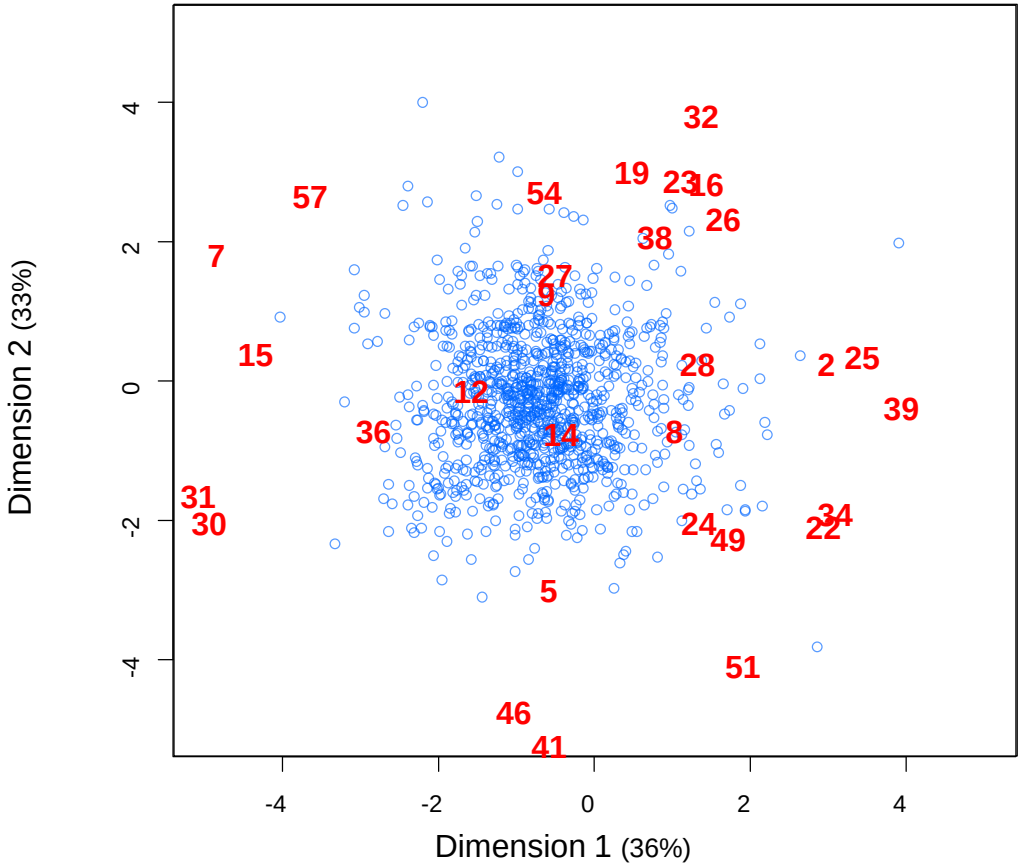
Sensory profile on 33 attributes (visual, odour, texture and taste)





MdPref solution

EuroSalmon data

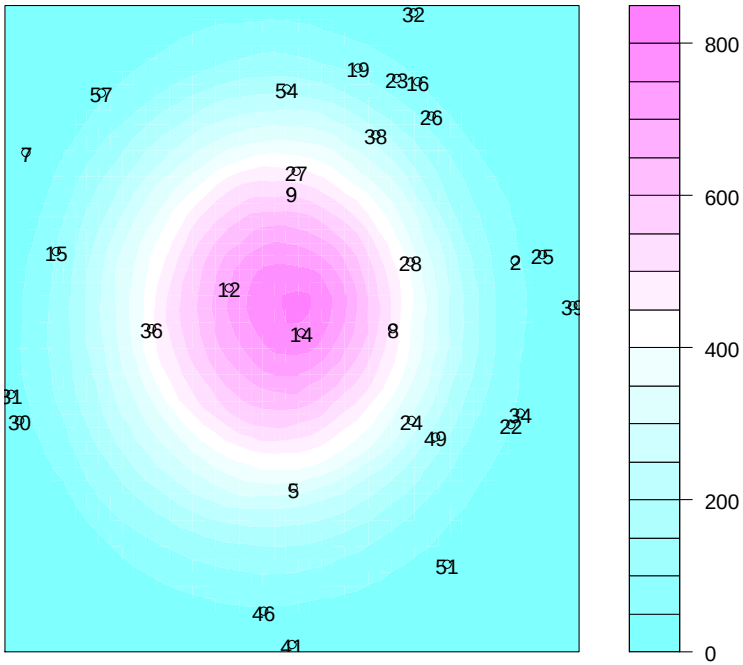


Unfolding solution

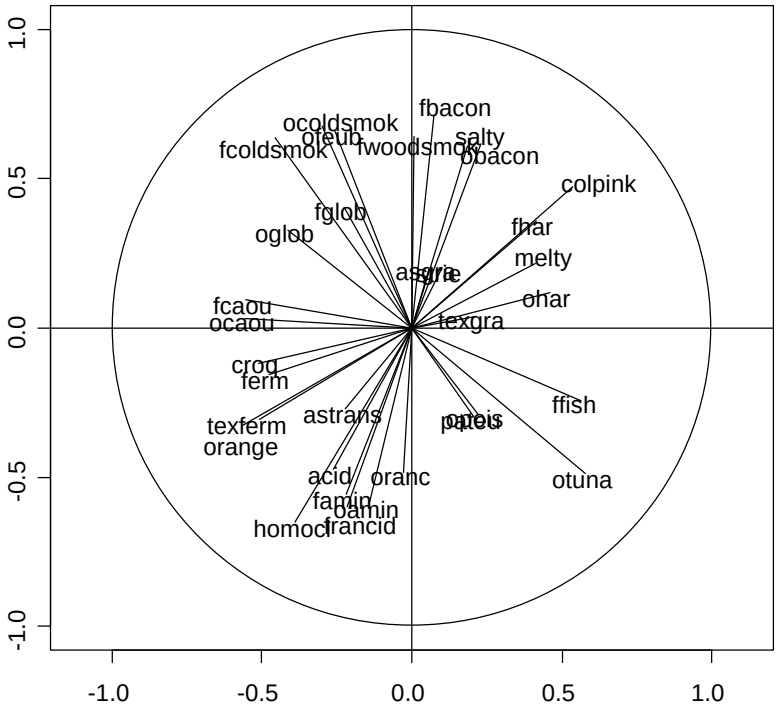
Stress Kruskal (3 dim)=0.04711564

Correlations with sensory attributes

Contour plot of preference



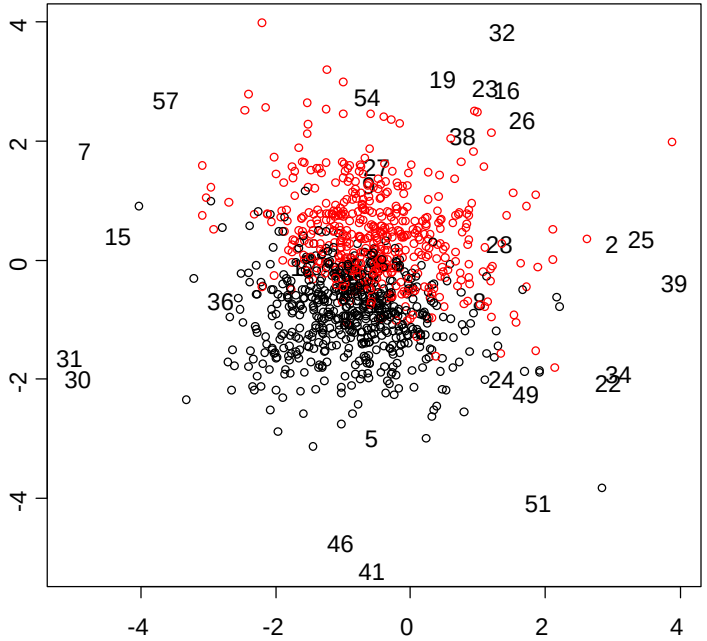
Correlations with attributes

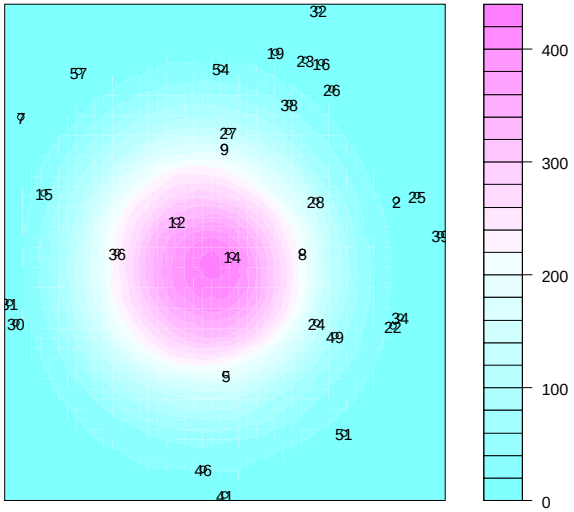


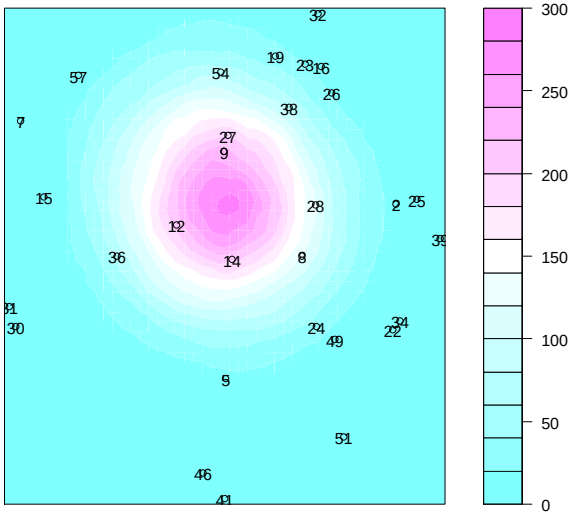
RV Unfolding / Profile
0.63524
RV MdPref / Profile
0.45334

Segmentation

Segmentation
in two classes

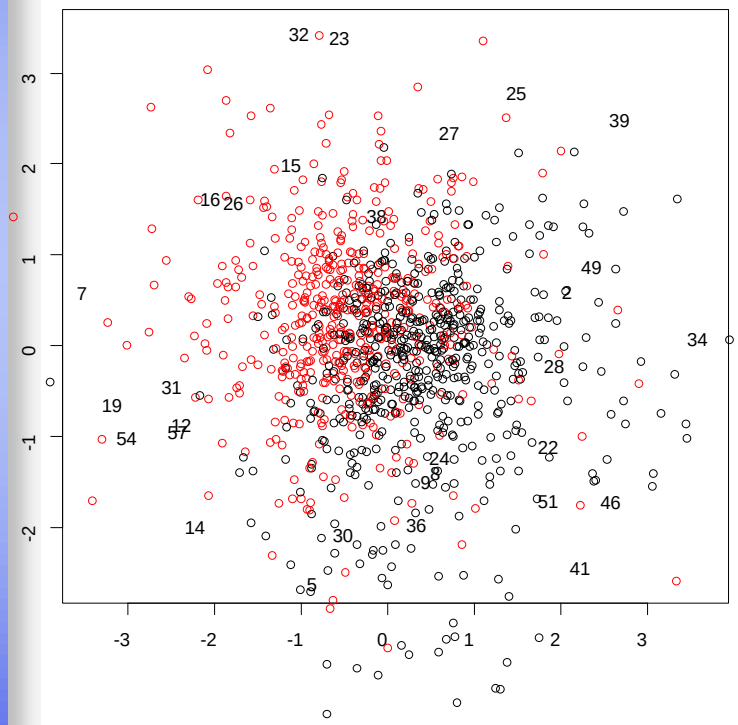


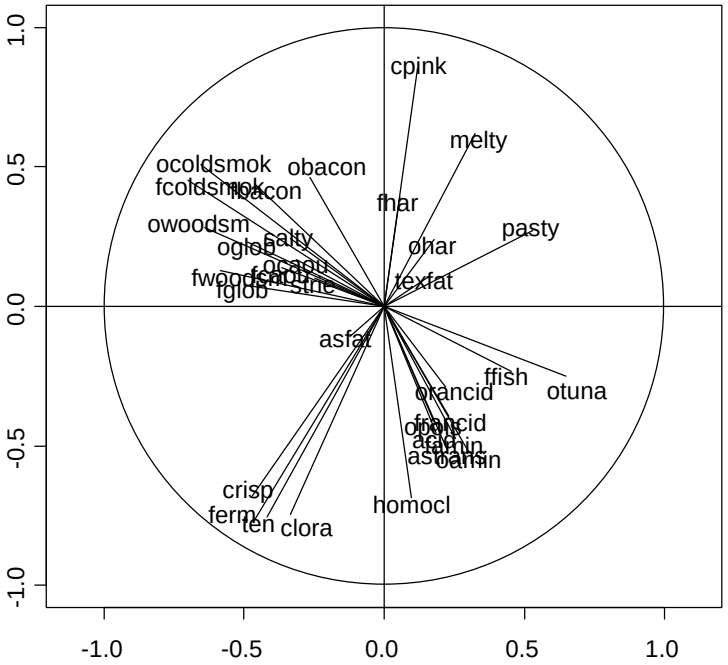




External preference mapping

Possible to constraint the coordinates of the products to be a linear combination of sensory attributes





Stress Kruskal =0.05359

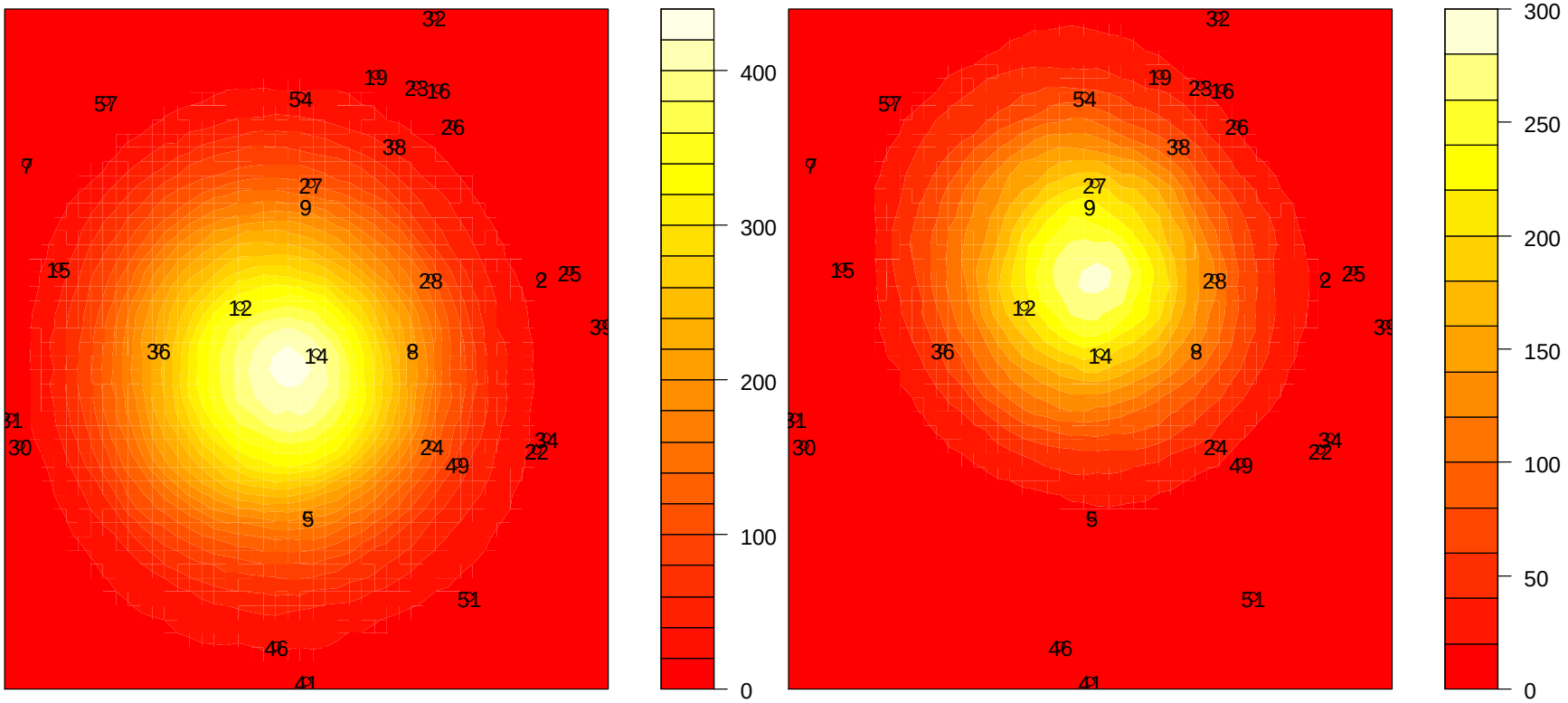
	D1	D2	D3
S1	0.17	0.90	0.16
S2	-0.47	0.13	0.75
S3	0.73	-0.05	0.31

Conclusion

Versatile models : transformations (metric *vs* non metric)
constraint (internal *vs* external)

Accuracy (recovery of sensory dimensions or experimental design)

Simple and direct interpretation


400
300
200
100
0
300
250
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0