Contribution ID: **63** Type: **not specified**

Active Learning for Effect Screening in Manufacturing

This paper addresses effect screening from observational data where sampling is constrained by cost, time, or process limitations, with a main focus on manufacturing applications. We propose a novel active learning strategy that introduces principles from optimal experimental design (A- and D-optimality) and combines it with an optimization for multicollinearity using Variance Inflation Factors (VIF), making the approach suitable for observational manufacturing data with strong dependency structures and feedback loops.

We aim to ultimately obtain prescriptive models consisting of the selected effects, for control and optimization of the manufacturing processes.

We evaluatethe performance of the proposed effect selection strategy across multiple methods, including Lasso, Pearson correlation, Boruta, and a Bayesian approach. The results indicate that although the strategy can improve screening efficiency, it can also lead to the selection of the irrelevant variables that are strongly correlated with truly relevant variables. As a result, correlated but non-relevant variables may be retained, while relevant variables may be excluded when multicollinearity is high.

These findings highlight an important trade-off between screening ability and predictive performance in constrained industrial sampling,and challenges the purpose of sampling.

Special/ Invited session

Young Statisticians

Classification

Both methodology and application

Keywords

Active Learning, Optimal Experimental Designs, Manufacturing

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Track Classification: Other/special session/invited session