Optimum sugar reduction definition in carbonated soft drinks and influence of the labelling, using survival analysis

M. Michalet[a], H. Allain[a] ★, L. Pérès[b], L. Berthaud[b], J. Picherit[b]
[a]MANE, Le Bar sur Loup – France; [b]TECHNISENS, La Rochelle - France

Introduction

Several surveys show that consumers declare they are ready to reduce their sugar consumption, but does this ring true when consumers are tasting sugar reduced products? To get answers to this question, MANE launched a large consumer survey to determine the "sugar reduction breaking point" beyond which soft drinks are no longer accepted.
For that purpose, a survival analysis has been conducted.
Besides, literature shows that the labelling of products may influence consumers' acceptance. This context effect was investigated in this survey with a focus on sugar reduction.

Materials & methods

400 orange CSDs consumers – FR
- 200 branded: **informed** on sugar content
- 200 **blind**

Questionnaire
- Overall liking
- Purchase intent
- Just about right scales: *sweetness, acidity, flavour strength*

Products (Table 1)
- **8°bx**
- **6°bx**
- **5°bx**
- **4°bx**

Survival analysis is usually used in medical field. The purpose is to model an event on a time scale [1]. This method also allows through Kaplan Meier log rank test [2] either to evaluate treatments effectiveness or to define sample groups (Fig.1).
Survival analysis can also be used in consumer science [4]. The issue is to define the event : which criteria is adapted to the problematic ? For our topic, should it be purchase intents ? Liking ? By replacing the time by the sugar reduction ratio, the survival analysis helped us to accurately measure the sugar level no longer accepted by the consumers.

Applying survival analysis to determine the "sugar-reduction breaking-point" in soft drinks

Acceptance rate determination

Purchase intent is routinely used to obtain sales predictions. Besides, the penalty analysis results were taken into account.

We considered that the products' liking was penalized when there was:
- A lack of flavour intensity
- An unbalance sweet/acid ratio

Finally, the acceptance rate of a product was defined by the % of consumers left after having removed the consumers rejecting it.

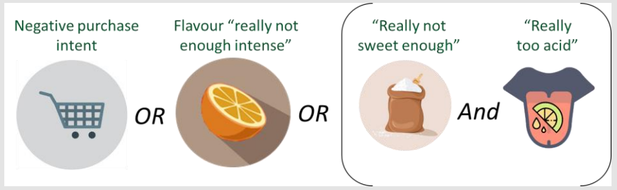

Figure 2: rejection criteria

Running survival analysis

Starting point: the acceptance rate for 8°bx was supposed to be 100% as assessors were assumed to be regular consumers of this product.

Then: the acceptance rate was calculated for 6°bx, 5°bx, and 4°bx by removing the assessors who did not accept the product according to the defined criteria (Fig.2).

Finally: results were modelled using the R survival package [3]. Following the binomial distribution [4], the significant proportion of consumers accepting the products was 56% (with 95% confidence level).

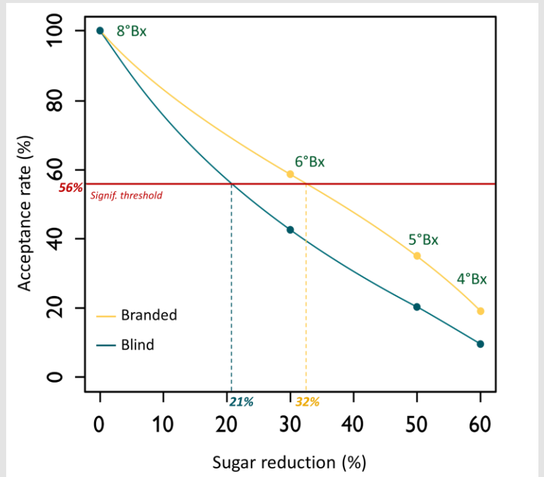

Figure 3: survival analysis results

Conclusions

- Sugar reduction breaking point for orange CSDs: -21% (6,8°bx) for blind consumers; -32% (5,8°bx) for informed consumers.
- Sugar-reduced orange CSDs are better accepted when their sugar content and their sugar reduction ratio are communicated to the consumers.
- The survival analysis approach helped us to finetune the sugar-reduction ratio that can be accepted by soft drinks consumers.

Product name	°Brix (Total sugars)	Added sugars (g/100mL)	Information given to the « branded group »
8°bx	8	7	Sugar : 7g/100mL
6°bx	6	5	Sugar : 5g/100mL – with 30% less sugar than other CSDs from the market
5°bx	5	3,5	Sugar : 3,5g/100mL – with 50% less sugar than other CSDs from the market
4°bx	4	2,5	Sugar : 2,5g/100mL – with 60% less sugar than other CSDs from the market

Table 1: evaluated products

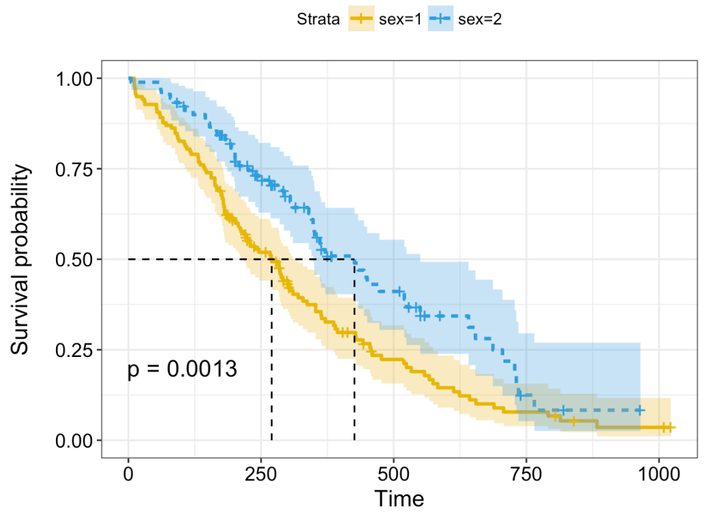

Figure 1: Example of survival analysis results [3]

References:
[1] Clark, T.; Bradburn, M.; Love, S.; and Altman, D (2003). Survival Analysis Part I: Basic concepts and first analyses. *British Journal of Cancer* 89, 232 – 238.
[2] Kaplan, E.; and Meier, P (1958). Nonparametric Estimation from Incomplete Observations. *Journal of the American Statistical Association* (1958) 53, 457-481.
[3] Survival analysis on R http://www.sthda.com/english/wiki/survival-analysis-basics
[4] Chambault, M. (2019). Sugar reduction: how low can we go? A novel application of Survival Analysis. *Pangborn 2019, Edinburgh (Scotland).*