

SENSOMETRICS 2004

NEW DEVELOPMENTS IN
PREFERENCE MAPPING TECHNIQUES :
FINDING OUT A CONSUMER OPTIMAL PRODUCT,
ITS SENSORY PROFILE
AND THE KEY SENSORY ATTRIBUTES.

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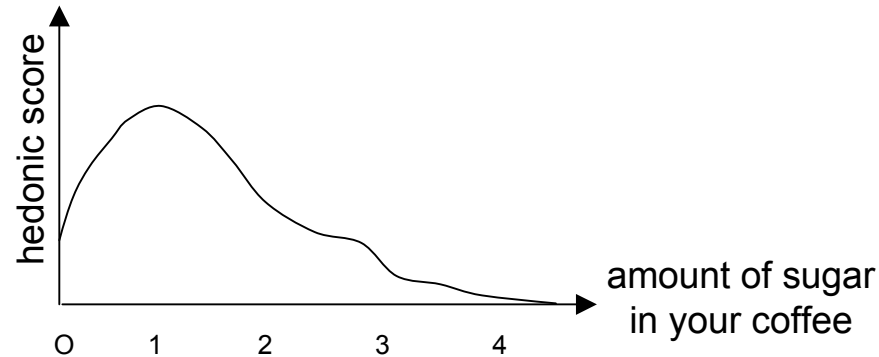
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In most cases preferences are not linear



In most cases consumers equally likes products with really different sensory properties

*Just think to your own experience !
If you likes fruit yoghurts ...
do you still choose the same flavor ?*

*An interesting fact, you can verify on your own sets of data, is the following:
Perform cluster analysis to obtain homogeneous group of consumers.
(I strongly suggest that you will use standardized scores by consumer)
Then for each cluster, plot the dendrogram of the products ...
you will see that the paired products differs from one cluster to another.*

Quantitative Variables



Description of the products by expert panelists

Quantitative Variable



Hedonic scores given to the products by a given consumer



Quadratic model

If y_6 represents the score of the 6th product

$$y_6 = \alpha_0 + \alpha_1 C_1 + \alpha_2 C_2 + \alpha_3 C_1^2 + \alpha_4 C_2^2 + \alpha_5 C_1 C_2$$

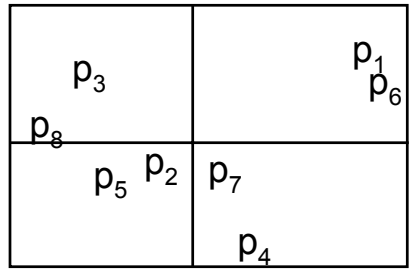
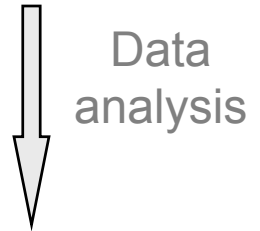
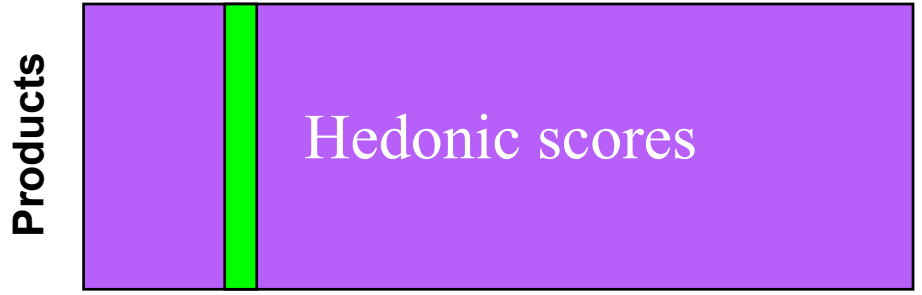
where C_1 and C_2 are the coordinates of product 6 on the expert map



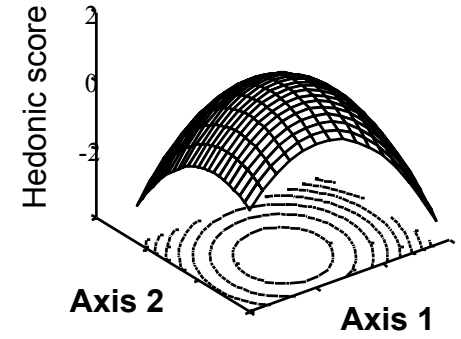
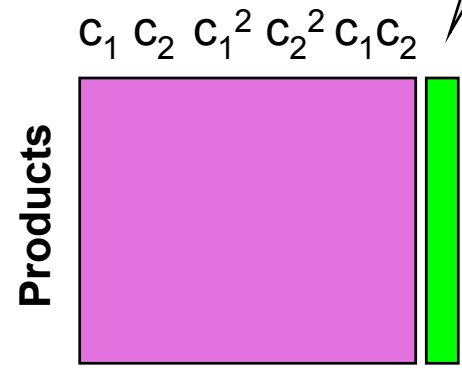
QUADRATIC PREFERENCE MAPPING

Sensory attributes

Consumers

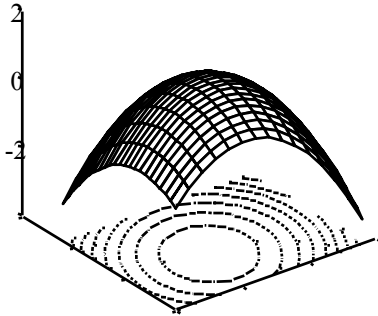


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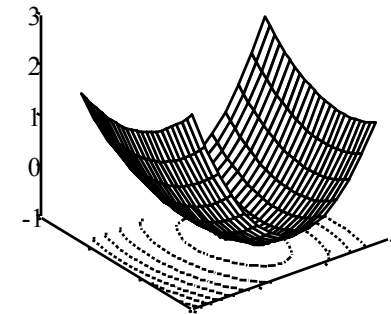


map of the products

3 kind of consumers

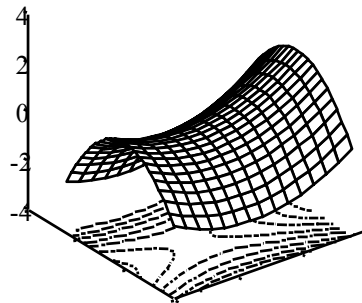


***Those expressing
a real preference***



***Those expressing
a dislike***

The eclectics
*(representing more
than 75 % of the
consumers in most cases)*





GIVAUDAN STUDY

9 products : P1 P2 P3 P4 P5 P6 P7 P8 P9

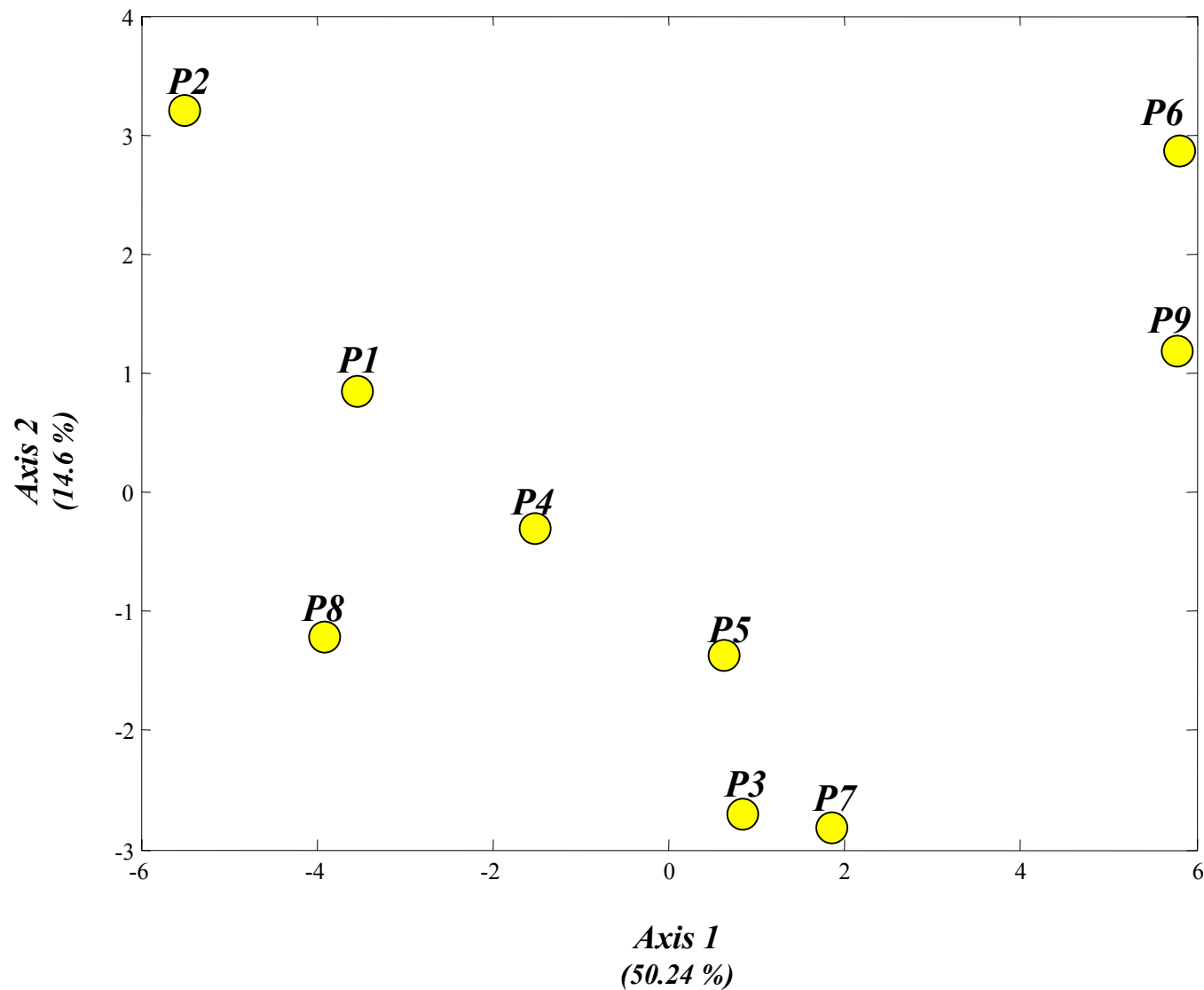
Q.D.A. 13 panelists
 3 replications
 30 attributes

Consumer study 323 consumers
 3 countries



Principal Component Analysis

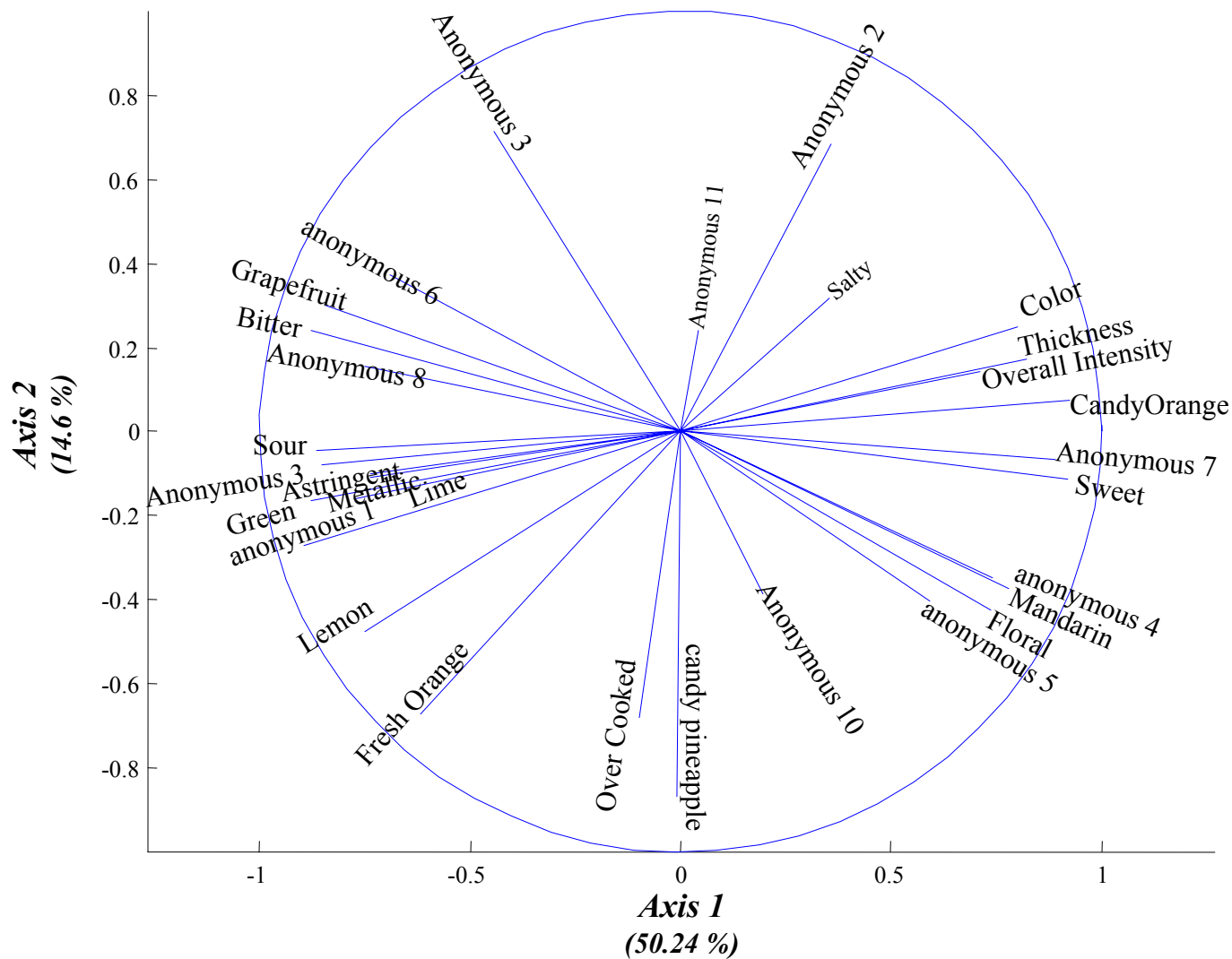
Individual plot : axis 1 – axis 2





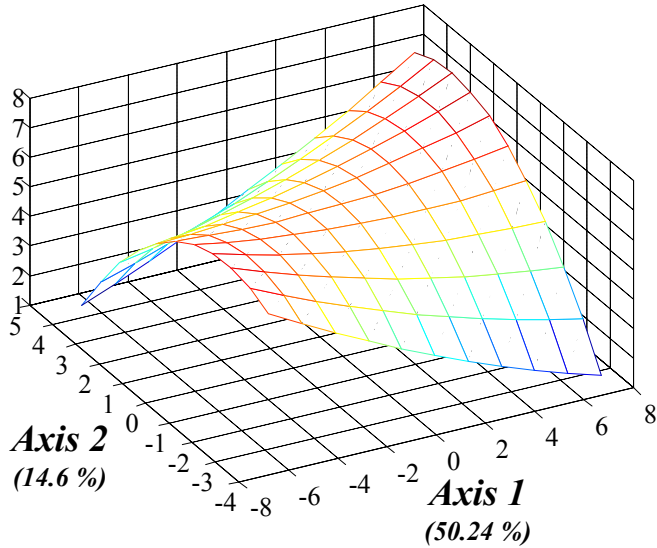
Principal Component Analysis

Variable plot : axis 1 – axis 2

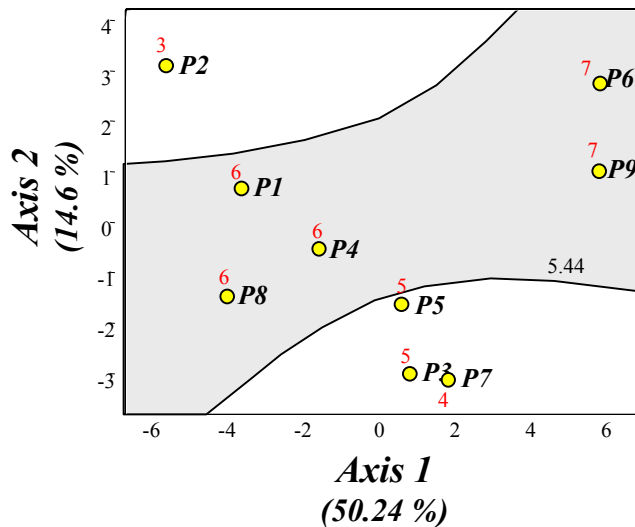
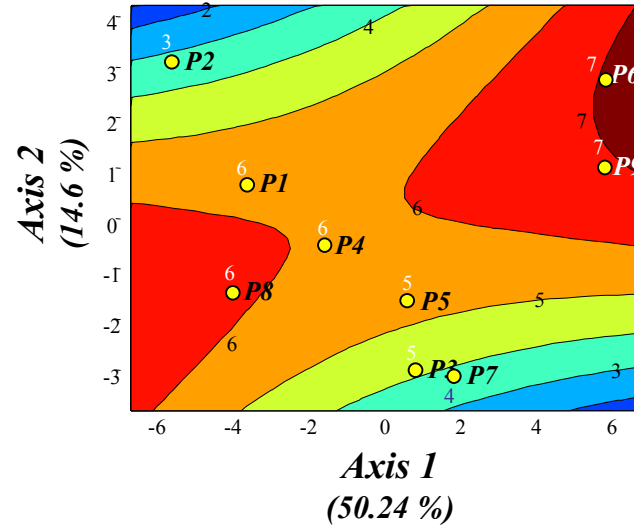




INDIVIDUAL FITTING (consumer 72)



Region of preference for the 72th consumer
($R^2 = 0.948$)



Mean value = 5.444

$$C_{72}(x,y) = 1 \quad \text{if} \quad f_{72}(x,y) \geq 5.444$$

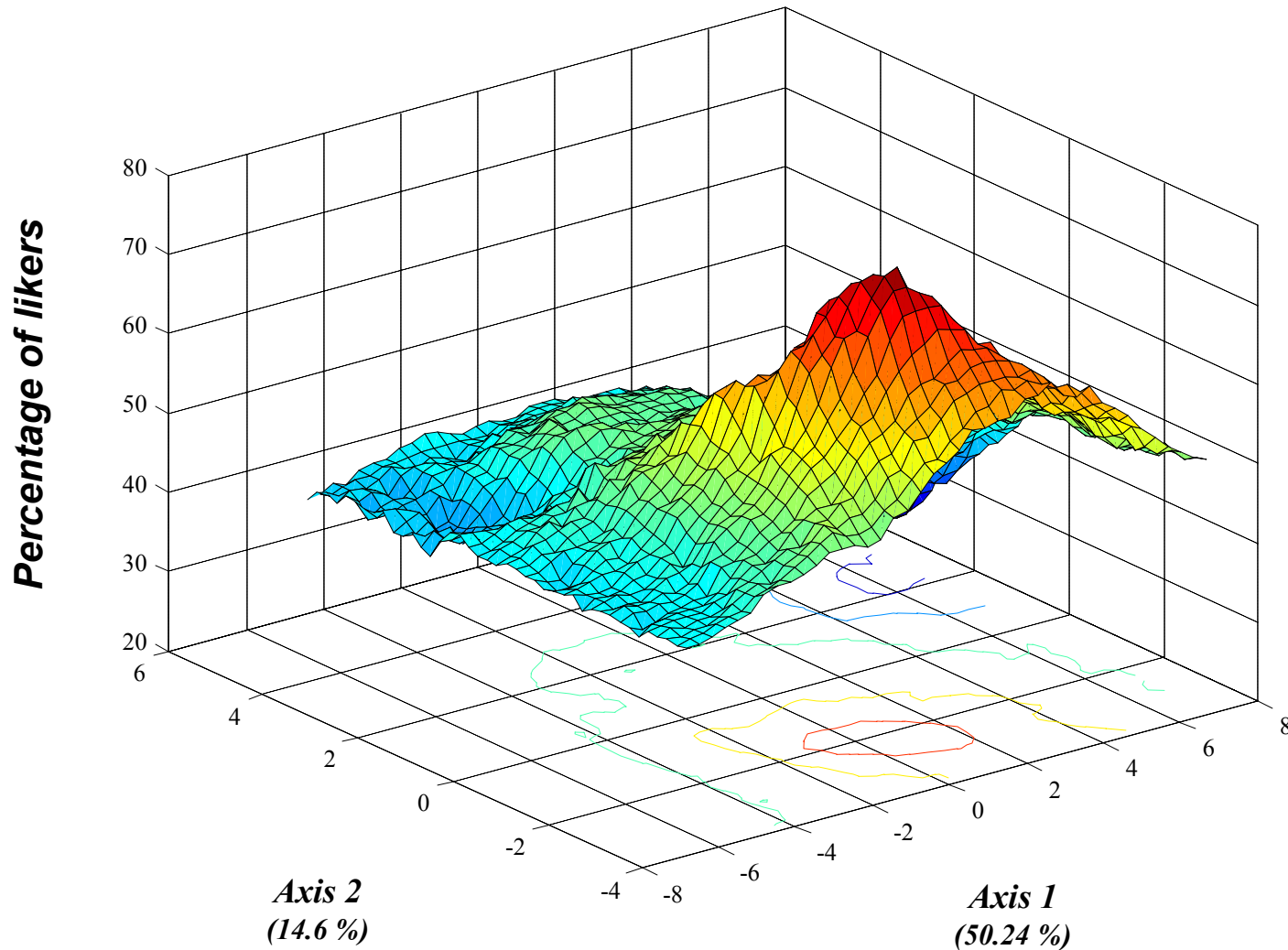
$$C_{72}(x,y) = 0 \quad \text{if} \quad f_{72}(x,y) < 5.444$$

$$\text{Pref (x.y)} = 100 * \frac{\sum_{i=1}^n C_i (x.y)}{n}$$

Pref (x.y) is the percentage of consumers that likes the product with coordinates x and y on the sensory map.



Preference response surface for all the consumers





COMMENTS

With respect to the previous process, we obtain the same results if we use centered and reduced scores by consumer.

P ₁	P ₂	P ₃	P ₄	P ₅	P ₆	P ₇	P ₈	P ₉
6	3	5	6	5	7	4	6	7

mean value = 5.444
std dev. = 1.333

0.4167	-1.8333	-0.3333	0.4167	-0.3333	1.1667	-1.0833	0.4167	1.1667
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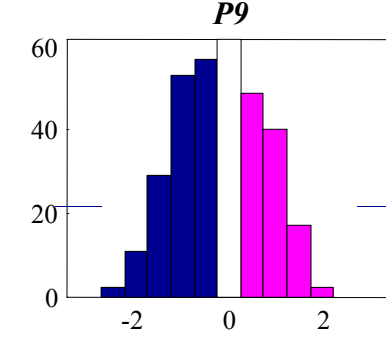
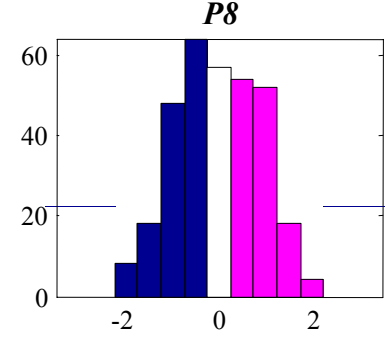
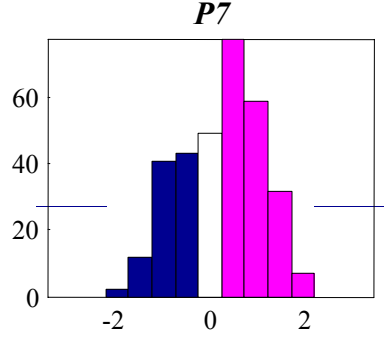
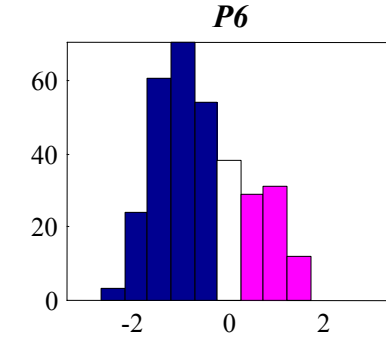
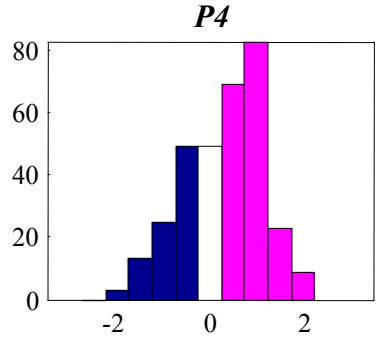
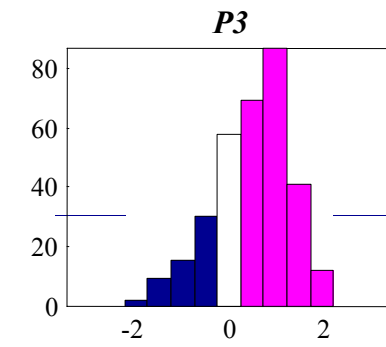
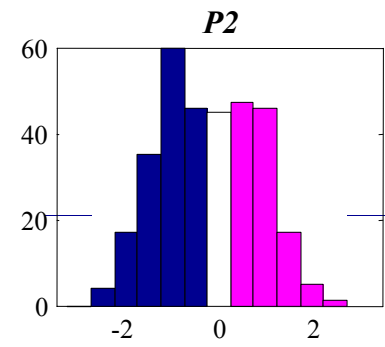
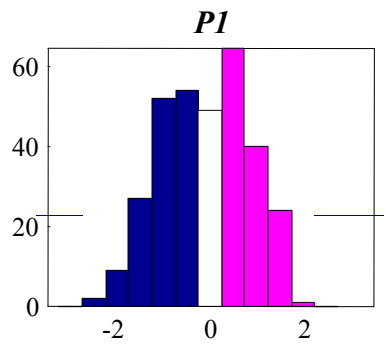
minimum score
-2

mean score
0

maximum score
+2

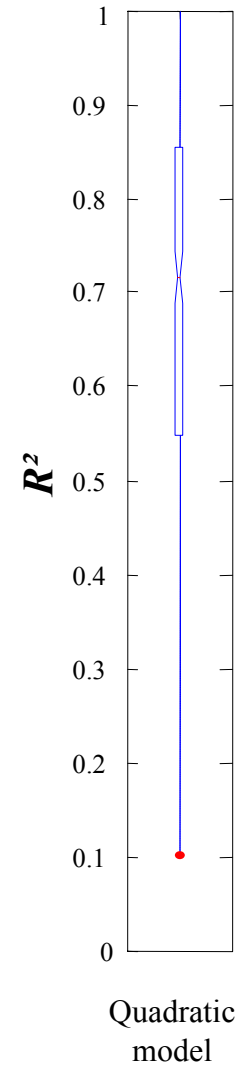
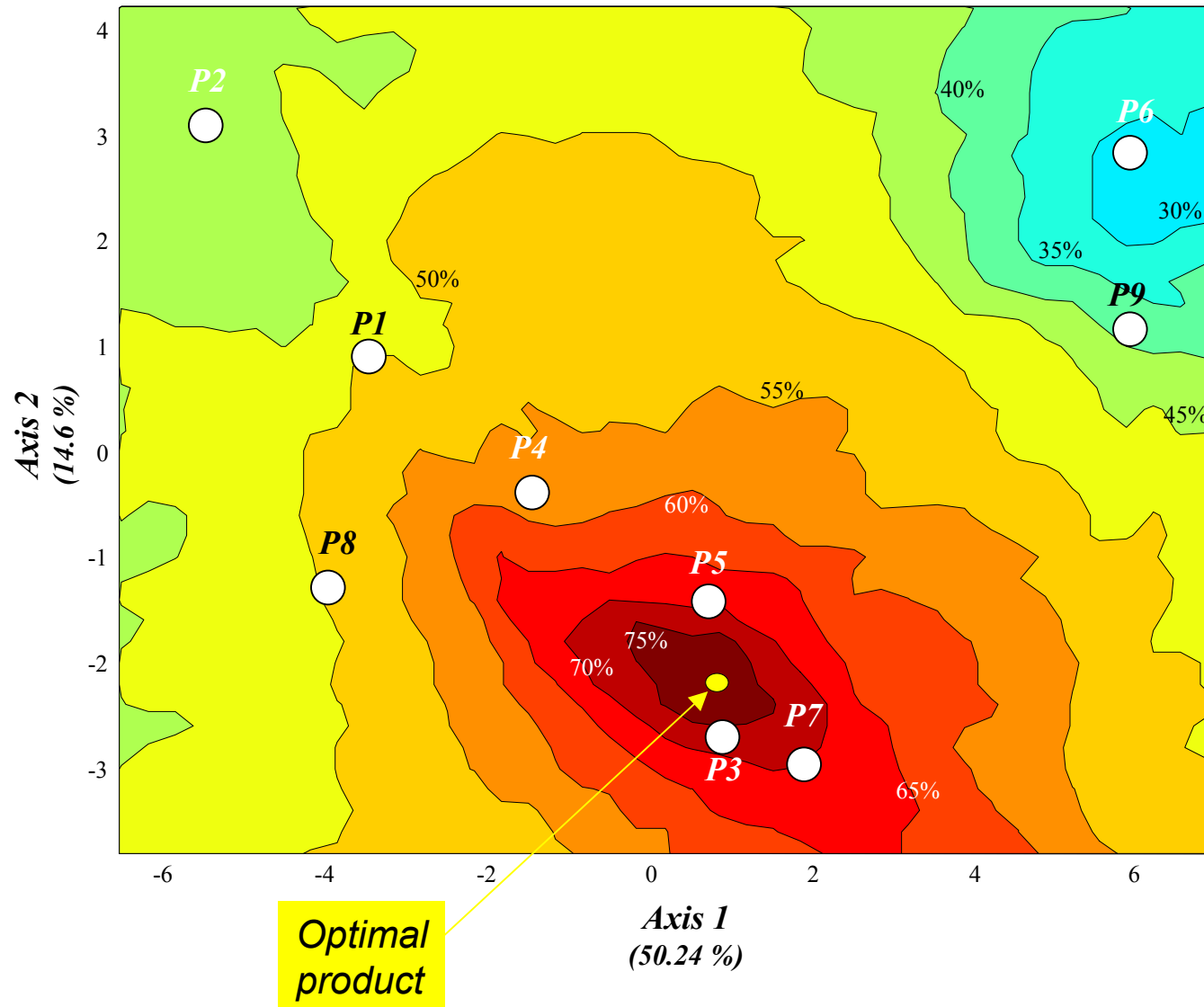


Standardized preference scores by product for the consumers





Preference of all the consumers

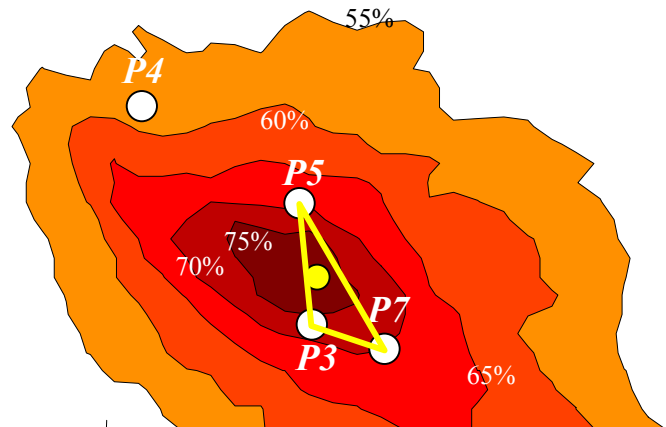




Definition of the optimal product as a barycenter of 3 real products

	x-coordinate	y-coordinate
Optimum n° 1	0.820	-2.193

79.3 % of the consumers will like this product



Reference products to determine the optimal product for the consumers are :

	x-coordinate	y-coordinate	Percentage of liking
P3	0.79	-2.68	73 %
P5	0.60	-1.35	68 %
P7	1.79	-2.79	74 %



Definition of the optimal product as a barycenter of 3 real products

	x-coordinate	y-coordinate
P3	0.79	-2.68
P5	0.60	-1.35
P7	1.79	-2.79
P_{opt}	0.82	-2.193

$$\alpha_1 x_3 + \beta_1 x_5 + \gamma_1 x_7 = x_{opt}$$

$$\alpha_1 y_3 + \beta_1 y_5 + \gamma_1 y_7 = y_{opt}$$

$$\alpha_1 + \beta_1 + \gamma_1 = 1$$

$$\alpha_1 = 0.525$$

weight $\beta_1 = 0.373$

$$\gamma_1 = 0.101$$

Apply the same linear combination to all the sensory attributes



Sensory profile of the optimal product for all the consumers

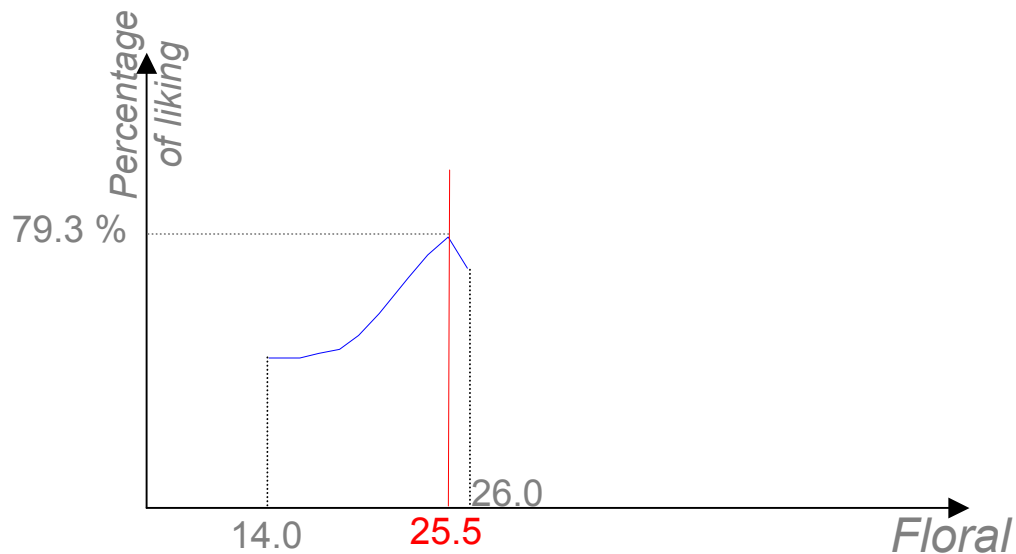
Overall Intensity	:	88.5	Anonymous 2	:	11.0
Sweet	:	94.5	candy pineapple	:	39.5
Sour	:	48.0	Lemon	:	35.0
Bitter	:	22.0	Lime	:	23.5
Metallic	:	9.5	Grapefruit	:	18.0
Astringent	:	55.5	Anonymous 6	:	14.0
Salty	:	14.5	Anonymous 5	:	15.0
Anonymous 3	:	25.5	Green	:	21.0
Thickness	:	44.0	Floral	:	25.5
Color	:	60.0	Anonymous 4	:	23.0
Anonymous 1	:	43.5	Anonymous 7	:	16.0
Fresh Orange	:	45.5	Anonymous 8	:	2.5
Candy Orange	:	38.5	Anonymous 9	:	6.5
Overcooked	:	31.5	Anonymous 10	:	6.5
Mandarin	:	37.0	Anonymous 11	:	5.0



SENSITIVITY STUDY AND KEY SENSORY ATTRIBUTES

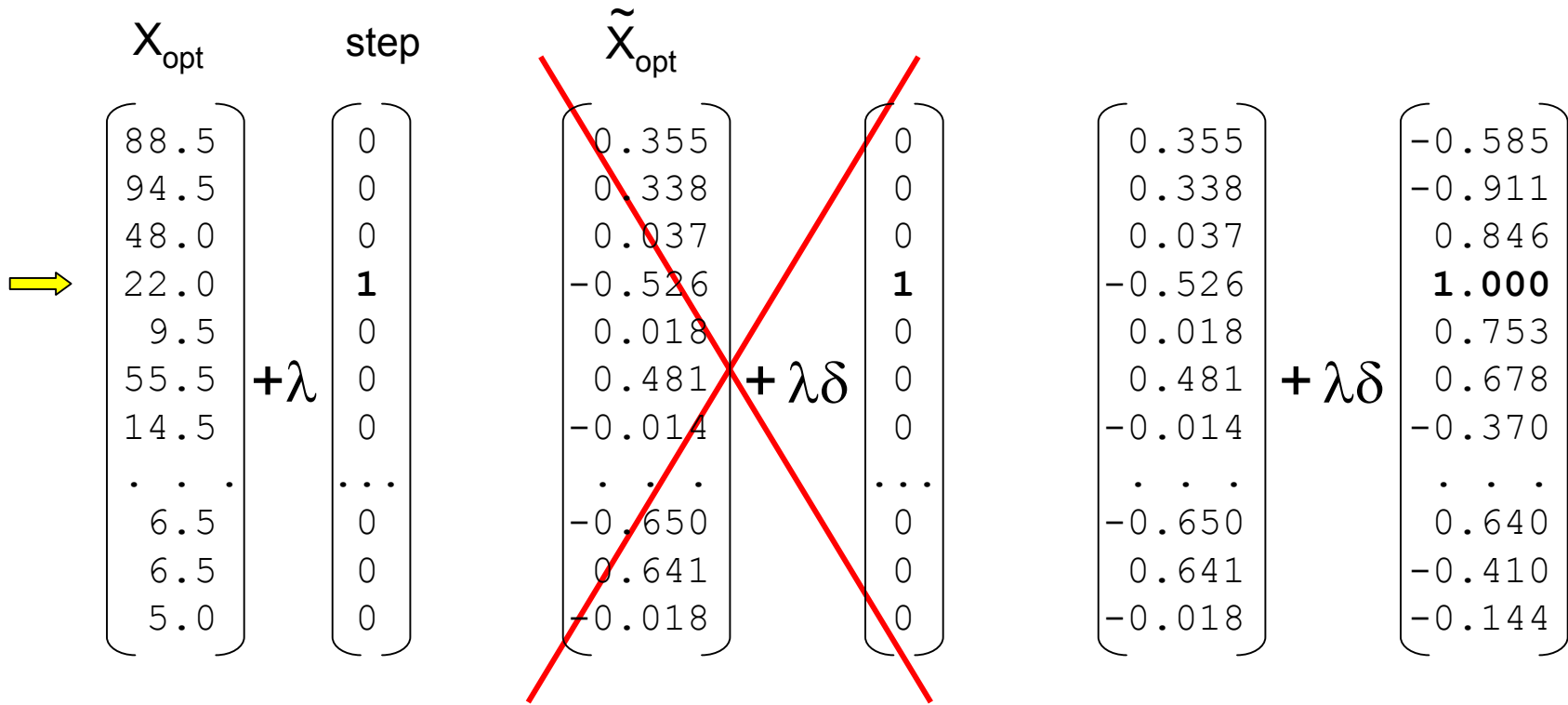
The virtual optimal product is now define by its sensory characteristics !

But, what happens if the real value of an attribute differs of the target value ?





SENSITIVITY STUDY AND KEY SENSORY ATTRIBUTES





SENSITIVITY STUDY AND KEY SENSORY ATTRIBUTES

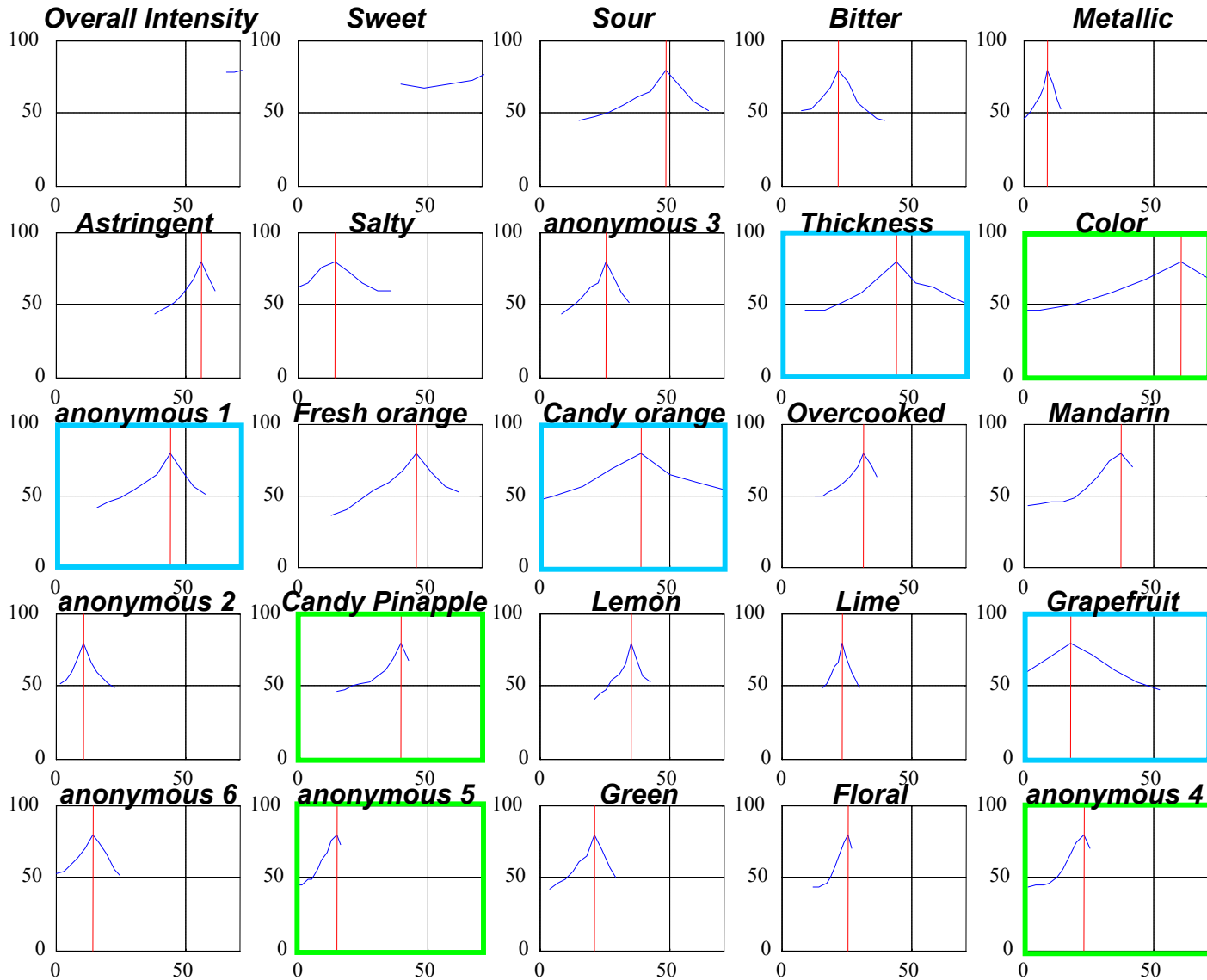
To be consistent we must take into account the correlations between the different attributes.

if the change of the reduced attribute A_i is δ
then the change for the reduced attribute A_j must be $\delta \cdot \rho_{ij} \quad \forall j \neq i$

For all the attributes the changes are done with respect to the optimum target value.

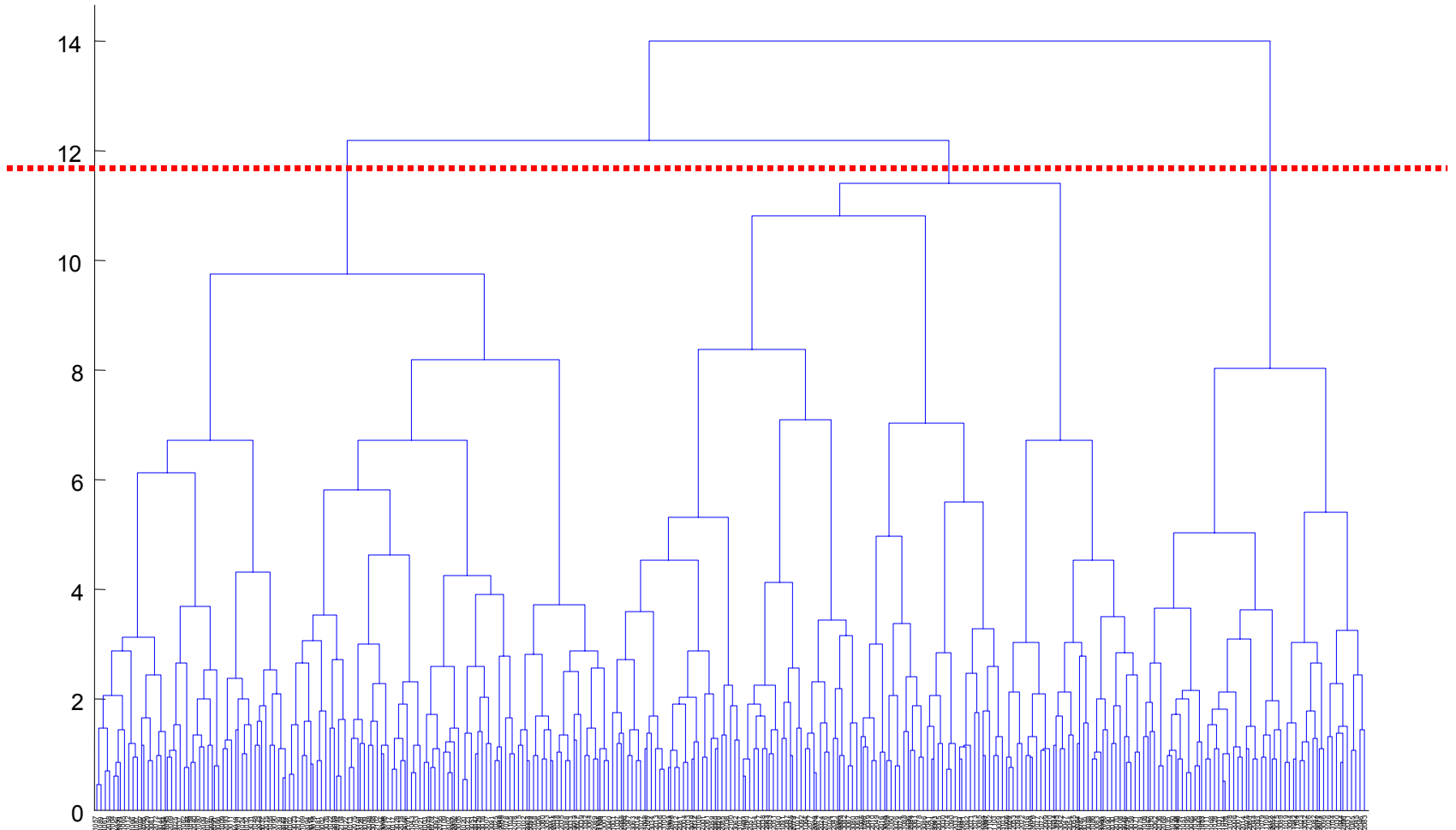
From the new set of values we compute the projection on the map (x,y) and the result is given by $\text{Pref}(x,y)$

Sensitivity study for all the consumers





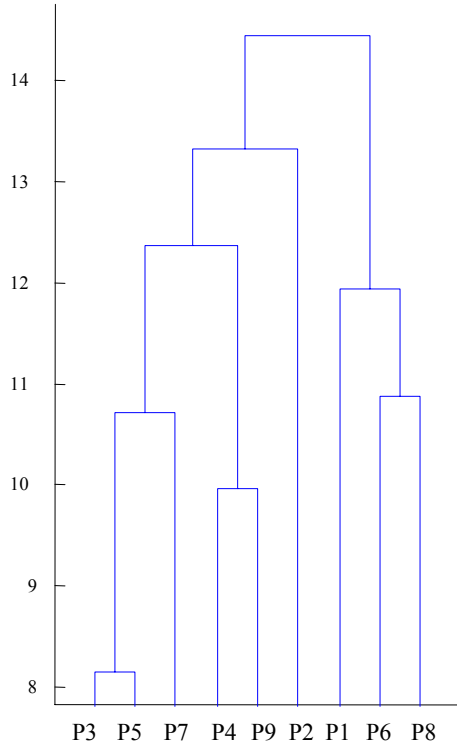
CLUSTER ANALYSIS OF THE CONSUMERS



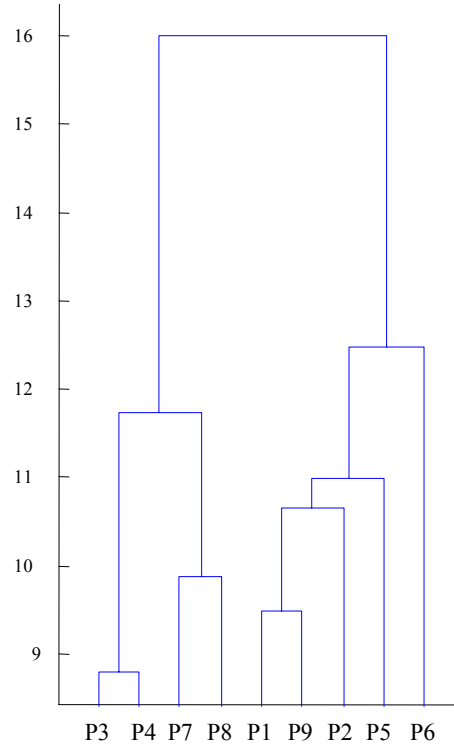


CLUSTER ANALYSIS OF THE PRODUCTS FOR THE THREE CLUSTERS

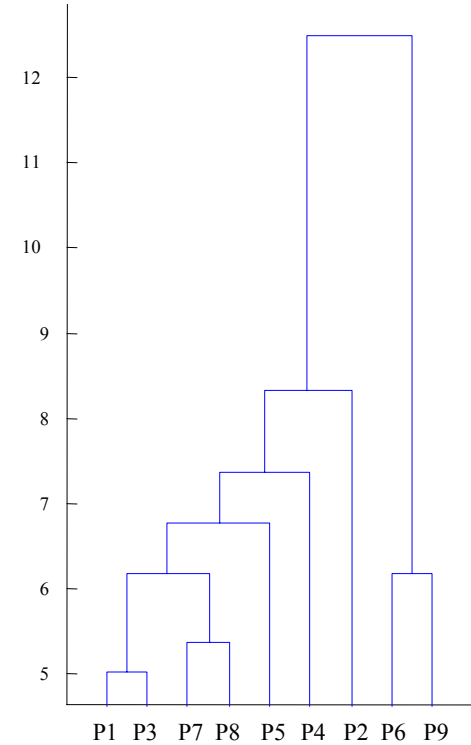
Cluster 1
(135 consumers)



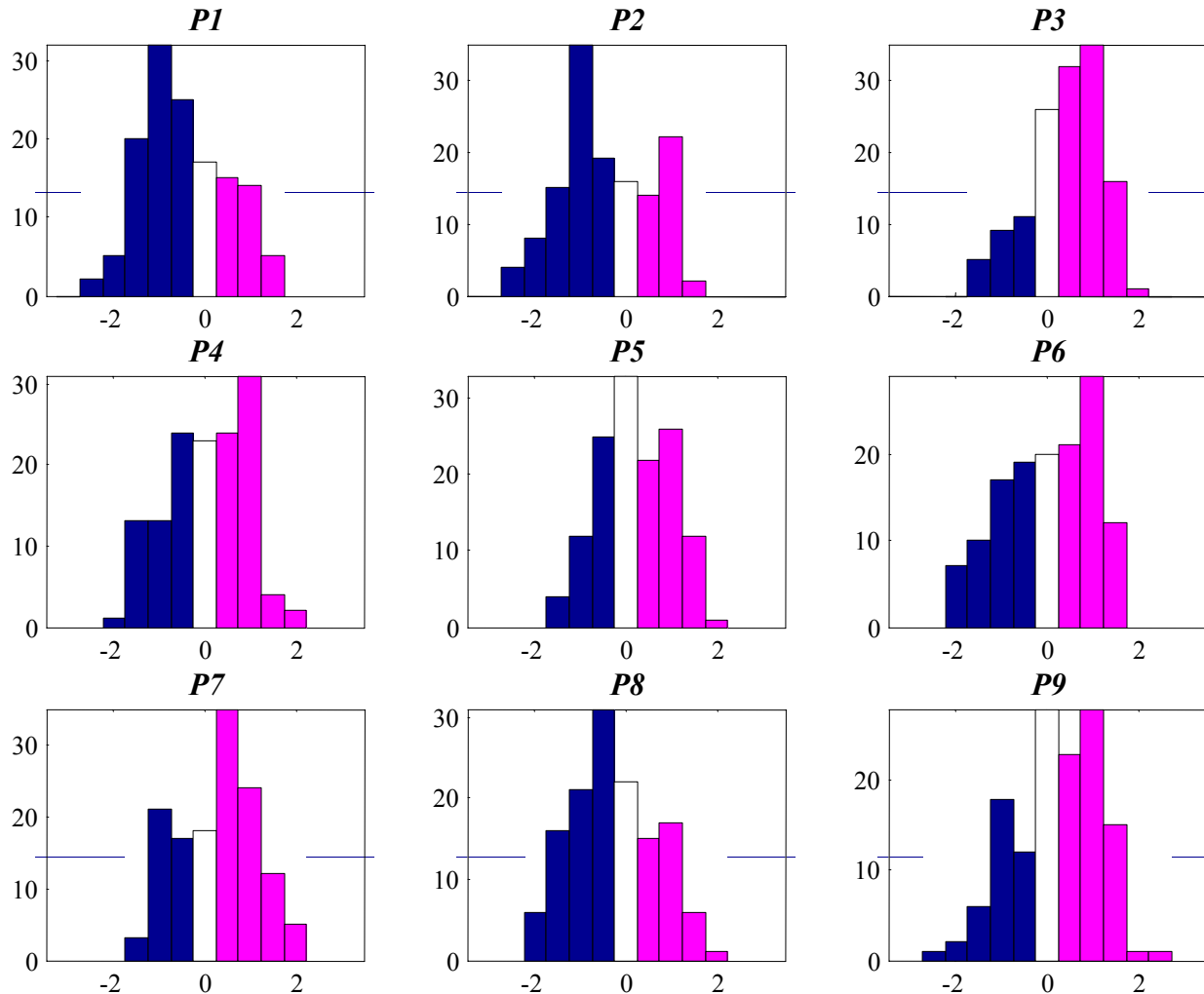
Cluster 2
(131 consumers)



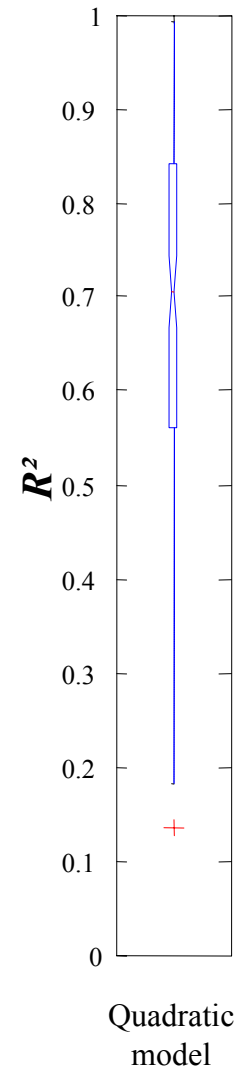
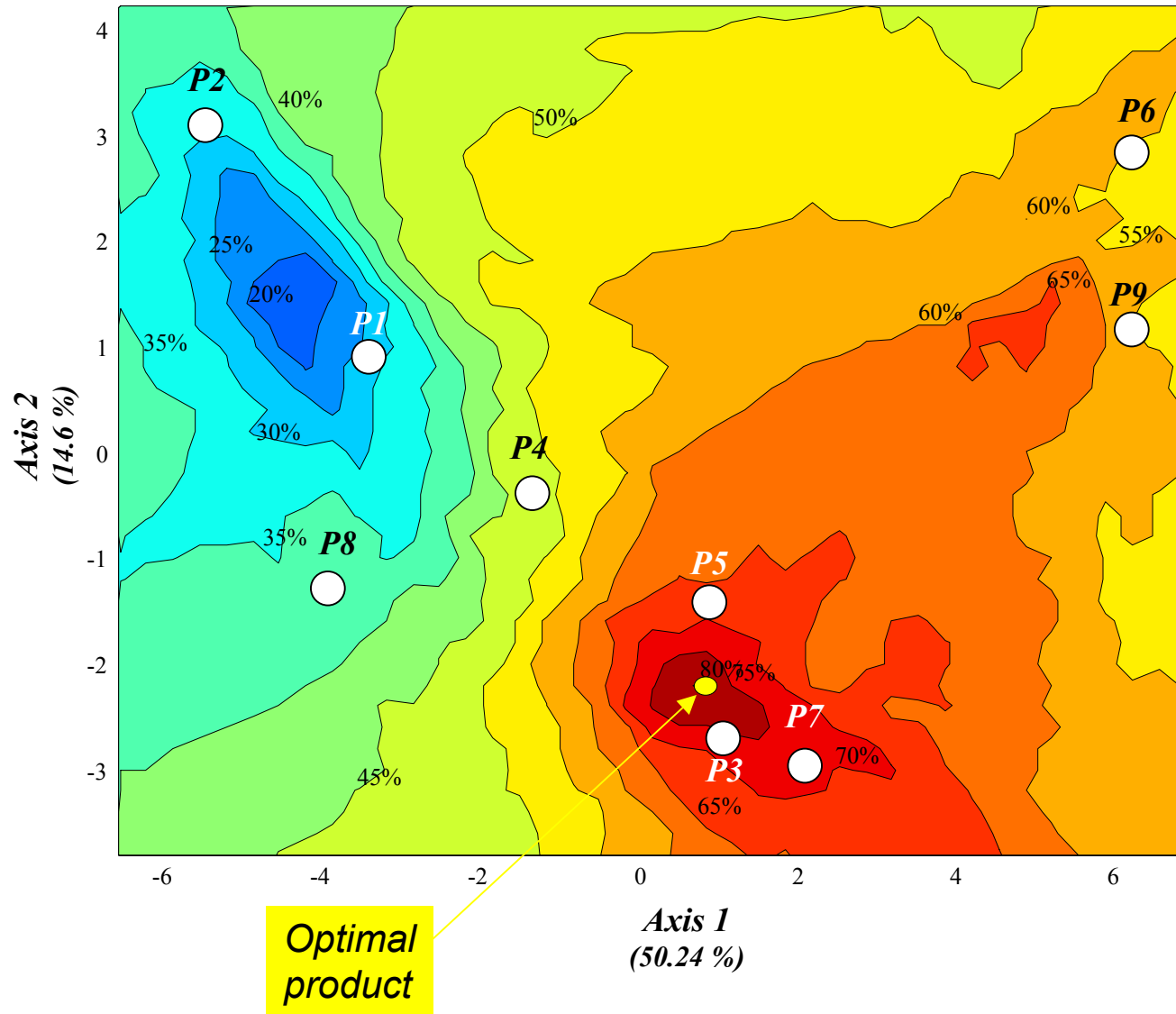
Cluster 3
(57 consumers)



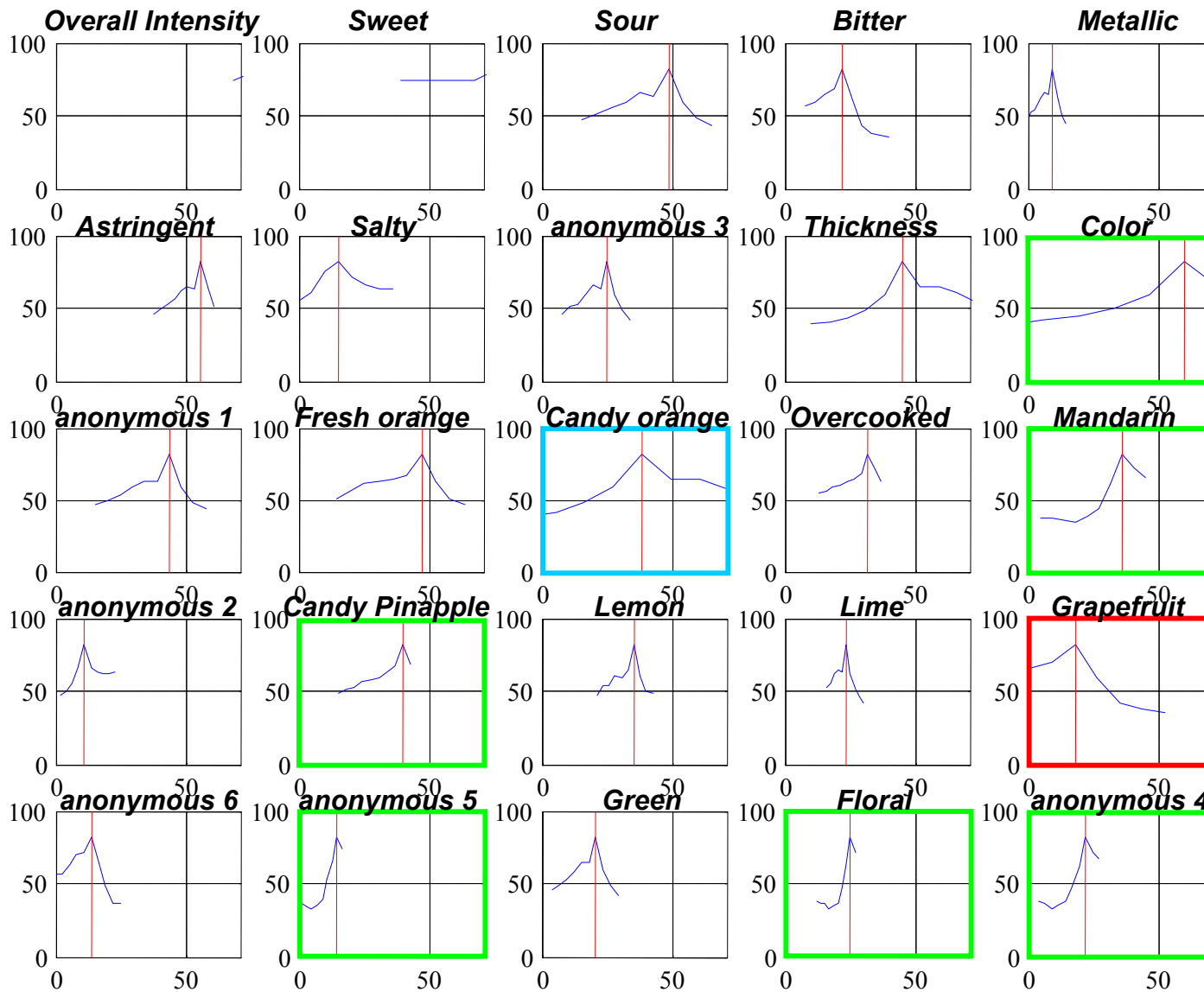
Standardized preference scores by product of the 1st cluster



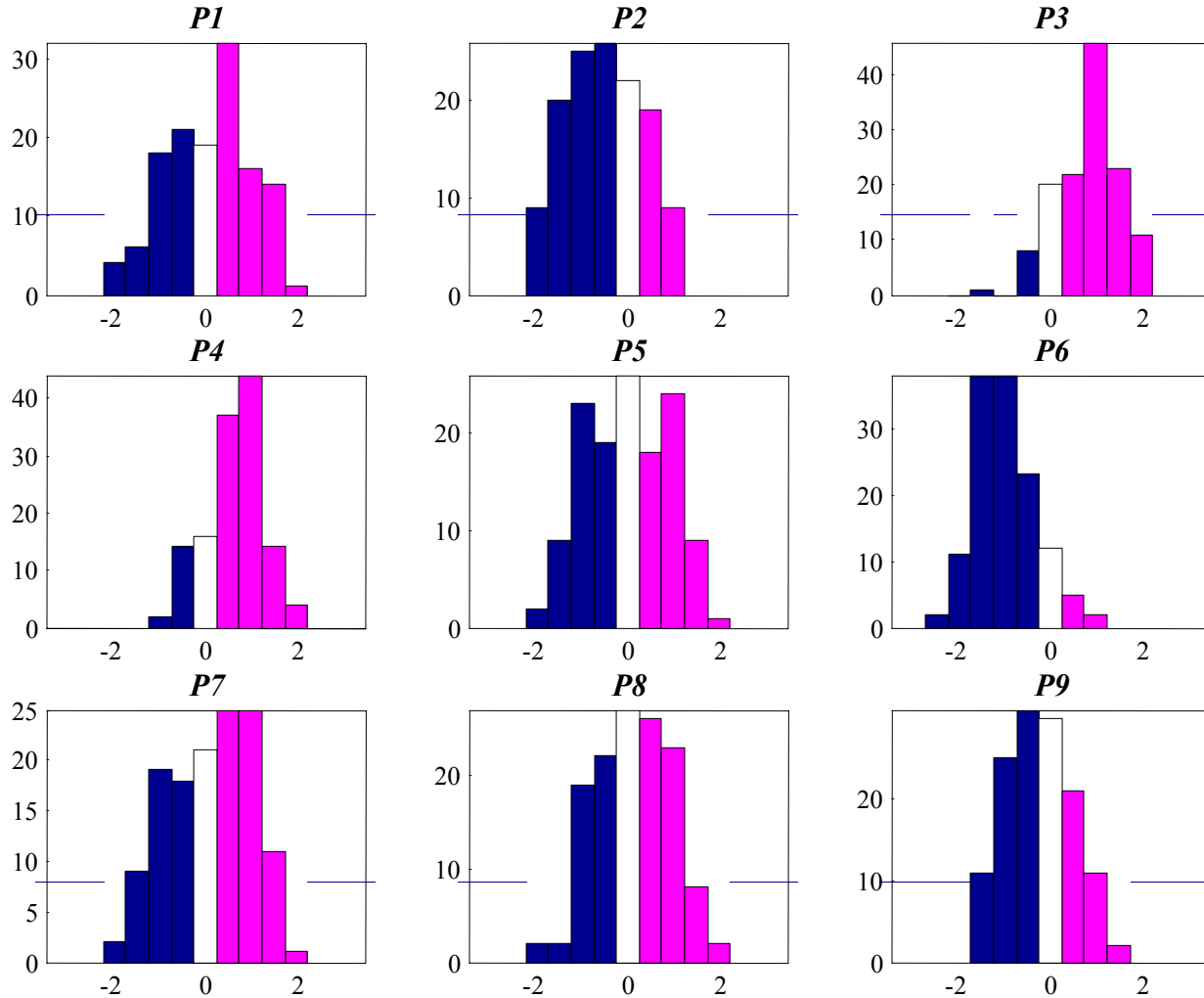
Preference for cluster n°1 : 135 consumers



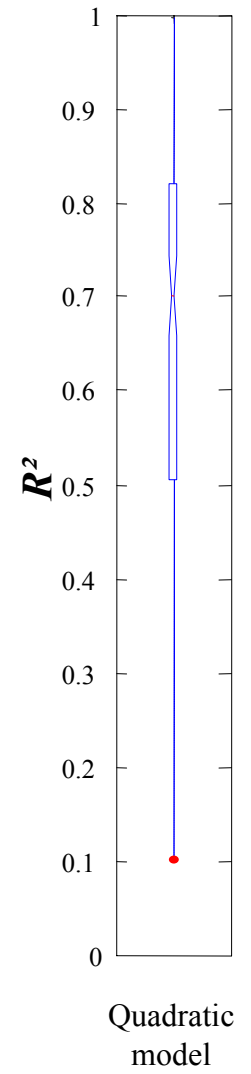
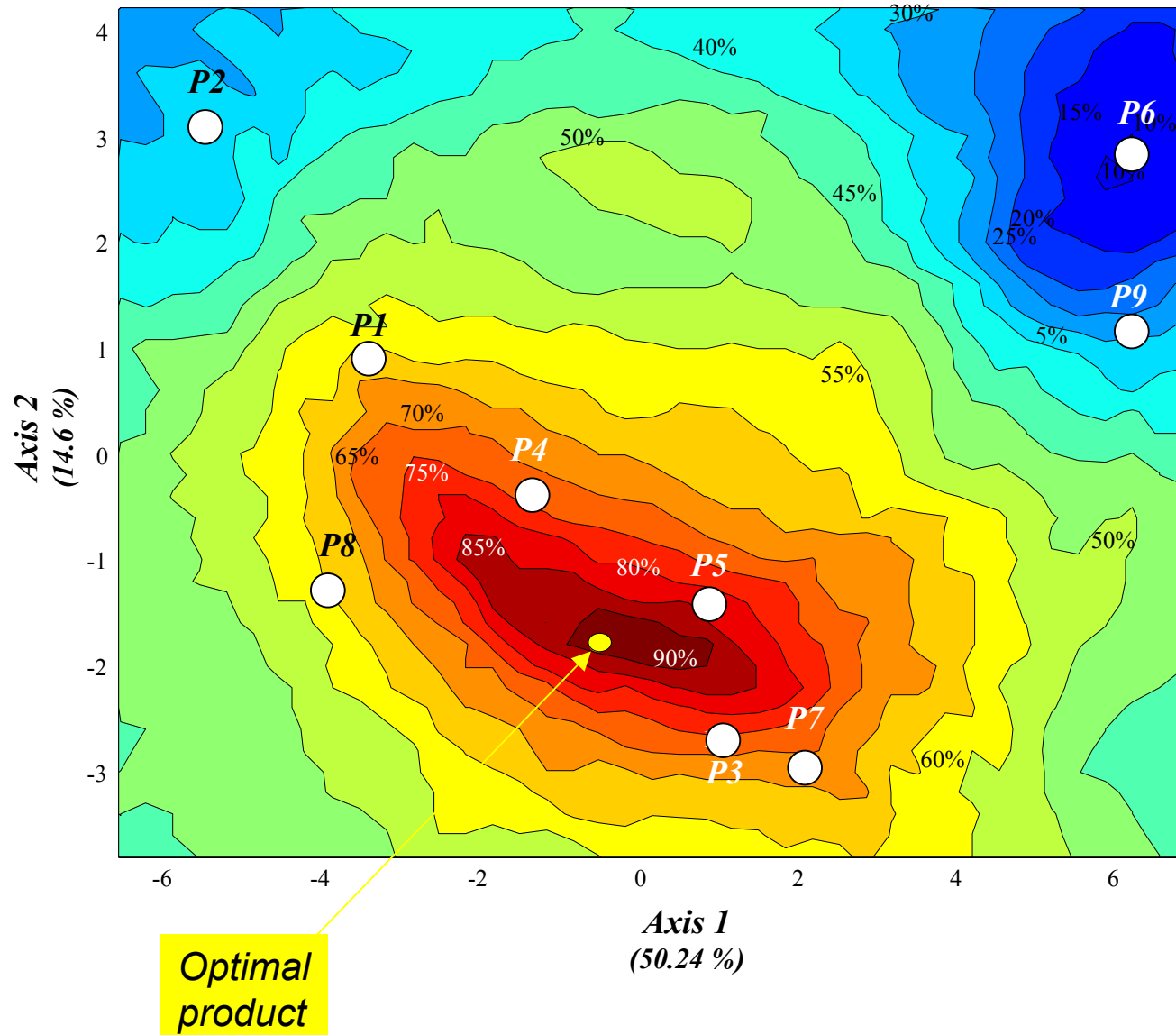
Sensitivity study for the 1st cluster



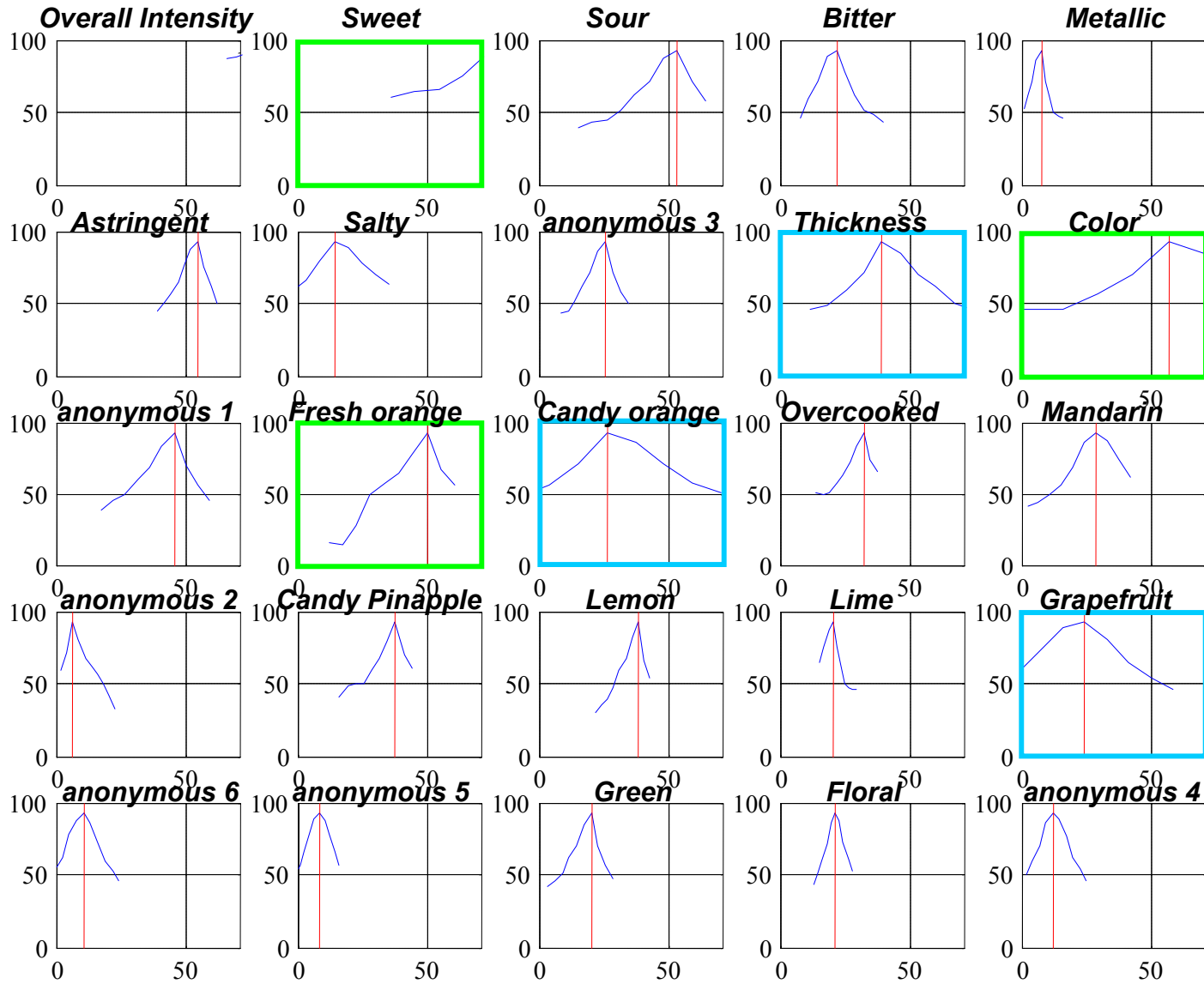
Standardized preference scores by product of the 2nd cluster



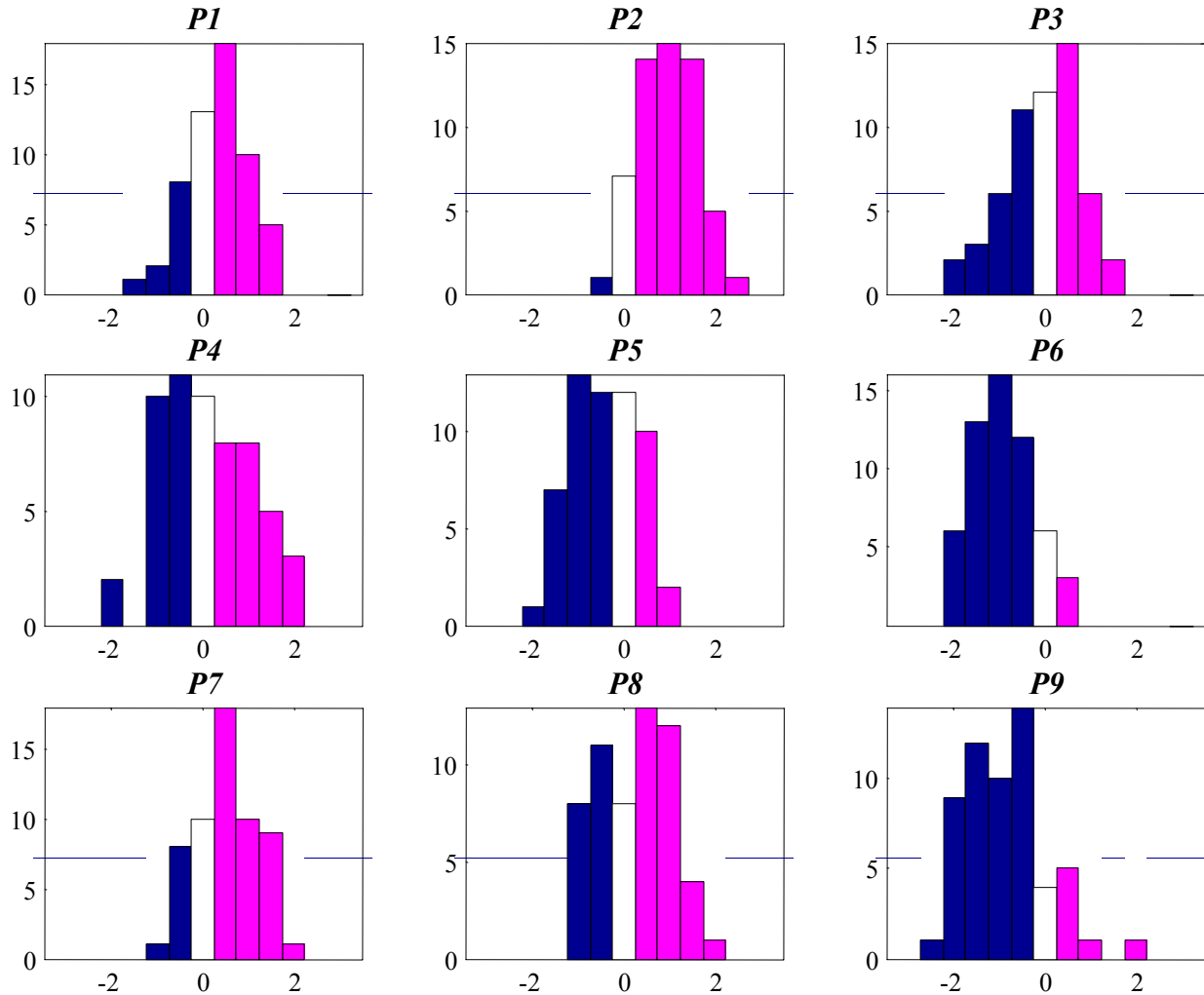
Preference for cluster n°2 : 131 consumers



Sensitivity study for the 2nd cluster

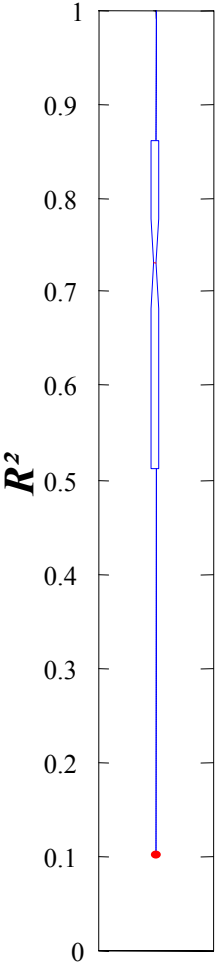
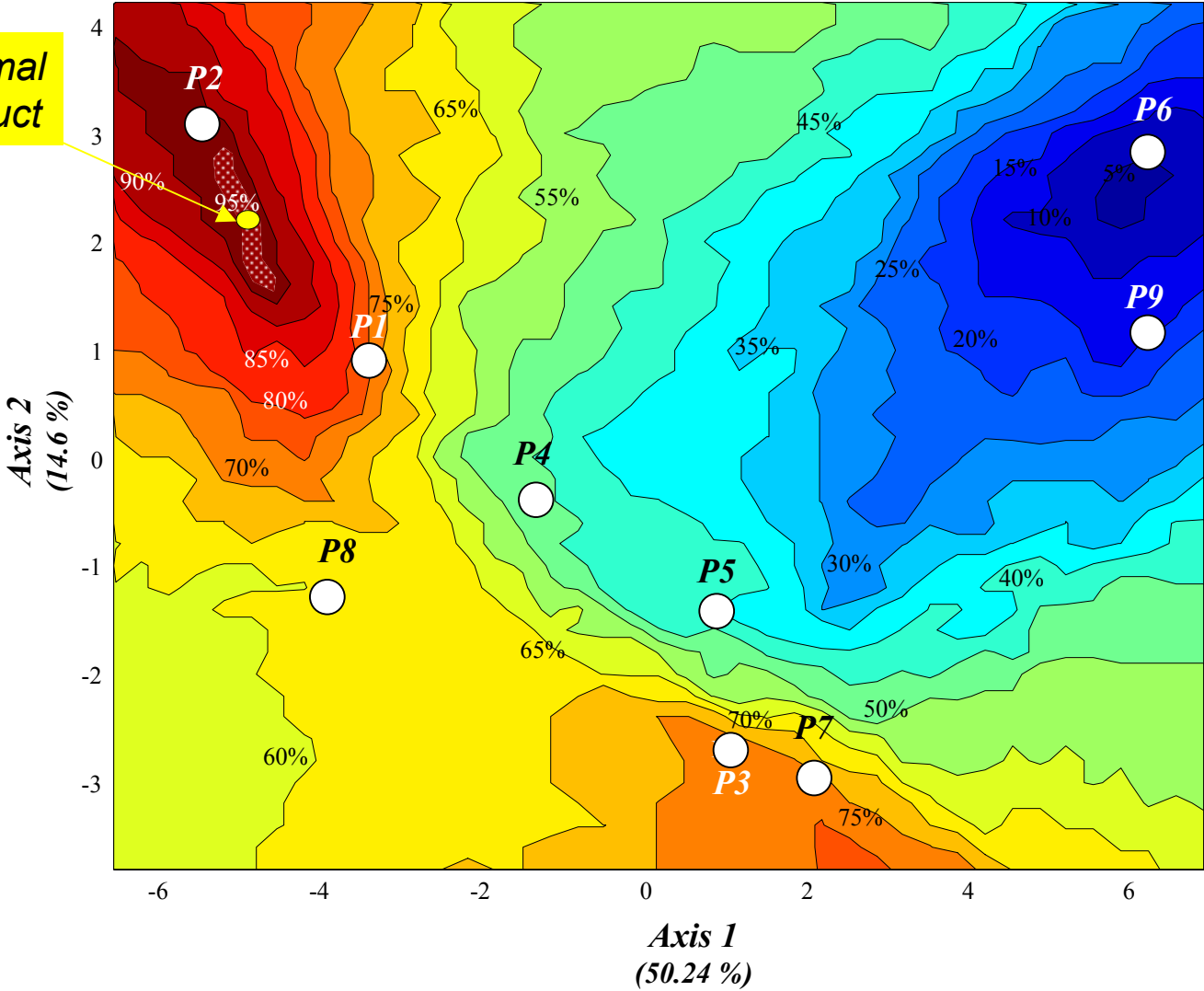


Standardized preference scores by product of the 3rd cluster



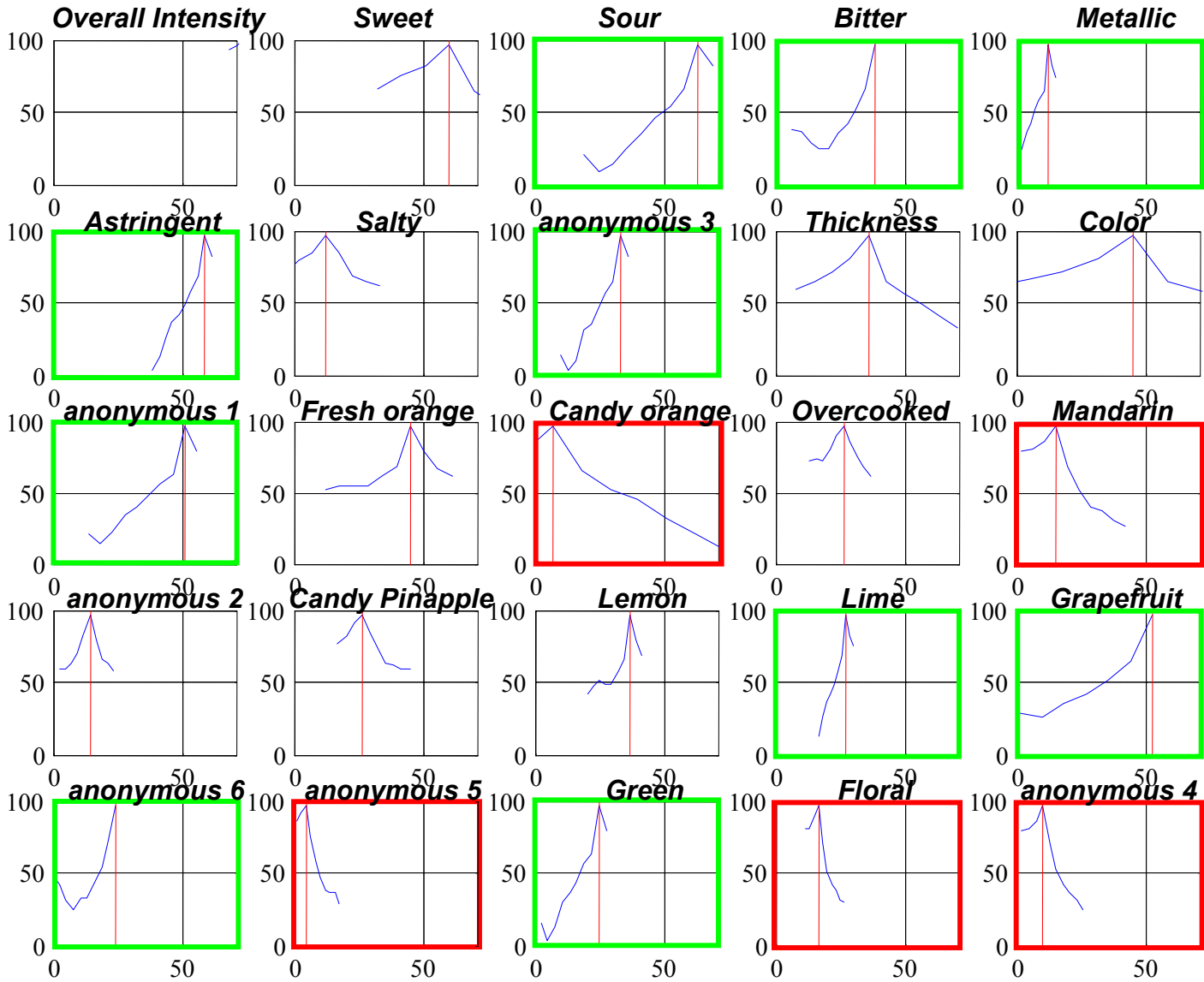
Preference for cluster n°3 : 57 consumers

Optimal product



Quadratic model

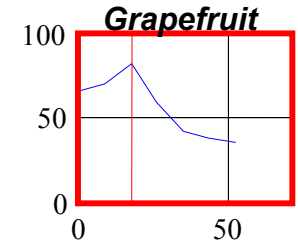
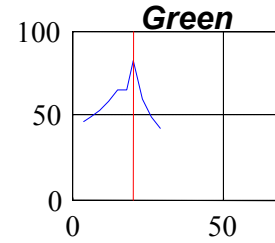
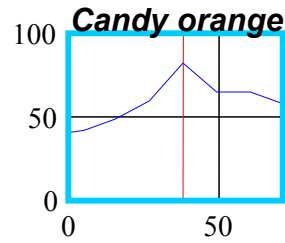
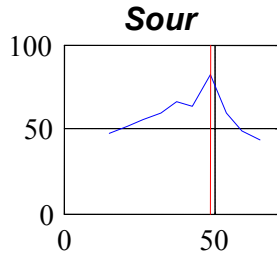
Sensitivity study for the 3rd cluster



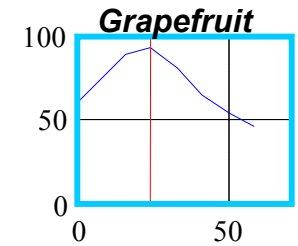
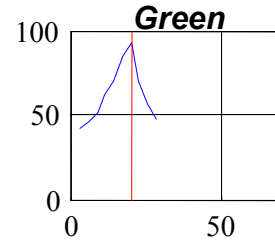
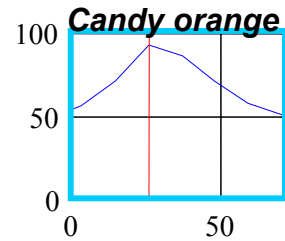
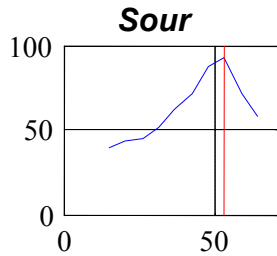


COMPARISON OF THE CLUSTERS

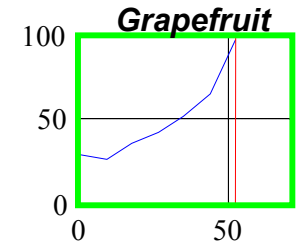
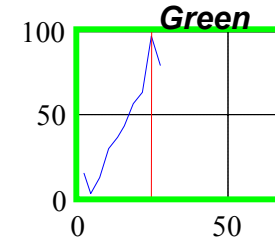
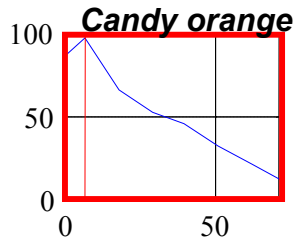
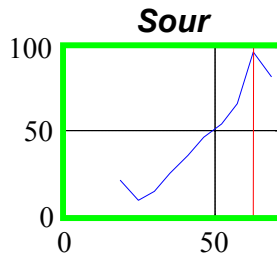
**Cluster
n° 1**



**Cluster
n° 2**



**Cluster
n° 3**





IMPROVEMENTS

- In most studies C.V.A. give better predictions of the preference than the P.CA.
- Find the optimum is done using the same procedure
- A sensitivity study is also possible ... using the **Within covariance matrix** instead of the correlation matrix