Auction Throttling and Causal Inference of Online Advertising Effects

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Causally identifying the effect of digital advertising is challenging, because experimentation is expensive, and observational data lacks random variation. This paper identifies a pervasive source of naturally occurring, quasi-experimental variation in user-level ad-exposure in digital advertising campaigns. It shows how this variation can be utilized by ad-publishers to identify the causal effect of advertising campaigns. The variation pertains to auction throttling, a probabilistic method of budget pacing that is widely used to spread an ad-campaign’s budget over its deployed duration, so that the campaign’s budget is not exceeded or overly concentrated in any one period. The throttling mechanism is implemented by computing a participation probability based on the campaign’s budget spending rate and then including the campaign in a random subset of available ad-auctions each period according to this probability. We show that access to logged-participation probabilities enables identifying the local average treatment effect (LATE) in the ad-campaign. We present a new estimator that leverages this identification strategy and outline a bootstrap procedure for quantifying its variability. We apply our method to real-world ad-campaign data from an e-commerce advertising platform, which uses such throttling for budget pacing. We show our estimate is statistically different from estimates derived using other standard observational methods such as OLS and two-stage least squares estimators. Our estimated conversion lift is 110%, a more plausible number than 600%, the conversion lifts estimated using naive observational methods.

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