Construction of confidence areas in sensometry

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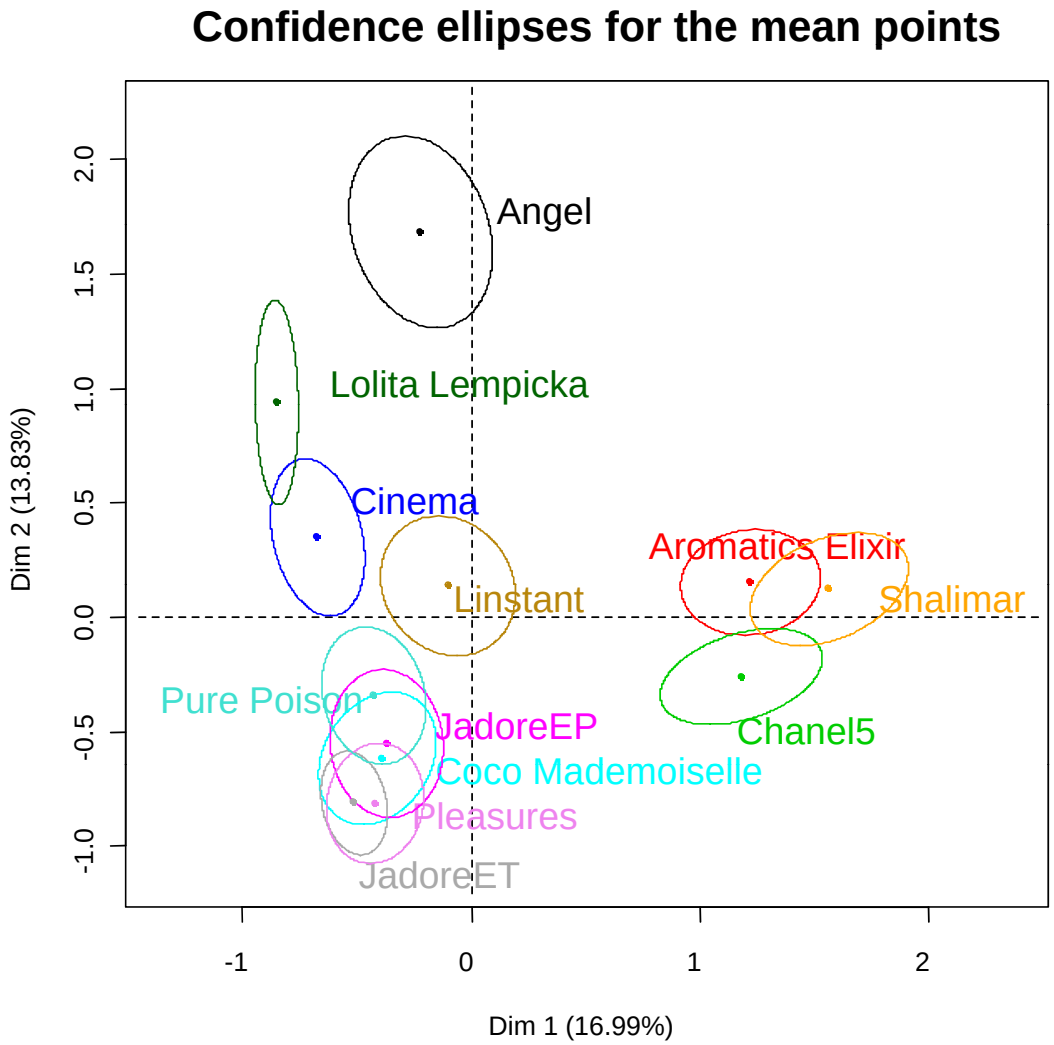
An example of sorting task

	J.1	J.2	J.3	J.4	J.5
Angel	exotic;sweet;pleasant	flowery;soft	fruity;strong	vanilla;spicy;spirit of islands	to eat;sweet
Aromatics Elixir	strong;alcoholized	strong;man	heady	rough;strong	old
Chanel5	soap;clean	G4	heady	toilet	soap
Cinema	flowery;lilac	flowery;artificial;grass	fruity;middle	sweet	soft
Coco Mademoiselle	soap;clean	flowery;soft	fruity;middle	softness;flowery	soft
JadoreEP	soap;clean	flowery;soft	sweet;light	softness;flowery	flowery
JadoreET	soap;clean	flowery;artificial;grass	sweet;light	softness;flowery	flowery
Linstant	G3	flowery;soft	fruity;strong	sweet	old
Lolita Lempicka	exotic;sweet;pleasant	flowery;soft	fruity;middle	vanilla;spicy;spirit of islands	to eat;sweet
Pleasures	G3	strong;man	fruity;strong	sweet	flowery
Pure Poison	flowery;lilac	flowery;soft	tangy;deodorant	softness;flowery	soft
Shalimar	strong;alcoholized	flowery;artificial;grass	strong;lavander	mustiness;aggressive	old

An example of sorting task



Bootstrap technique

Real jury

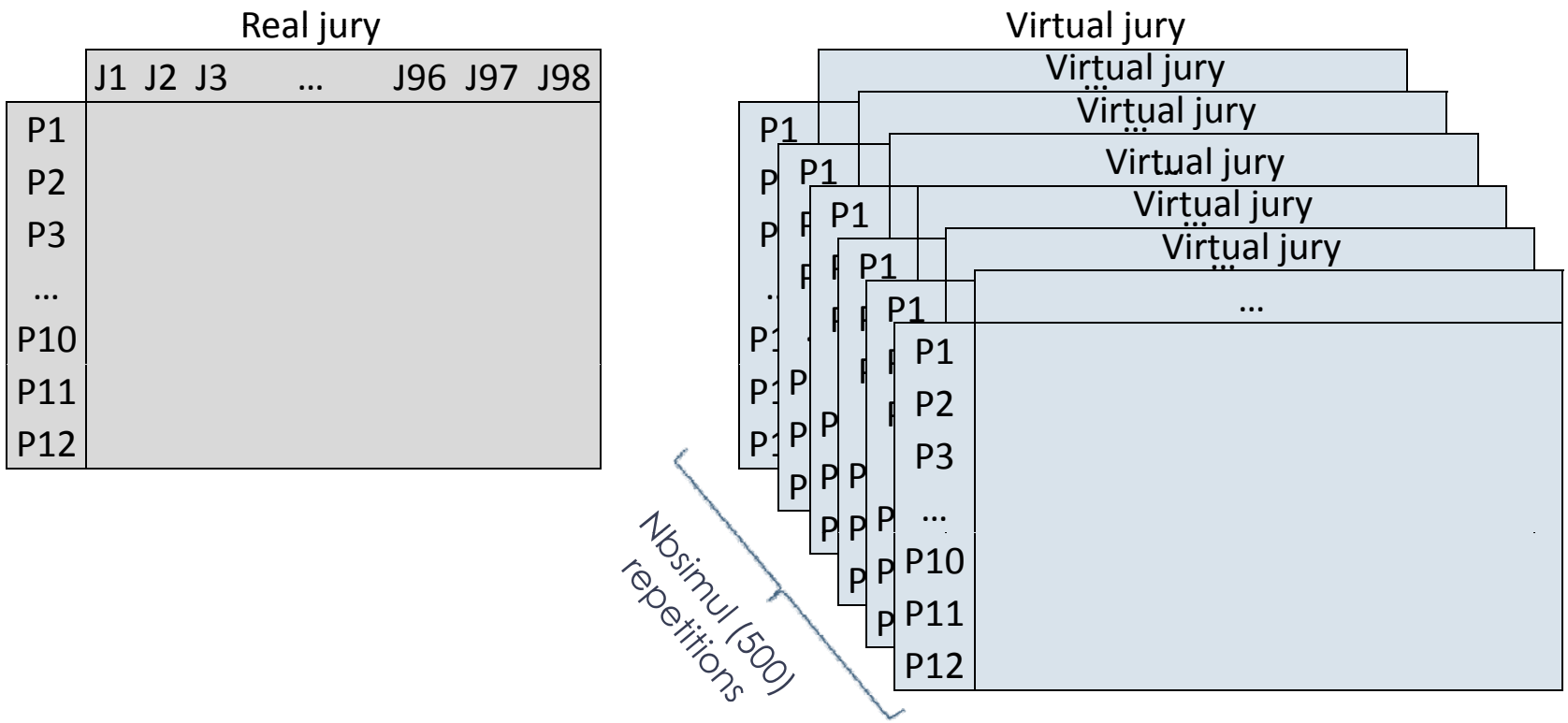
	J1	J2	J3	…	J96	J97	J98
P1							
P2							
P3							
…							
P10							
P11							
P12							

Virtual jury

	J1	J1	J19	…	J98
P1					
P2					
P3					
…					
P10					
P11					
P12					

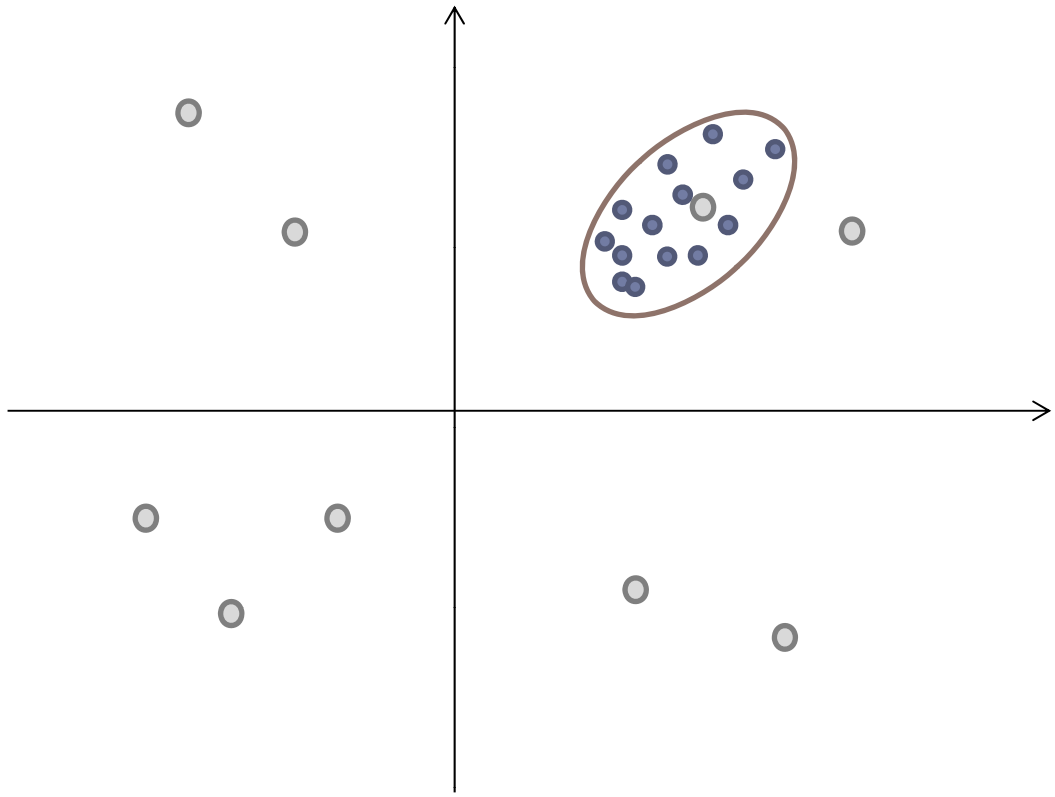
=> Random re-sampling with replacement

Bootstrap technique



- 2 ways to use bootstrapped virtual juries :
  - By projection (partial bootstrap)
  - By procrustean rotation (total bootstrap)

Partial bootstrap



1. Principal Component method on the data of the real jury

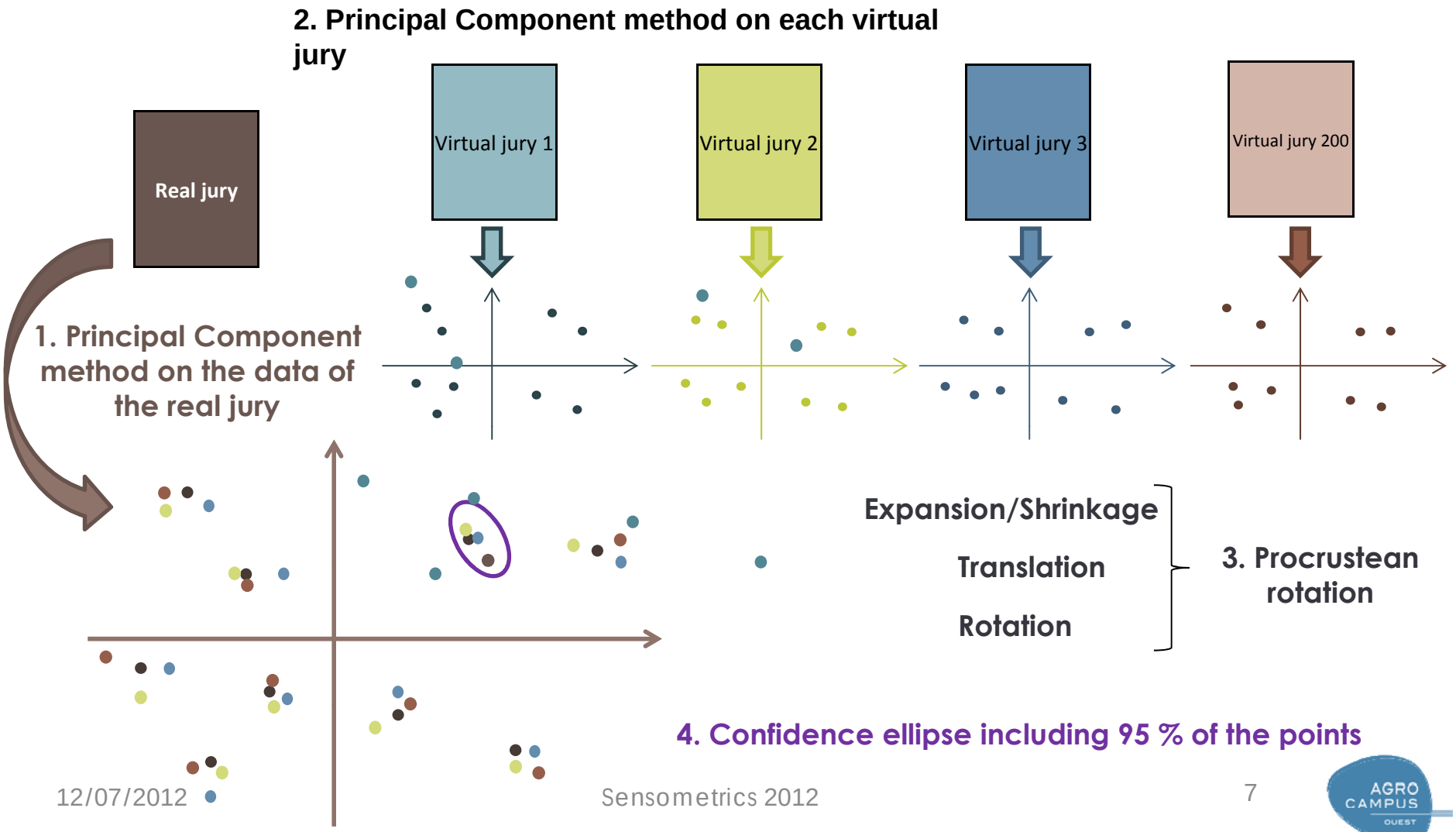
2. Projection of the judges of a virtual jury

3a. Calculation of the virtual jury's barycenter

3b. Calculation of the barycenters

4. Ellipse including 95% of the points

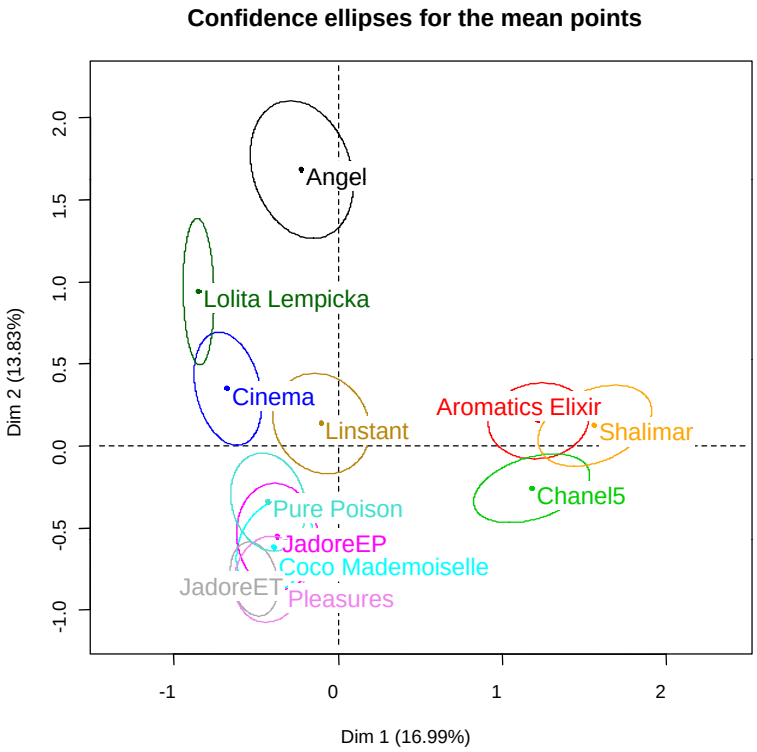
Total bootstrap



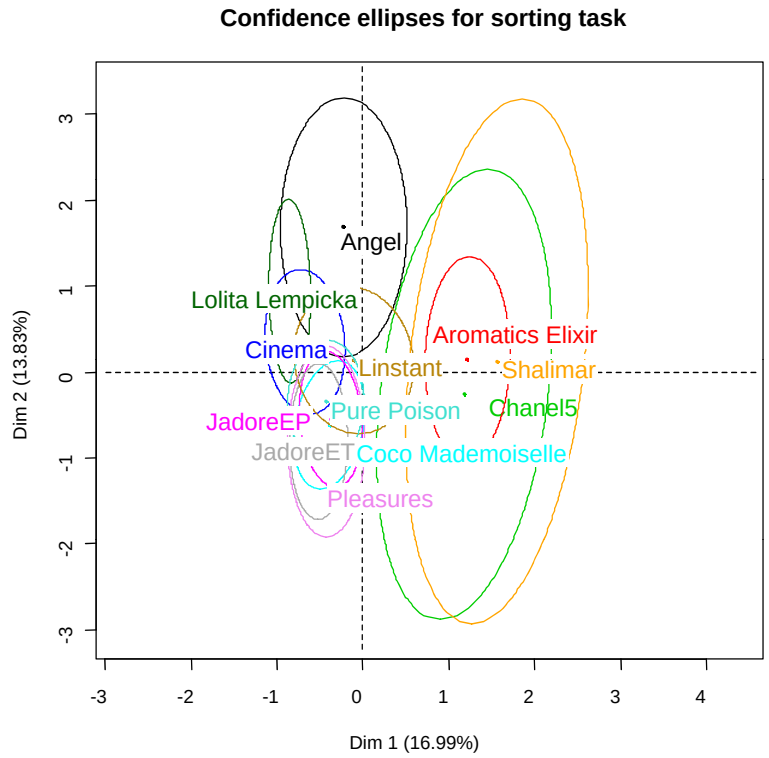
Comparison of partial and total bootstrap

Example of a sorting task dataset

Partial bootstrap



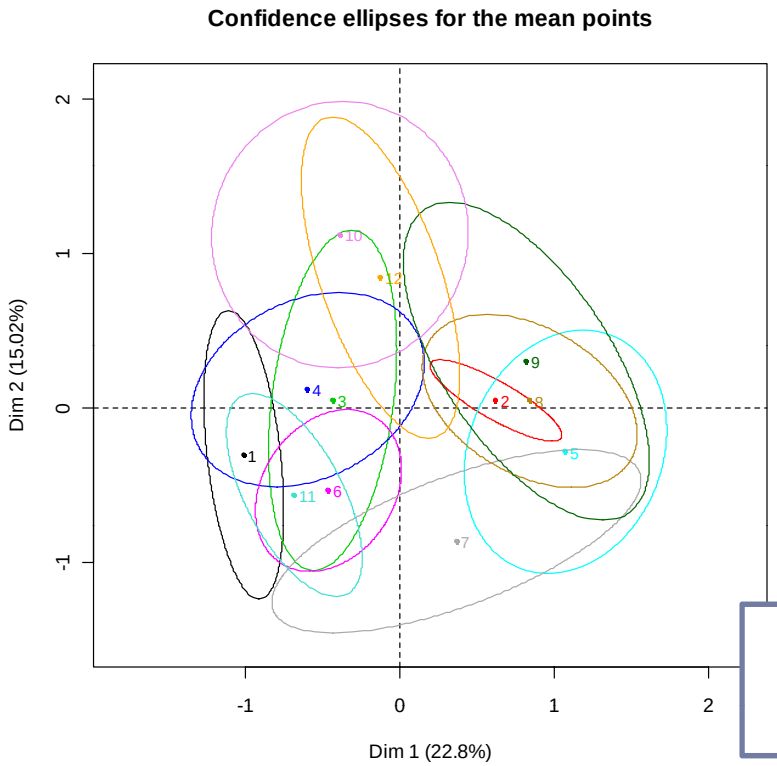
Total bootstrap



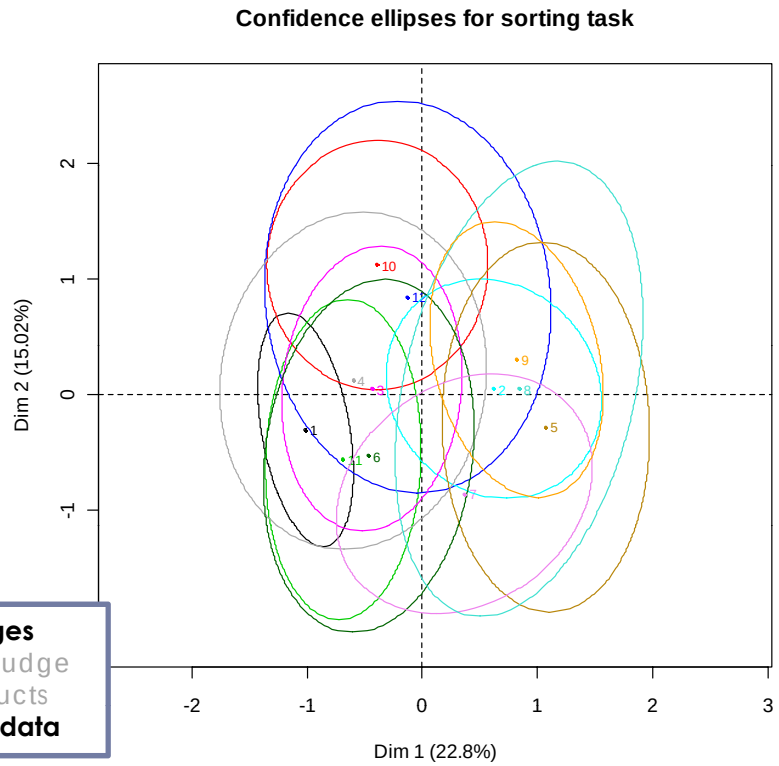
Comparison of partial and total bootstrap

*Example of a **RANDOM** sorting task dataset*

Partial bootstrap



Total bootstrap

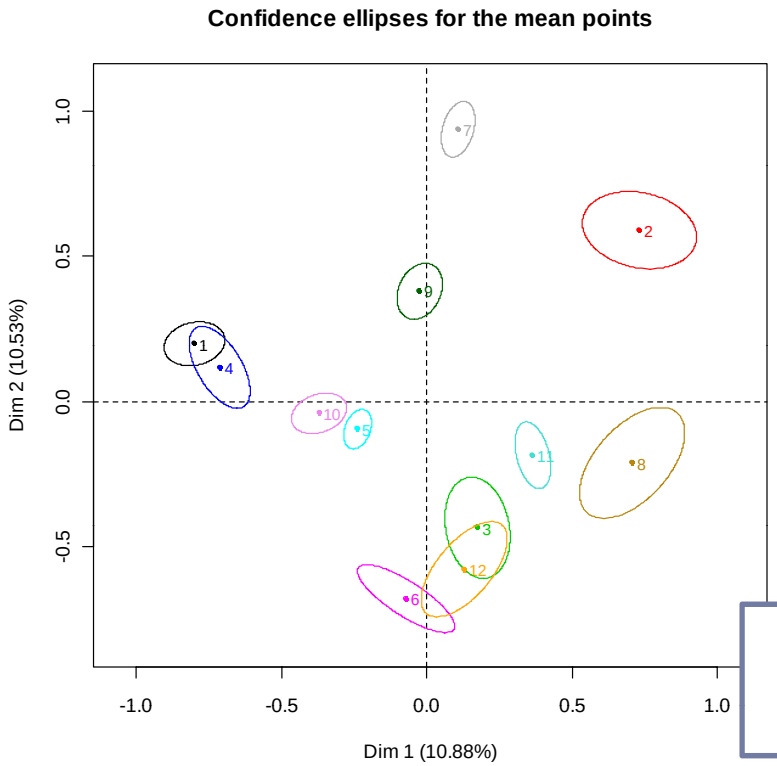


10 judges
3 groups/judge
12 products
Random data

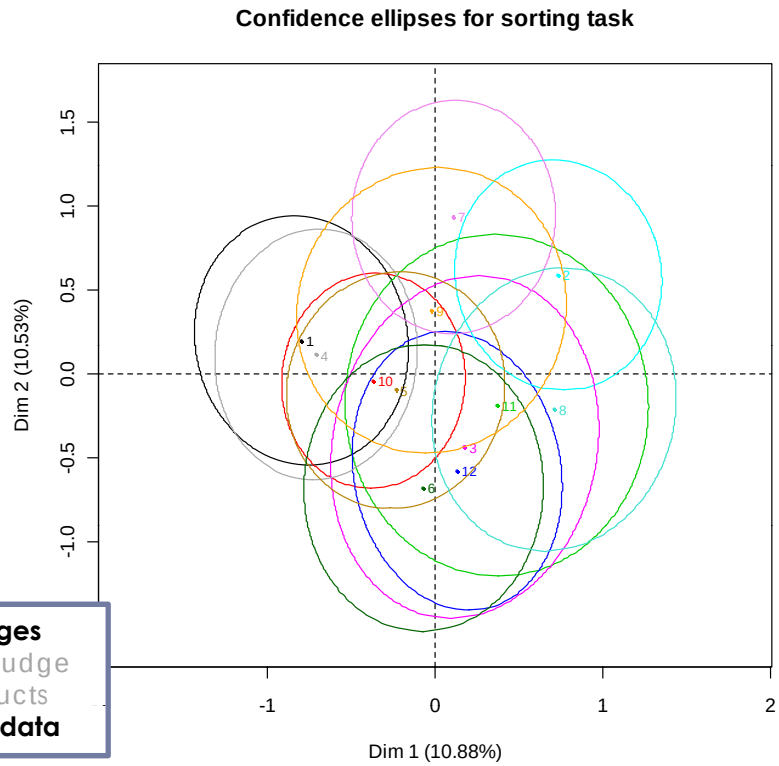
Comparison of partial and total bootstrap

*Example of a **RANDOM** sorting task dataset*

Partial bootstrap



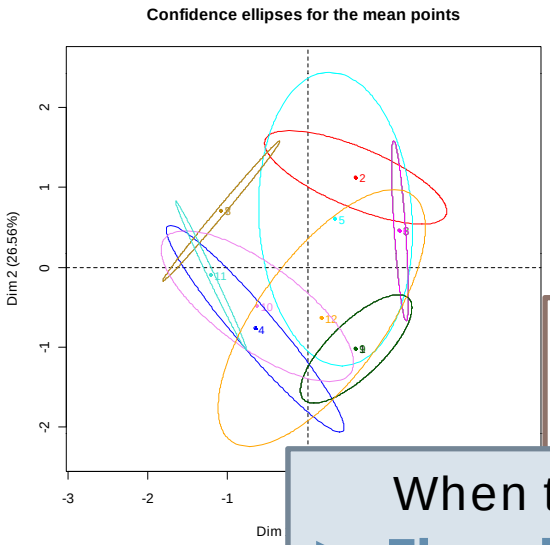
Total bootstrap



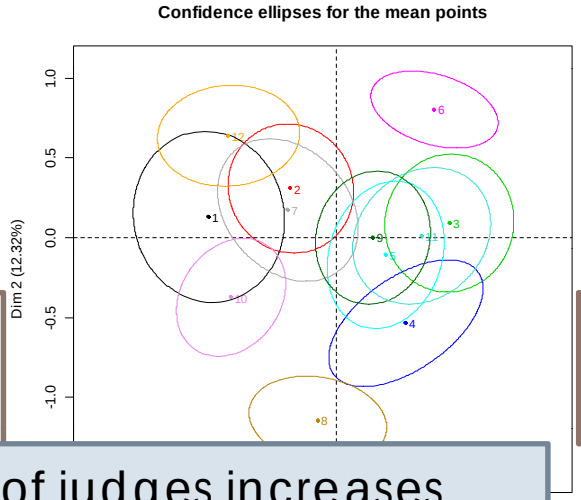
300 judges
3 groups/judge
12 products
Random data

Why partial bootstrap doesn't work ?

I. Random qualitative dataset



3 judges
3 groups/judge
12 products
Random dataset

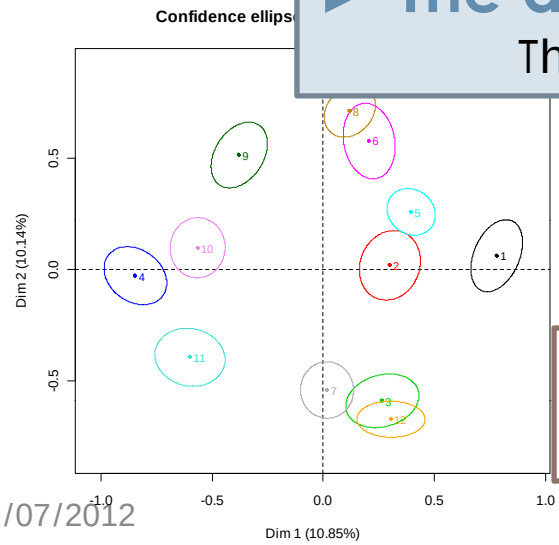


30 judges
3 groups/judge
12 products
Random dataset

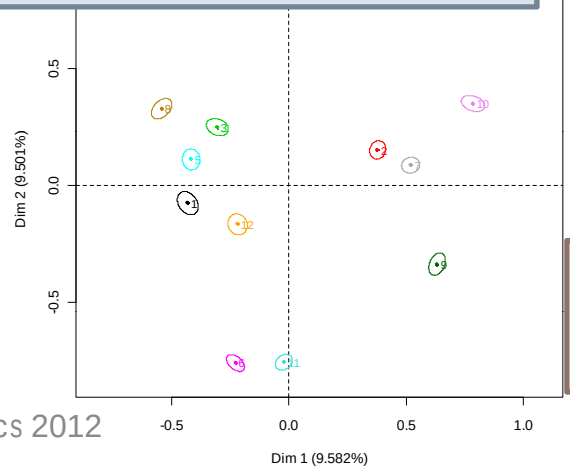
When the number of judges increases

▶ **The dimensionality increases**

The ellipses become smaller



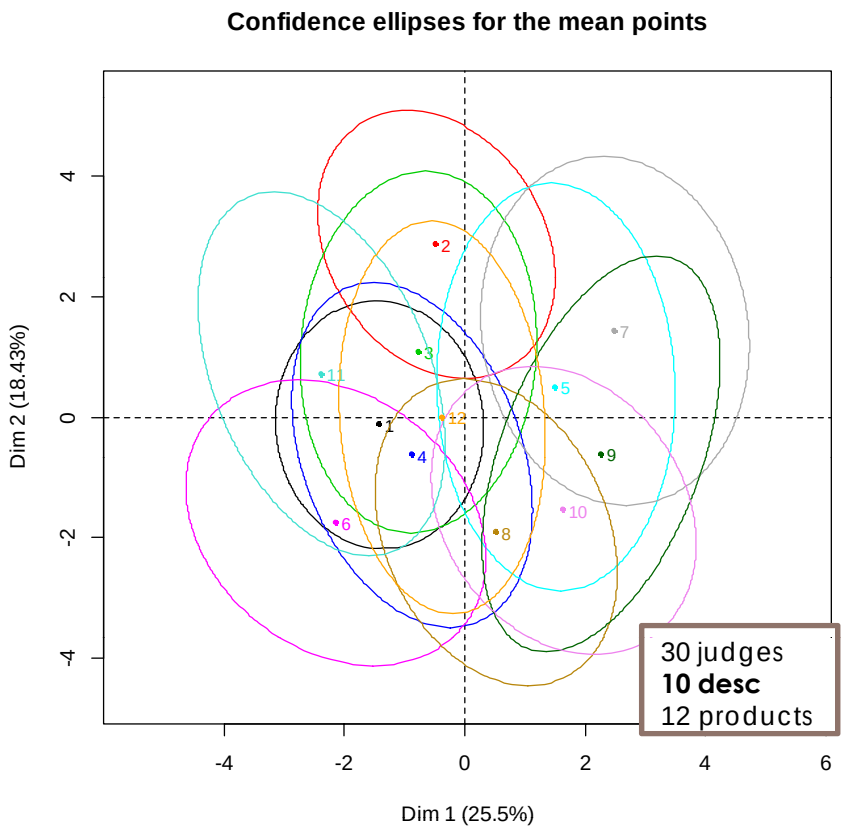
300 judges
3 groups/judge
12 products
Random dataset

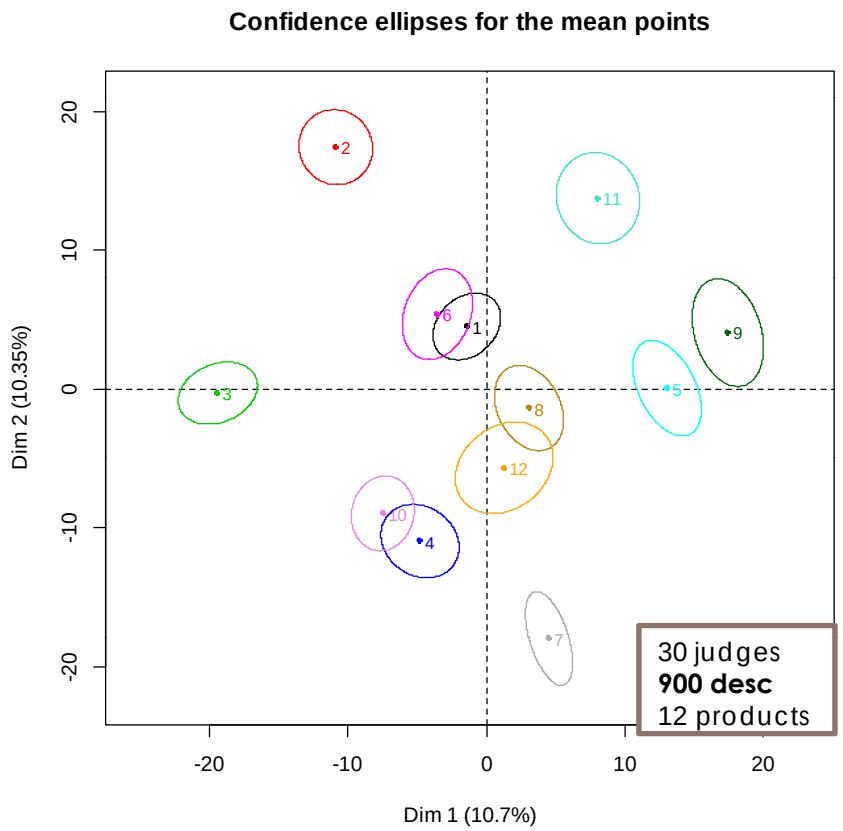


3000 judges
3 groups/judge
12 products
Random dataset

II. Quantitative dataset

*An example of QDA (**RANDOM** quantitative dataset)*

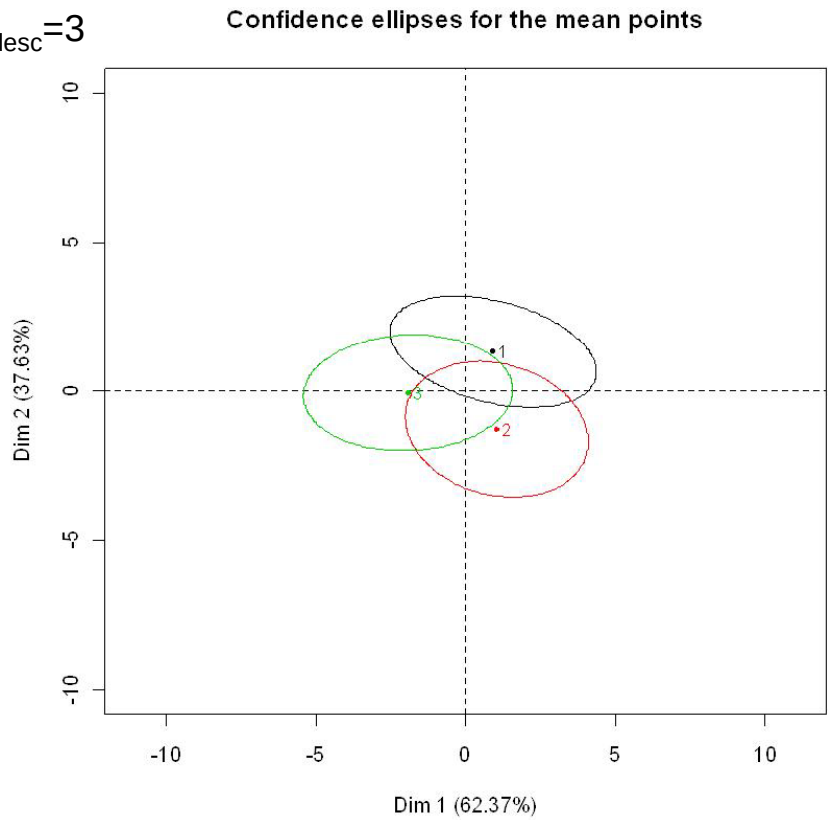




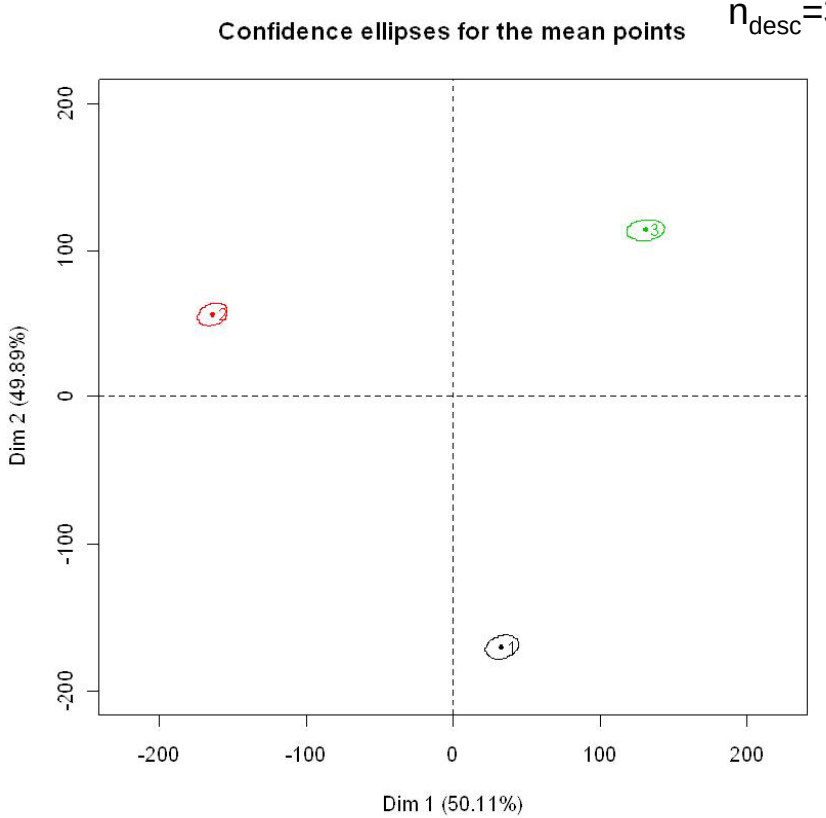
II. Quantitative dataset

*A simple **RANDOM** dataset*

n_{desc}=3



n_{desc}=30000

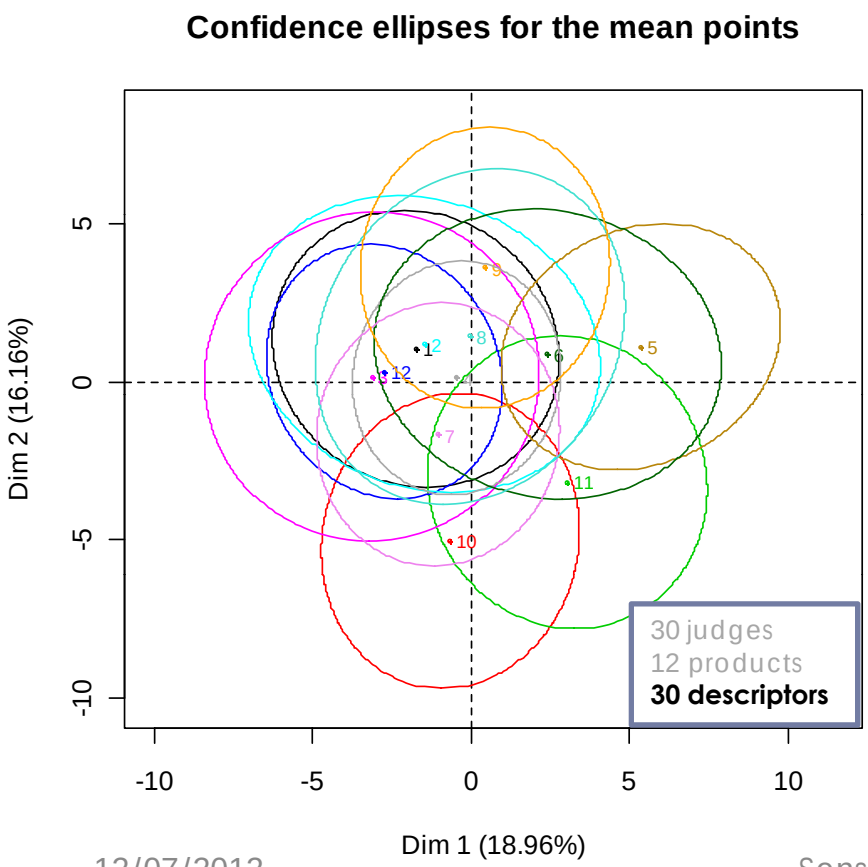


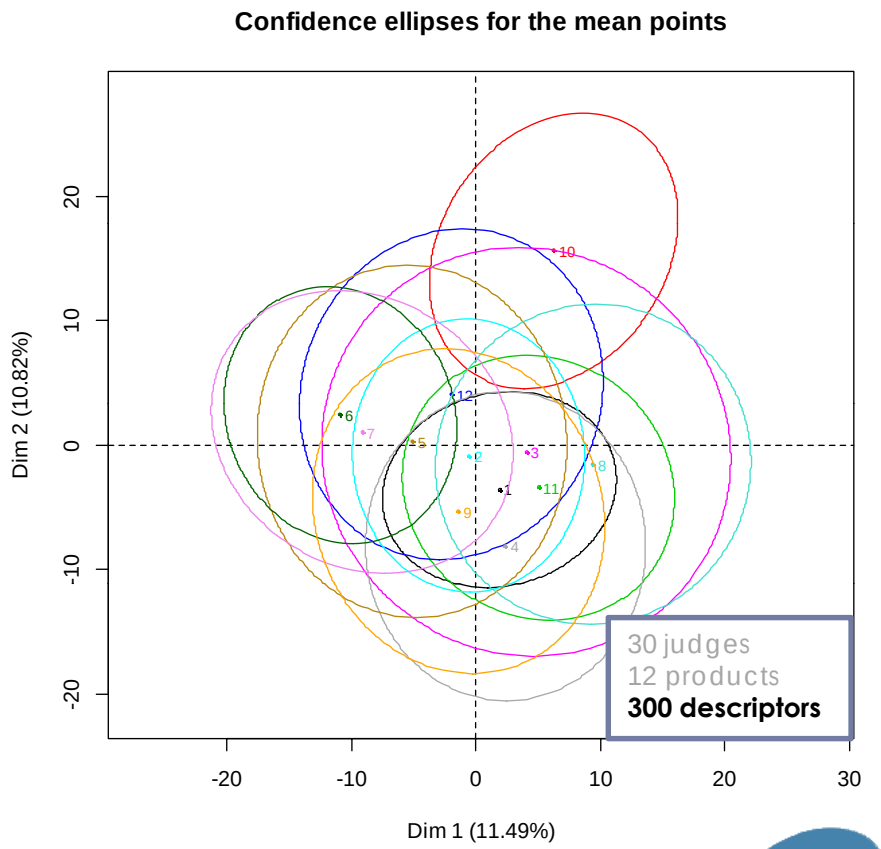
Projection of the average points of the virtual juries in illustrative
=> A point is a product as seen by a virtual jury

Validity of total bootstrap

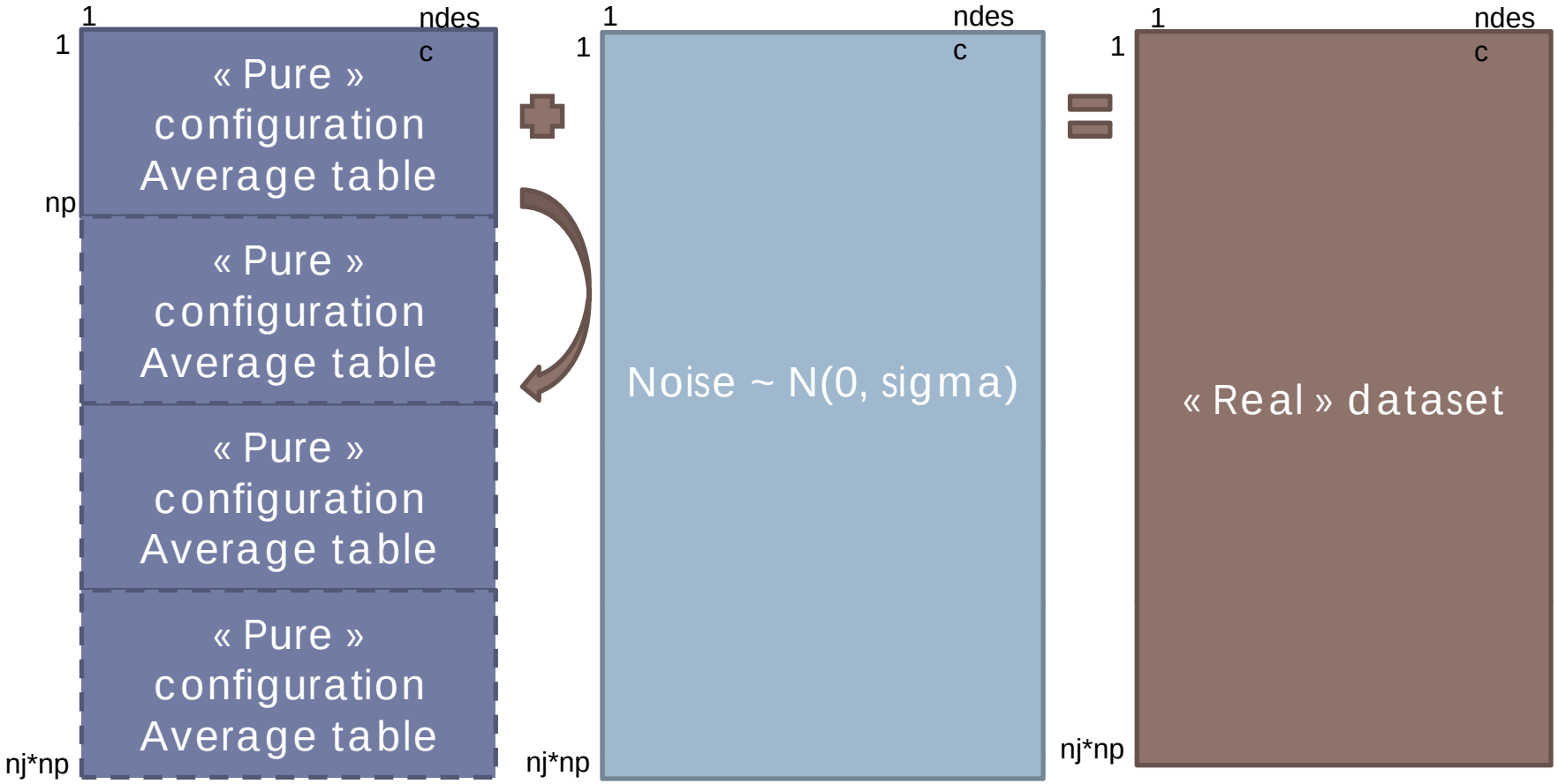
The case of completly random data

RANDOM data without structure



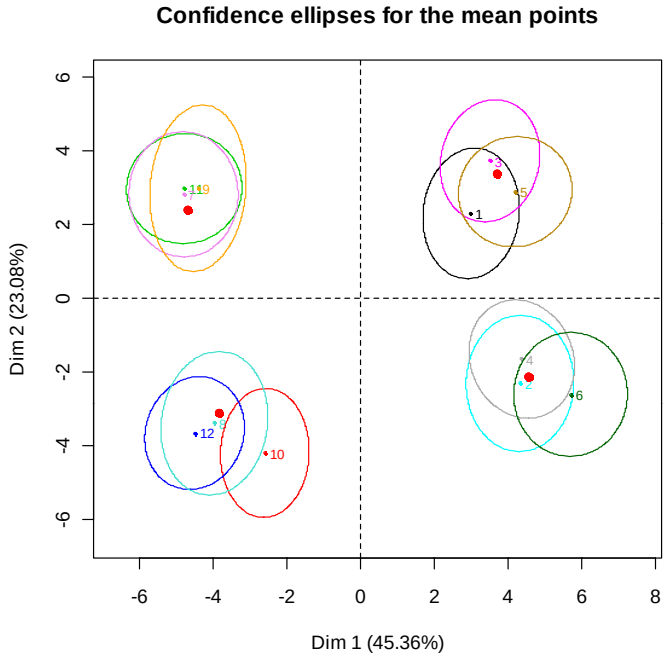


Data simulation procedure



Do the ellipses include the « real » structure of the data ?

Count the number of times that a point is included in an ellipse, given its coordinates on the factorial plan



	Sd	Frequence
Structured dataset	0.1	92,09%
	0.5	91,5%
	1	91,67%
	1.5	91,09%
	2	89,5%
	3	91,75%
	4	91,92%
	7	94,92%

	n_j	12	30	90	210
α = 5%	12	88,50	88,08	89,17	92,42
	30	91,42	90,00	91,00	93,92
	200	94,08	94,33	95,33	93,92

The proportion tends to 95% when the number of judges increases (asymptotic behavior of bootstrap techniques)

Conclusion

- One parameter must be chosen:
  - **Number of dimensions** for the procrustean rotations
    => n = 2 in many sensometry applications

- **Dimensionality problem** highlighted :
  Confidence ellipses are essential (but may be built according to total bootstrap)

- **Total bootstrap can be applied to all holistic** approaches:
  - Napping
  - Sorting task
  - Hierarchical sorting
  - Free Choice Profiling

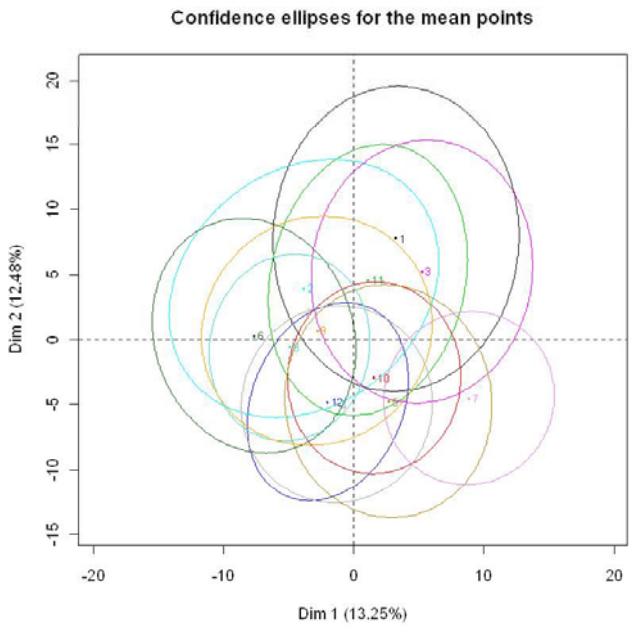
- Available into the **R package SensoMineR** through the boot function

Thank you

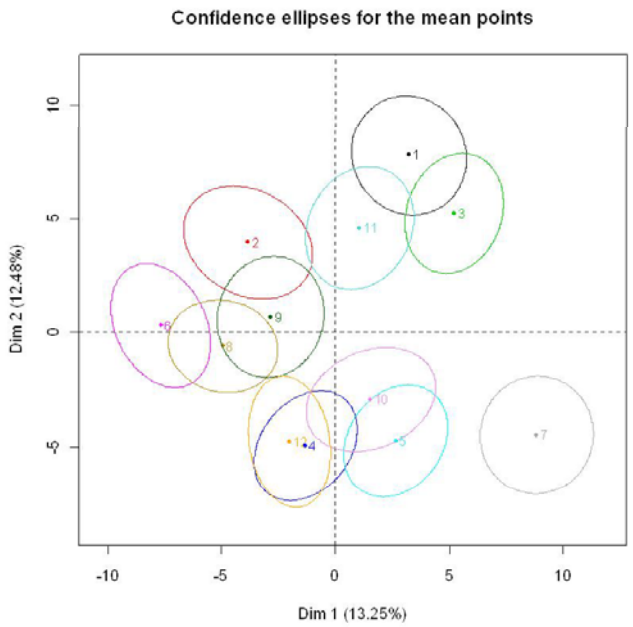
Do you have any questions ?

L'évolution de la taille des ellipses en fonction du nombre de dimensions utilisées pour les rotations procustéennes

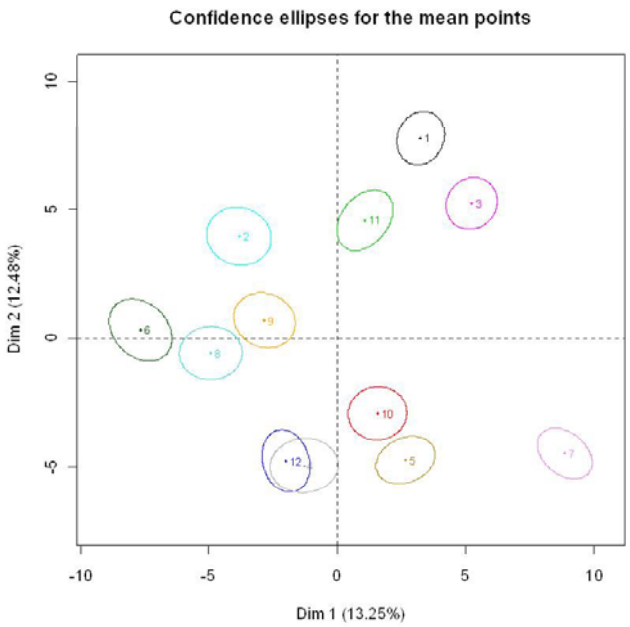
30 juges
12 produits
Sans structure



ncp=2



ncp=7



ncp=11