Planning Online Advertising Using Lorenz Curves

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December 11, 2015

Abstract:
We study the online display advertising problem in which advertisers’ demands for ad exposures (impressions) of various types compete for slices of shared resources. In general, advertisers prefer to receive impressions that are evenly-spread across the audience segments they target, as well as evenly-spread across time. In order to accomplish this, we use the Gini coefficient measure and formulate single- and multi-period optimization planning problems that maximize the spreading of impressions across targeted audience segments while limiting demand shortfalls. The contributions of this study are manifold. First, we show how Gini-based metrics can be used to measure several dimensions of spreading that publishers of online advertising care about. Second, we provide adaptations of existing ad planning models to measure Gini-based performance. Third, we quantify the potential benefits of using Gini-based metrics. Fourth, we propose a visualization approach to display the results obtained with the Gini-based performance metrics. We graph the Lorenz curves, describe their practical interpretation, and explain how managers can use the Gini coefficients and the corresponding Lorenz curves to effectively monitor several performance dimensions of a publisher’s ad delivery system. Fifth, we introduce a novel optimization-based decomposition scheme to efficiently solve the proposed Gini-based problem formulations. Our decomposition scheme incorporates ingredients from the Dantzig-Wolfe decomposition and subgradient optimization methods, and exploits the special structure of the Gini-based ad planning problems. Finally, we show that our proposed decomposition method is on average 60 times faster than solving the Gini-based formulation directly.