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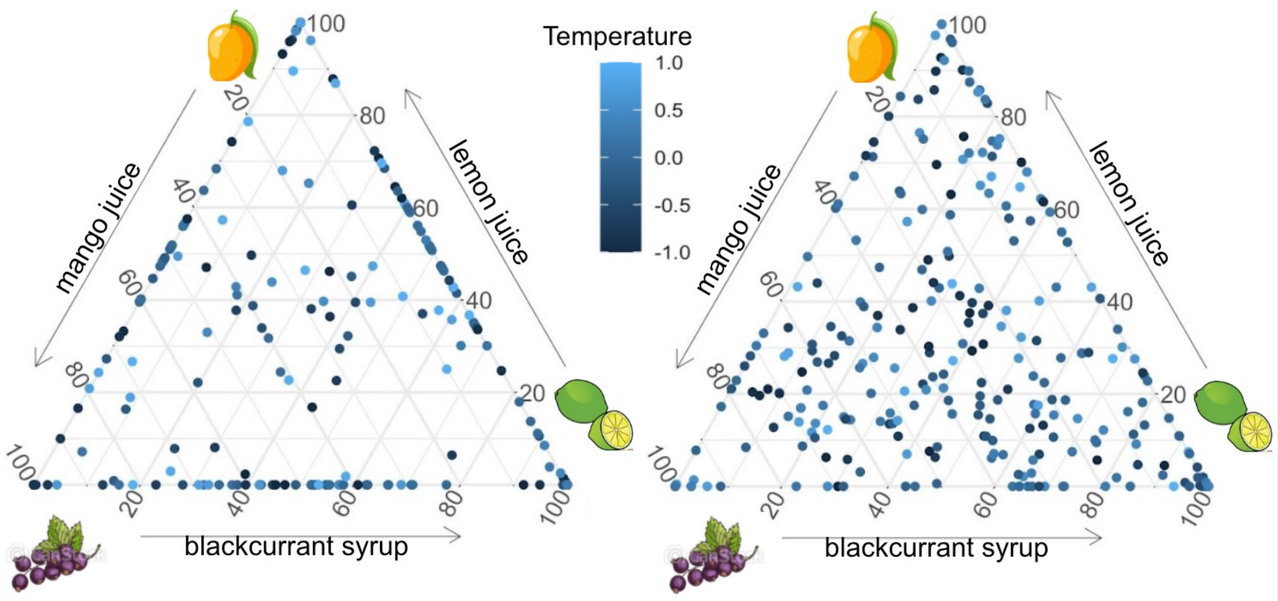
Bayesian optimal designs for choice experiments involving mixtures of ingredients and process variables

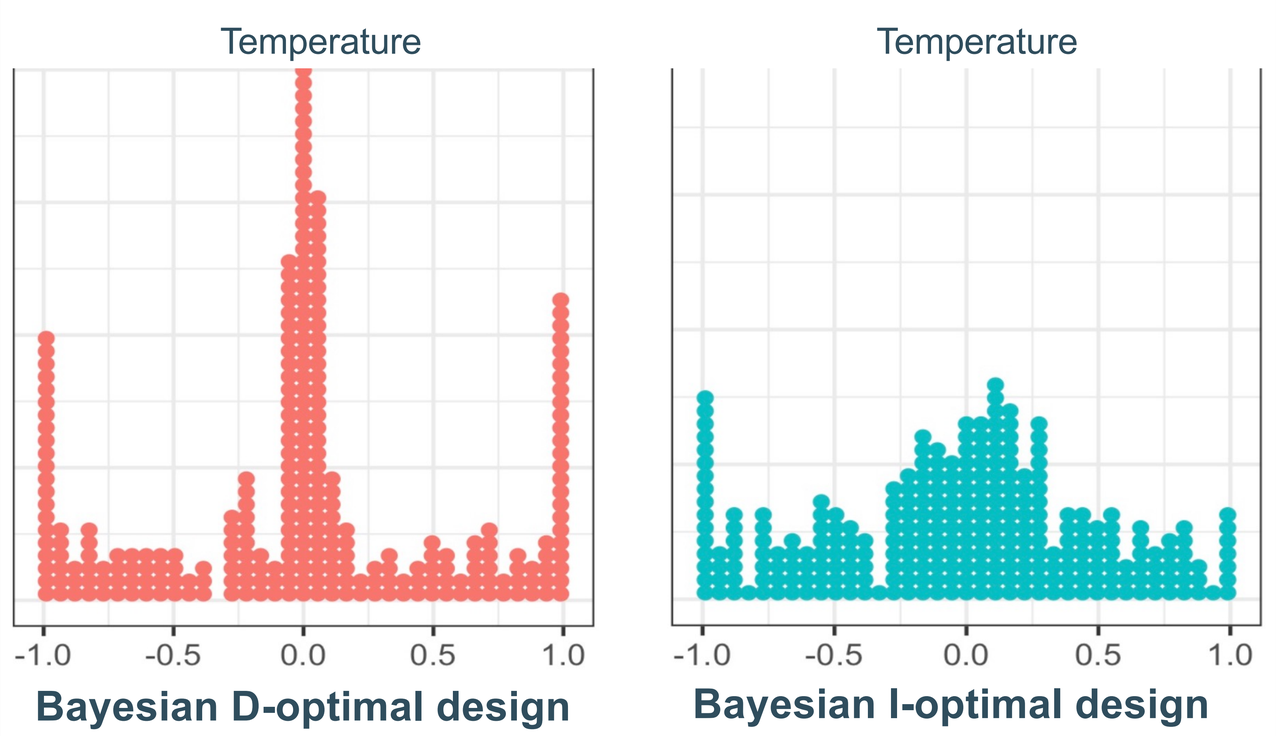
Introduction

- **Discrete choice experiments** are used to quantify consumer preferences by collecting preference data and having respondents choose between different alternatives.
- Many products and services can be described as mixtures of ingredients, e.g., a cocktail, a bread, or a fish patty.
- **Choice experiments involving mixtures of ingredients have been overlooked**, especially in the optimal design area, and little work involves process variables.
- In experiments with mixtures, we need precise predictions because often the goal is to find the mixture and process variable settings that optimize the respondents' utility; hence, **I-optimality is more suitable** than D-optimality.
- Optimizing designs with respect to D- and I-optimality requires the information matrix of the model, which depends on the unknown parameter vector.
- Using a **prior distribution** is useful to solve the circular problem caused by that dependence.

Results

- Tasting of fruit cocktails made of mango juice, blackcurrant syrup, and lemon juice, served at different temperatures.
- Design of 140 choice sets of size 2.





Contributions

- Theory for choice experiments involving mixtures and process variables
- Computationally efficient definition for I-optimality for choice experiments involving mixtures.
- Embedded this theory and definition in a coordinate-exchange algorithm to find optimal designs.
- Demonstrated that the I-optimal designs perform better than their D-optimal counterparts in terms of the variance of the predicted utility.
- Created an accessible and open-source R package with our algorithms.

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Code for R package: https://github.com/mariobecerra/opdesmixr