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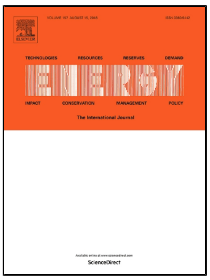

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Assuring Explainability on Demand Response Targeting via Credit Scoring

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Abstract: As data-driven innovation becomes a main trend in the energy sector, explainability of data-driven actions is becoming a major fairness issue for the residential applications, and it is expected to become a requirement for regulatory compliance. Explainability, however, often demands a sacrifice in prediction performance and affects the effectiveness of data-driven actions. In this study, we consider data-driven customer targeting in an incentive-based residential demand response program, and investigate the explainability-performance tradeoff when using simple-rule based, machine learning, and credit scoring methods. Credit scoring, that has been a popular solution in the finance discipline for over 60 years, is a scorecard based modeling method that can surely provide explainability. We first provide the detailed steps of applying credit scoring to the demand response problem. Then, we use a dataset of 14,525 households obtained from a real demand response program and analyze two prediction problems – participation prediction and behavior change prediction. The results show that credit scoring can achieve a comparable performance as the best-performing machine learning methods while providing full explainability. Our results suggest that credit scoring can be a promising explainability option for broader energy sector problems.

Keywords: Residential DR, Explainability, Prediction Performance, Credit Scoring

1. Introduction

Demand Response (DR) started to attract a great interest because it can prevent the imbalance between power supply and power demand during peak hours without building additional power plants [1]. One of the main economic benefits comes from the avoided or deferred capacity costs for building new power plants or upgrading transmission and distribution infrastructures, and the economic analysis can be found in the literature such as [2, 3, 4]. DR encourages power customers to reduce power consumption so that the consumption does not exceed the amount of generated power. To induce customer engagement, DR operators may use two types of strategies: price-based and incentive-based. Price-based DR is based on dynamic pricing rates, such as raising electricity rates at peak hours. Incentive-based DR provides compensation to the individual participants for the amount of electricity load reduction during the critical period [5, 6]. Incentive-based DR operator issues a power reduction request, or *DR event*, during the critical period when power supply-demand imbalance is anticipated. While the price-based DR applies the same tariff to all registered customers, incentive-based DR is applied only to the participating customers for each individual DR event.

The consistent participation rate and behavior change are key requirements for an incentive-based DR program to be recognized as a reliable power source. If a DR program cannot be trusted for reducing power by a predictable amount, extra power generators need to be turned on in case the DR program fails and the resulting supply-demand imbalance causes a damage to the grid. Besides the required consistency, it can be less cost effective to recruit all accessible customers for a DR event. If data is available, it can be more efficient to identify a small group of target participants who are likely to participate and likely to make behavior changes and recruit them for a DR event. Such a data-driven DR targeting process [7, 8, 9], the process of selecting customers who have large DR potential, can help optimize DR reliability while maintaining a fixed level of enrollment expenditure. In this paper, we consider two types of prediction problems on data-driven DR targeting: who will participate in the DR event