Decision Optimizer – Generating causal predictive models

Sebastien Lannez[1], Livio Bertacco[1], Claudio Gambella[1],
Ryan Weber[2], Ben Willcocks[1]
[1] FICO, Xpress, UK
[2] FICO, Xpress, US
sebastienlannez@fico.com

Mots-clés *: Finance, Predictive Causal Models, MIP, NLP.*

1 Introduction

The Decision Optimizer application[1] is an optimization software leveraging various optimization algorithms with the goal to empower non-OR professionals with a tool that seamlessly performs optimal assignment of treatments to a portfolio of customers. The underlying problems are based on the Generalized Assignment Problem. They consider different kinds of constraints (budget, ratio, …) and allow for generating optimal decision trees.

The optimization models solved by the application depend on structural inputs (values are certain, like the composition of the portfolio or customer attributes) and uncertain inputs (values are uncertain but predictable, like the impact of treatments on customers). While the tool allows for using and editing the predictive models that are required to produce the uncertain data, the skills required to create these Causal Models[2] is usually not available to the typical Business Analyst.

To simplify the experience of the user, we developed a component which can be used by Business Analysts with either advanced or basic knowledge of predictive modeling to seamlessly create Predictive Causal Models that are suitable for predicting the impact of the treatment assignment on every customer of the portfolio. The approach is generic enough to be applied to a wide variety of business problems that Decision Optimizer aims to solve.

One of the difficulties encountered when generating these models from historical data is caused by the usually limited number of observations (hundreds of thousands) compared to the number of predictors (hundreds), and the overall high number of predictors to be considered. Furthermore, there is inherent historical data bias, because the historical actions were likely targeted on certain segments, consequently there may be significant data gaps for some actions.

The approach we will describe during the talk, is composed of two steps. The first step will produce a predictive model biased by the historical actions and using a formulation based on univariate predictive models[3]. This first step is meant to provide an initial weight configuration. This biased predictive model is used to generalize the historical observations, so the second step is based on this predictive model rather than on the historical data. The second step takes the biased predictive model and some a priori knowledge about the action effect provided by the end user to produce the final predictive model.

This talk introduces the Decision Optimizer software to provide insights into how the predictive models are used by Business Analyst. Then, the Decision Optimizer – Action Effect Modeling functional blocks are presented to provide an overview of the data and application flow required to generate models, which capture the casual effect (and not just the correlation effect). Finally, we will present the logical mathematical models that are solved to produce these predictive models. We conclude our presentation with a discussion about the practical implication of solving the optimization models using a MIP and an NLP solver.

Références

[1] Sébastien Lannez, Livio Bertacco, Neill Crossley, Zsolt Csizmadia and Susanne Heipcke. *Decision Optimizer 7.0: A novel approach to optimization modelling*. ROADEF, 2017.

[2] Judea Pearl. *Causality: Models, reasoning and inference (second edition).* Cambridge, 2009.

[3] Thomas Barrau and Raphael Douady. *Artificial Intelligence for Financial Markets : The polymodal approach*. Springer, 2022