Price Discrimination with Fairness Constraints

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ABSTRACT

Price discrimination – offering different prices to different customers – has become common practice. While it allows sellers to increase their profits, it also raises several concerns in terms of fairness. This topic has received extensive attention from media, industry, and regulatory agencies. In this paper, we consider the problem of setting prices for different groups under fairness constraints.

In this paper, we propose a formal framework for pricing with fairness, including several definitions of fairness and their potential impact on consumers, sellers, and society at large. In a first step towards the ambitious agenda of designing pricing strategies that are fair, we consider the simplest scenario of a single-product seller facing consumers who can be partitioned into two groups based on a single, binary feature observable to the seller. For each group, we assume that the seller knows the valuation distribution and the population size. The seller's goal is to maximize profit by optimally selecting a price for each group, subject to a fairness constraint which may be self-imposed or explicitly enforced by laws and regulations.

We first propose four definitions: fairness in price, demand, consumer surplus, and no-purchase valuation. With our model and definitions in place, we first show that satisfying all four fairness goals simultaneously is impossible unless the mean valuations are the same for both groups. In fact, even achieving two fairness measures simultaneously cannot be done in basic settings. We then consider the impact of imposing each fairness criterion separately, and identify conditions under which the consumer surplus and the social welfare increase or decrease. Under linear or exponential demand, we show that imposing a small amount of fairness in price or no-purchase valuation increases social welfare, whereas fairness in demand or surplus reduces social welfare. We fully characterize the impact of imposing different types of fairness for linear demand. We discover that imposing too much price fairness may result in a lower social welfare relative to imposing no price fairness. Imposing demand and surplus fairness always decreases social welfare. However, imposing no-purchase valuation fairness always increases social welfare. We also extend our results to the cases when there are multiple groups or there is an unprotected feature.

Finally, we computationally show that most of our findings continue to hold for three common nonlinear demand models. Our results and insights provide a first step in understanding the impact of imposing fairness in the context of pricing.

CCS CONCEPTS

• **Applied computing** → **Economics**; Law; • **Information systems** → *Personalization*; • **Social and professional topics** → **Pricing and resource allocation**.

KEYWORDS

fairness, price discrimination, personalization, social welfare

ACM Reference Format:
Maxime C. Cohen, Adam N. Elmachtoub, and Xiao Lei. 2021. Price Discrimination with Fairness Constraints. In *Conference on Fairness, Accountability, and Transparency (FAccT '21), March 3–10, 2021, Virtual Event, Canada.* ACM, New York, NY, USA, 1 page. https://doi.org/10.1145/3442188.3445864

Link to the full paper: https://dx.doi.org/10.2139/ssrn.3459289

FAccT '21, March 3–10, 2021, Virtual Event, Canada

ACM ISBN 978-1-4503-8309-7/21/03.
https://doi.org/10.1145/3442188.3445864