Data Description for Tutorial 4 and 5[*]

June 9, 2024

Part I

Low Carbon London Trial

Background

Following the Climate Change Act 2008, and the associated commitment by the UK to reduce greenhouse gas emissions by 80% by 2050, the UK is poised for a significant transformation in how electricity is both consumed and generated. Therefore, during 2011 and 2014, the UK government decided to run a series of studies called "Low Carbon London (LCL)." It is a pioneering project that has trialled and demonstrated a broad range of smarter potential approaches to how distribution network operators may invest and operate in the future.

One such trial is a field experiment that tested the demand-side responses to dynamic pricing of electricity. Residential customers, facilitated through smart meters, were offered a dynamic Time-of-Use (dToU) tariff, not previously trialled in the UK. The values of the price bands were: high price: 67.20 pence/kWh; mid-price: 11.76 pence/kWh; and low price: 3.99 pence/kWh. To study the effects of dynamic pricing on the electricity conservation of residential customers, researchers designed a field experiment.

The Field Experiment

The field experiment consisted of two groups, a dTOU tariff group group receiving the experimental dTOU tariff (treated) and a non-Time-Of-Use (nonTOU) group receiving a standard flat tariff (control). With the access to smart meters, the researcher were able to record detailed
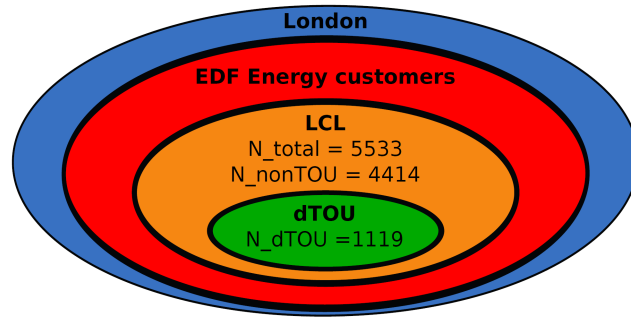

Figure 1: Venn Diagram of the Sample Selection

electricity usage data (at half-hour intervals), the main outcome variable of the field experiment. In addition, the experiment started on January 1st, 2014 and lasted until the end of 2014. Overall, we have electricity usage data of 2 years (2013 and 2014), 1 year before the treatment and 1 year after. 5,000 households were recruited in the experiment.

However, the assignment to the treated and control group is not random. The participation in the dTOU tariff requires the formal consent from households. In addition, households were given £100 for their participation in the dTOU tariff. The following Venn diagram shows the sample selection. Although the control group is a random sample of residential customers, the treatment group is based on self-selection.

In the practical session, you are given a random sample of the field experiment data. The key objective is to use difference-in-difference method to estimate the average treatment effect on the treated (ATT) and evaluate the validity of the DID method with pre-trend analyses.

Part II

Optimizing Bidding Strategies for EveryDay Medical

Background

Elsa (BAM at RSM '20) had just finished her second phone call with EveryDay Medical (EDM), her new pricing optimization client. The issue at hand was one she knew intimately – how to help EDM, a provider of home and durable medical equipment and supplies, optimize its online bidding strategies for the Google search ads. A former engineer and computer science specialist, Elsa had recently founded Real Optimal, LLC, a startup consultantcy focused on online auction platforms. In this capacity, he was responsible for the development of bidding strategies for Google search ads.

In February 2002, Google introduced AdWords, which shaped the Internet pay-per-click advertising industry. Google AdWords was a quick and simple way to advertise on Google and its ad partners, regardless of one's budget. AdWords ads were displayed along with search results on Google, as well as on search and content sites in the growing Google Network, which included websites like AOL, EarthLink, HowStuffWorks, and Blogger. With AdWords, users were able to associate keywords with their ads for search results on Google and its search partners, and also specify the maximum amount of money they would be willing to pay for each click (users paid only when someone clicked on their ads).

The overall pricing model of Google AdWords is based on auctions, to be more precise, generalized second-price sealed-bid auctions. The key innovations of the AdWords auctions were the introduction of Quality Scores. Quality Scores and the bidding prices (cost-per-click) codetermine the AdRank (the rank of ads) of a company. Moreover, companies did not pay the full amount of a bid; instead they paid one penny more than the bid below (or, if the bidder's bid was the lowest, her or she paid the minimum).

EDM's Managerial Problems

Each month EDM budgeted $10,000 to spend on AdWords, representing 25% to 30% of monthly revenue. The company drove two-thirds of its revenues from manual wheelchairs, rolling walkers, and various other medical products and aids for daily living needed by the disabled and elderly. The average order value for such items was $100, and nearly 90% of sales were driven from PPC advertising. The company historically had taken a "*cast a wide net*" approach: bidding for top positions in broad keywords. A significant number of clicks and cost came from searchers forming search queries that included terms or phrases such as "discount wheelchairs" and "wheelchairs for rent". However, there keywords are generally competitive choices. EDM contacted Elsa to help them with understanding the improving the return on investment of their bidding strategies.

Managerially, for a given keyword, bidding too aggressively would generate additional clicks - at a risk, however, of paying more per additional click than what EDM could expect to earn from each of these clicks. On the other hand, bidding too conservatively might have resulted in ads appearing against fewer searches and in lower positions on the search results page, correlating to fewer clicks that might have turned out to be profitable.

Understanding the Position Effects

Elsa was faced with a difficult problem: how to evaluate the ROI for EDM's current bidding strategies? Elsa's goal was to find the optimal bid for each keyword that would yield the maximum amount of revenue for EDM within their budget constraints. To know the optimal bid, Elsa must understand the position effects of different keywords. This is becuase the most important issues in keyword auction is the position of the ad on the page. Because the position of an ad is

the outcome of an auction, higher positions cost more for the advertiser (all else remaining equal) and hence would be justified only if they generate higher returns for the advertiser. Measurement of causal position effects are thus of critical importance to the advertiser. However, measuring the causal position effects is very challenging, due to the inability to generate experimental variation in position in search advertising listings. This is because position is determined through an online auction, with competing advertisers bidding for their advertisements to appear in the listings.

The company offered the Elsa the access to their raw data from Google Analytics. For the past campaigns run by EDM, Elsa could observe, for each campaign the AdRank $(= QualityScores \times Bids$ that determines the final position of a search ad), the revenue of the campaigns, the actual positions of the campaign ads, among others. The below is a screenshot of the Google Analytics of EDM.

Figure 2: Overview of EDM's Past Campaigns