Multivariate preference mapping
(Flavoured waters)

Challenge

Investigate and map consumer preferences for a beverage manufacturer wanting to develop and introduce a flavoured water that will succeed in the market.

A beverage manufacturer wants to introduce a new type of flavoured water to the market. In the first stage of product development, he used a trained sensory panel to compare a set of test samples. Now, the objective is to investigate how consumers relate to the same test samples, in order to develop a water that will succeed in the market.

Water samples

Eighteen water samples were prepared according to a full factorial experimental design. Three factors were varied in the design: Flavour type (2 levels), flavour dosage (3 levels) and sugar content (3 levels). A trained sensory panel was used to evaluate the samples, and it was found that flavour type and sugar level had a large effect on the sensory properties, whereas flavour dosage only had a negligible impact.

Preference mapping

A selection of 180 consumers rated their overall preference on a 9-point scale. Each consumer tasted 10 of the eighteen samples, in such a way that each sample was rated by 100 consumers.

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PLS regression is a method that can be used to link two sets of variables, in order to describe how the variables are related to each other. In preference mapping, PLS regression is used to link sensory profiles to consumer preferences. The relationship between samples, sensory attributes and consumers can be interpreted through Scores plots (map of samples) and Loadings plots (maps of attributes and consumers).

Solution

Perform a PLS regression to interpret how the sensory attributes relate to the average consumer liking and analyse the effects with uncertainty testing.

PLS regression was performed using The Unscrambler® software. The preference map can be visualized by a bi-plot (Figure 1). This is a combined scores and loadings plot showing the eighteen flavoured waters (blue text) together with the 180 consumers (red dots). The sample labels indicate the flavour type (A or B) and sugar level (40, 60 or 80). Note that all the samples with flavour type B are located in the right-hand part of the plot, whereas flavour type A is to the left. Note also

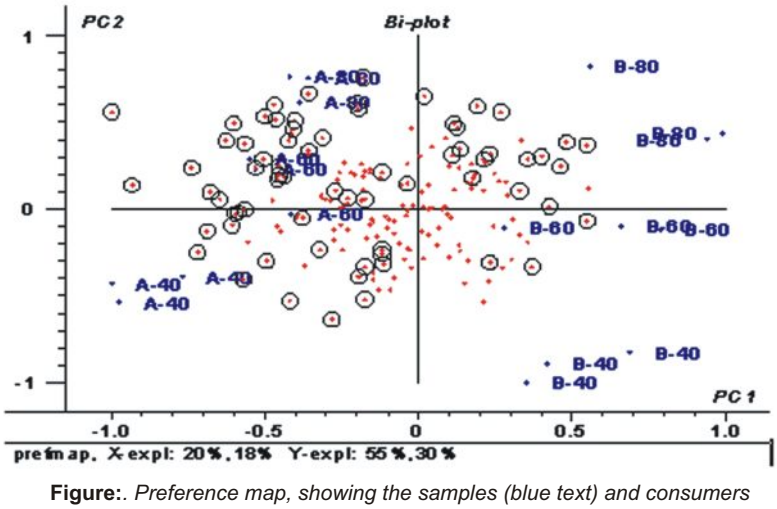

Figure:. *Preference map, showing the samples (blue text) and consumers (red dots). The sample labels indicate flavour type (A or B) and sugar level (40, 60 or 80). The circled consumers are significant.*

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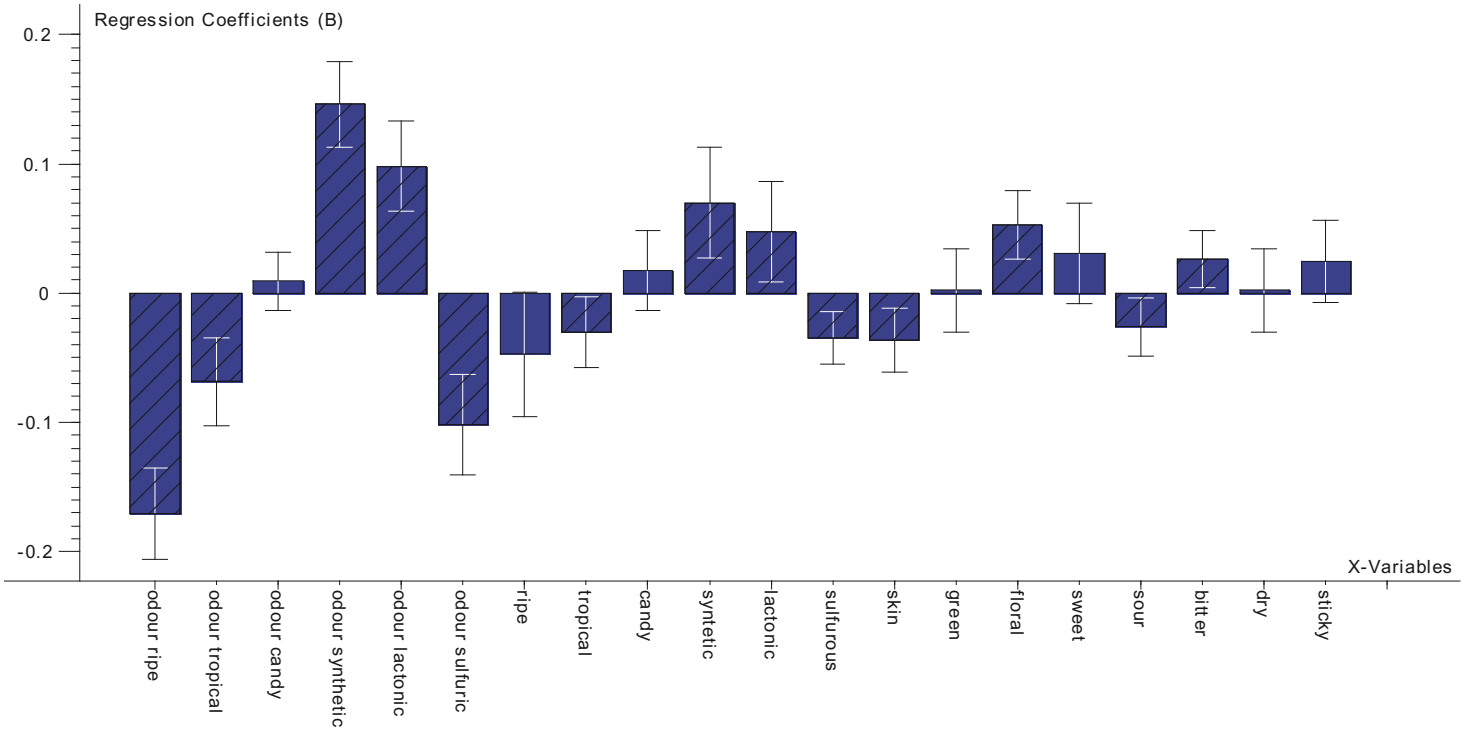

Figure 2: *Regression coefficients can be interpreted as divers of liking. The shaded bars represent significant attributes.*

that there is a systematic pattern due to sugar level: sugar level increases vertically in the plot.

The red dots in Figure 1 represent consumers, and the circled consumers are those who give a significant contribution, i.e. are able to discriminate between waters. We should therefore focus on the circled consumers. A majority of consumers are located in the left part of the plot, meaning that they prefer flavour type A over flavour type B. Most of the consumers are also focused around the sugar dosage 60, which is medium sugar level.

There is also a smaller segment of consumers in the upper right quadrant of the plot. These consumers prefer flavour type B, as long as the sugar level is not too low.

It was decided to target the consumers in the left part of the preference map, i.e. those who prefer flavour type A. An average preference was calculated for the reliable (circled) consumers in this part of the plot. A new PLS regression model was fitted, in order to describe how the sensory attributes relate to the average consumer liking.

Drivers of liking	
Positive	**Negative**
• Odour synthetic • Odour lactonic • Synthetic (Flavour) • Lactonic • Floral • Bitter	• Odour ripe • Odour sulphuric • Odour tropical • Skin • Sulphurous • Sour

Table 1: *Positive and negative drivers of liking, sorted by magnitude.significant.*

The model was validated with cross-validation, which also makes it possible to evaluate the significance of each attribute using The Unscrambler® uncertainty test. Validation results showed that the model was able to explain 85% of the variation in consumer preference, which means that the model is valid and the interpretations can be trusted.

Regression coefficients can be interpreted as drivers of liking. Figure 2 shows the regression coefficients, and the error bar indicates if the attribute has a significant impact or not. Table 1 lists the significant drivers of liking, sorted by importance.

Conclusion

The preference mapping revealed two segments of consumers: one large segment that prefers flavour type A and a smaller segment that prefers flavour type B. It was decided to target the largest segment. The preference map showed that these consumers were focused around sugar level 60, and the most important positive drivers of liking were synthetic and lactonic odour, while the most important negative drivers were ripe and sulphuric odour. Dosage level was not important for consumer liking, and was therefore kept at the low level.

Based on the preference map, the following recipe was selected for market launch:

- Flavour type A
- Sugar dosage 60 (medium)
- Flavour dosage 0.2 (low)

Application note overview

Software	The Unscrambler 9.7®
Methods	Preference mapping by PLS regression. Analysis of effects with uncertainty testing.
Data type	Sensory profiling data
Industry	Food and Beverage
Added Value	The company launched a new flavoured water on the market.