

A Study on Bid and Budget Optimization for Google AdWords

Harish Krishnan
Pricing Manager
Mitre 10 New Zealand Ltd
Auckland
New Zealand
Harish.Krishnan@mitre10.co.nz

Andrew J. Mason
Associate Professor
Faculty of Engineering
University of Auckland
New Zealand
a.mason@auckland.ac.nz

Abstract

Sponsored search auctions are ubiquitous these days and search engine marketing companies such as Google make billions of dollars in revenue. Advertisers spend significant portion of their marketing budget on sponsored search and this is only expected to increase in the future. Mitre 10 New Zealand Ltd is one such advertiser. This paper discusses the experiments conducted on Mitre 10's sponsored search auction data and the subsequent findings.

Initial results indicate the optimization problem to be stochastic in nature. This conjecture is strengthened by the findings of a scraping experiment conducted in two different search markets. Subsequent experiments conducted on various bid and budget amounts across different search markets present interesting findings on the nature of the relationship among the three key variables in a sponsored search process – bid amount (b), budget amount (B) and impressions (I). The paper then, outlines the future course of actions.

Key words: AdWords, pay per click advertising, optimization, hypothesis testing, stochastic process

1 Introduction

Mitre 10 New Zealand Ltd is a leading national retailer that specialises in Home Improvement and Hardware products. It uses the AdWords platform to place ads on Google's search engine page and partner webpages. The AdWords budget is limited and Mitre 10 wishes to maximise the ad displays (Impressions).

When a user enters a search term, Google matches it against a pool of keywords. It then *invites* advertisers who are interested in the keywords to participate in an auction. Google solves a complex optimization problem every time when an auction is conducted. Google's objective function would be to maximise it's revenue and the decision variables

would be the choice of advertises whose ads are to be displayed subject to the budget constraints of each advertiser. Each advertise would have specified a bid – the maximum amount they are willing to pay if their ads are clicked. Google adopts generalised second price auction mechanism and the winners of the auctions get their ads displayed. Advertisers would be charged the next highest bidder’s amount if their ads are clicked by the user. This is known as Cost Per Click (CPC). Advertisers would be invited to participate in auctions until their daily budgets are exhausted.

From an advertiser’s point of view, it’s a challenging problem to determine the right set of keywords, optimal bids and budget amounts. For an advertiser like Mitre 10, the problem is more complex, given the sheer volume of ad campaigns that run concurrently.

Our research aims to propose an algorithm that would maximise the clicks for an ad campaign, given a budget amount. We have conducted experiments to understand the relationship among bid amounts, budget amounts, impressions and clicks. We have presented our findings in this paper.

2 Experiments

2.1 National Campaign

The first experiment that we conducted was a to understand how Google’s auto bidding function works. AdWords offers many different bidding options and the one that is mostly used by Mitre 10 is Enhanced Cost Per Click strategy (ECPC). If this strategy is employed, Google will raise the manual bids for situations that seem more likely to a sale or other conversion on the website such as signing up a form or downloading a catalogue and lowers the bid for situations that seem less likely to lead to a conversion.

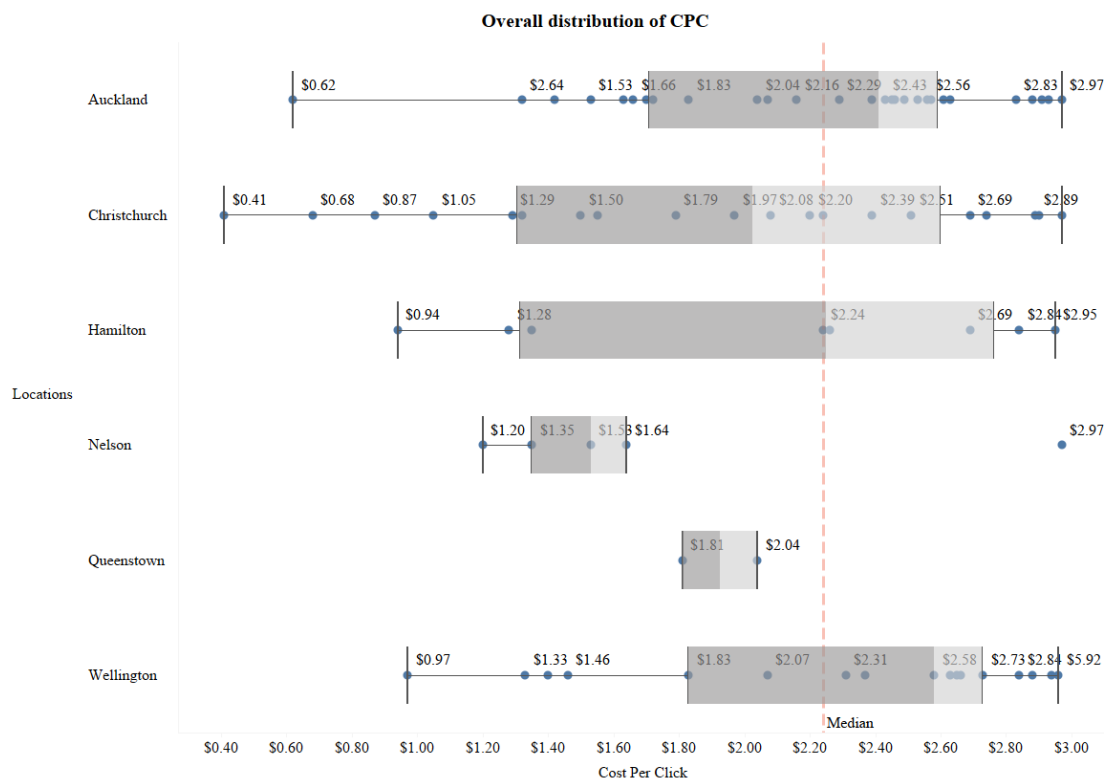


Figure 1. Distribution of CPC for “Cleaning Chemicals” Campaign

The experiment was conducted for the phrase “Cleaning Chemicals”. Cleaning Chemicals is a relatively non seasonal category for Mitre 10 from customer sales point of view. A national campaign with 438 different key words, a maximum bid amount of \$3 and a daily budget of \$10 was set up. After a month, the experiment revealed that the Cost Per Click (CPC) that Google charged Mitre 10 under the ECPC strategy had huge variability. Refer Figure 1.

Since there are many variables – keywords, locations, competition density etc, a new experiment was set up to try and reduce the variability

2.2 Micro Campaigns

A micro campaign was set up for the Wellington region with just one keyword – “cleaning detergents”. Rest of the settings were left unaltered - ECPC strategy, maximum bid amount of \$3 and daily budget of \$10. After a month the maximum bid amount was decreased to \$2 and a month later raised to \$4. The figure below shows the impact of changing the bid amount on impressions (lighter shade) and clicks (darker shade).

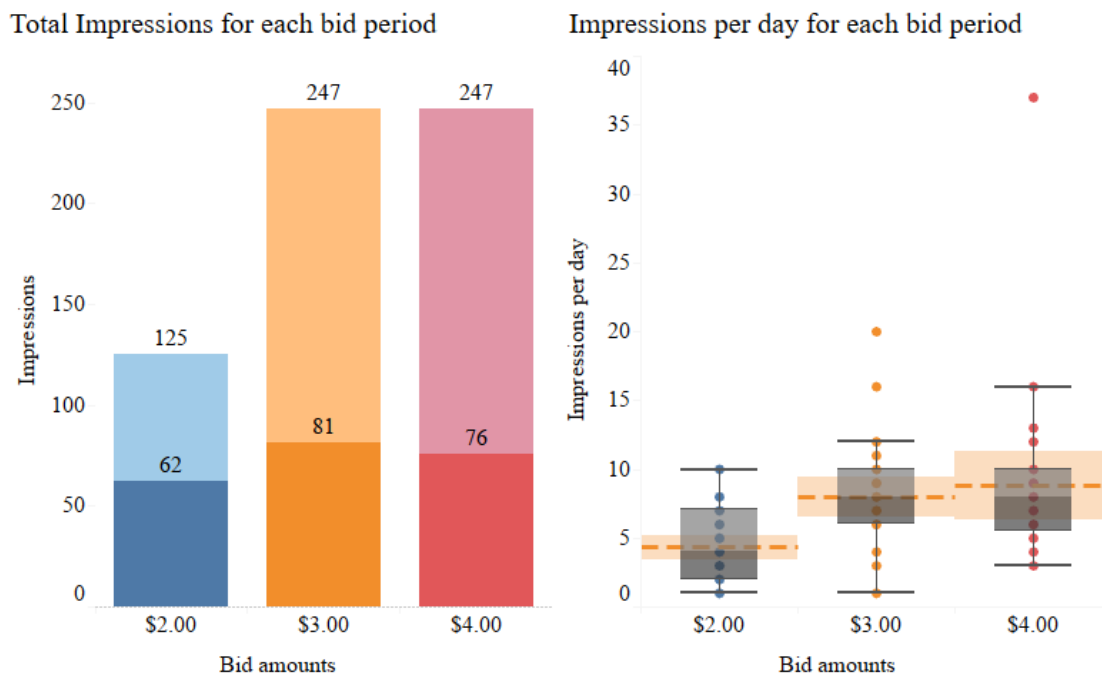


Figure 2. Impact of changing the bid amounts on impressions in Wellington

We observed that increasing the bid amount from \$2 to \$3 increased the impressions from 125 to 247 but had no impact when the bid was raised to \$4. Refer figure 2 – left hand plot. The right hand plot shows the distribution of daily impressions for each of the amounts with the 95% confidence interval for the average. Similar graphs are plotted for the actual amount paid by Mitre 10 (cost) for each of the periods and Cost Per Click.

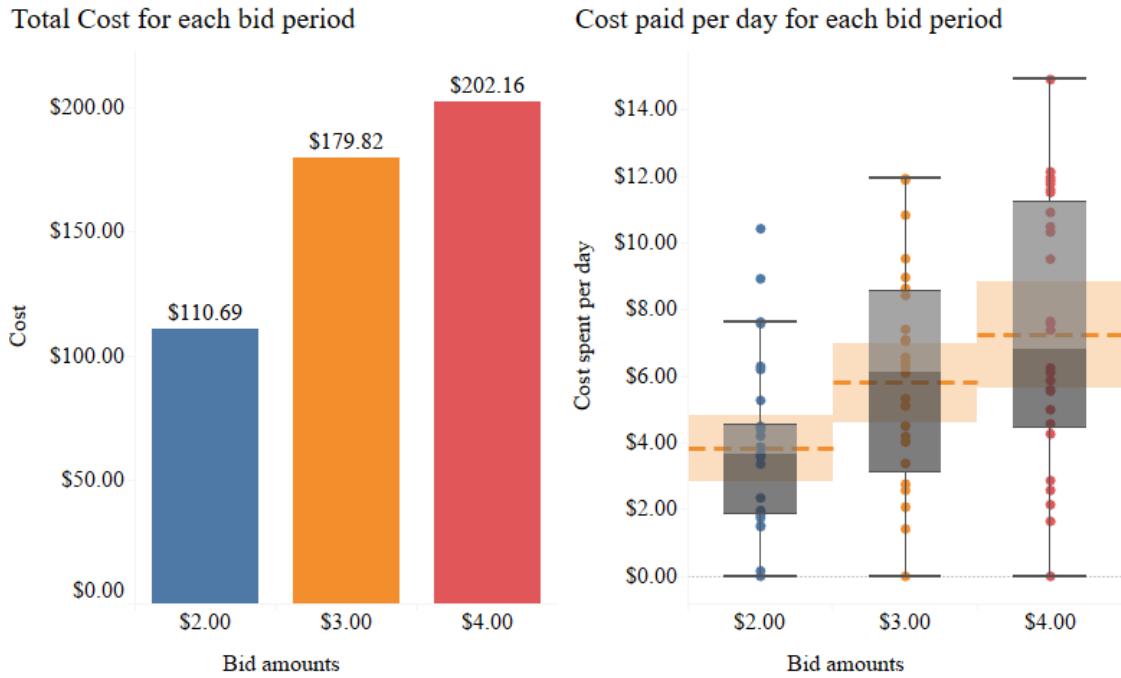


Figure 3. Impact of changing the bid amounts on cost in Wellington

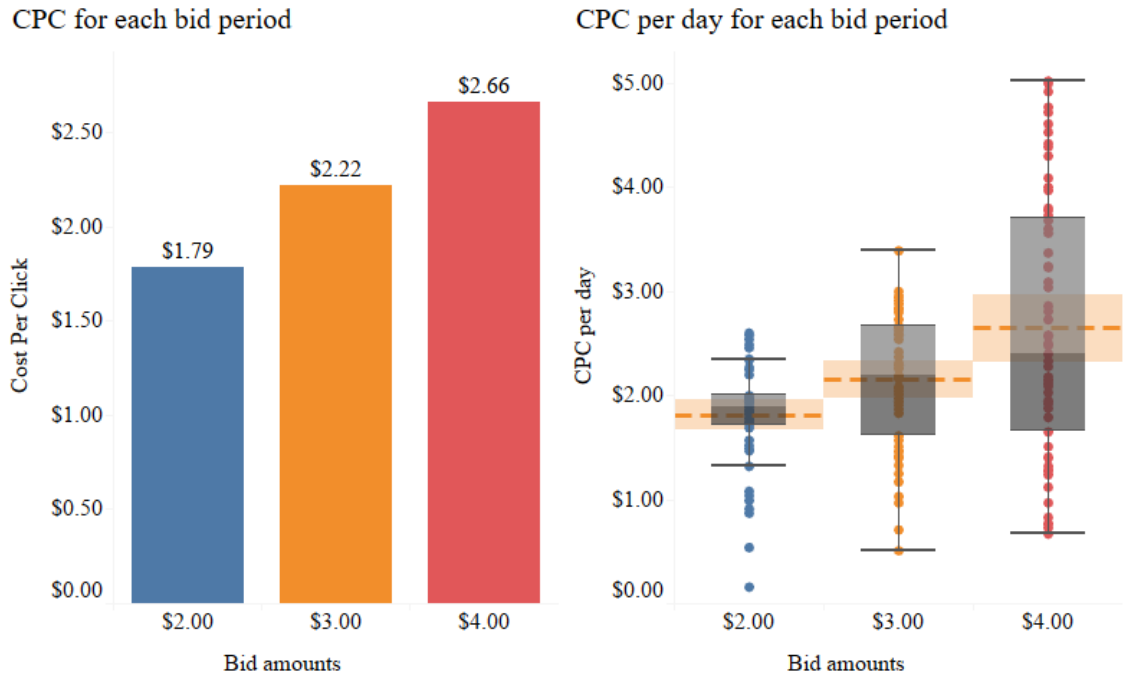


Figure 4. Impact of changing the bid amounts on CPC in Wellington

Though there was no increase in impressions when the bid amount was raised from \$3 to \$4, the total cost and cost per click went up. Refer to figures 3 and 4 which show the total cost and the cost per click for each of the bidding periods along with the distribution of daily costs and cost per click. The 95% confidence interval is also displayed. Similar experiments were conducted in Auckland and Christchurch as well and their respective observations are plotted. Refer figures 5 and 6.



Figure 5. Impact of changing the bid amounts on impressions, clicks, cost and CPC in Auckland

One interesting observation in Auckland region is the distribution of daily costs. We observed that it was consistently above the daily budget of \$10. This finding is crucial to Mitre 10 since the usual strategy is to allocate a uniform budget to all the centres.

A budget allocation thought process would help Mitre 10 to more effectively use its resources and experiments are currently underway to study the impact of budget amount changes on impressions, clicks, cost and cost per click

2.3 Scraping Experiment

Despite reducing the complexity, there is still a lot of variability in distribution of cost and cost per click in various micro campaigns. Subsequently, a scraping experiment was conducted in Auckland and Queenstown to understand how individual auctions work. A java code was written to copy a user search term relevant to cleaning detergents, enter the string on “Google Search” and note the ads and their positions in the first page. This was let to run for 24 hours. The experiment was conducted to understand how Google invites advertisers to participate in auctions.

Refer to Table 1 for findings.

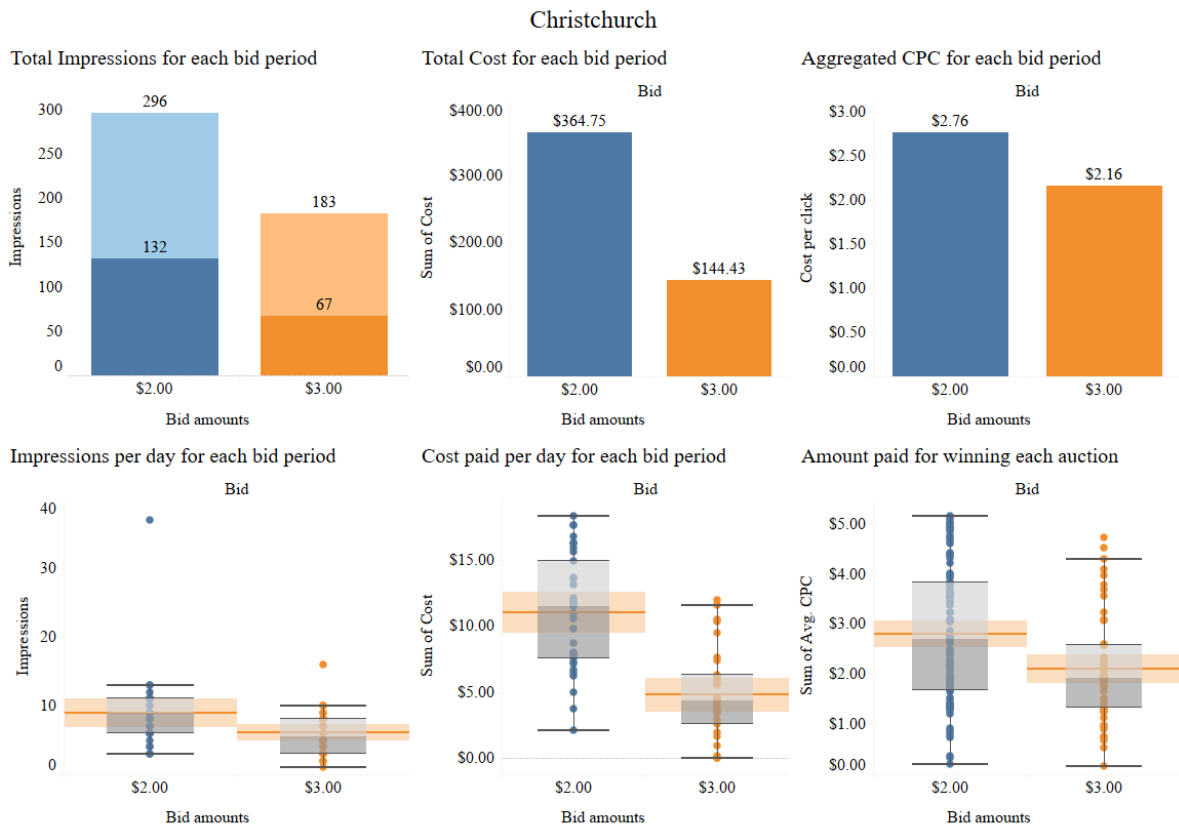


Figure 6. Impact of changing the bid amounts on impressions, clicks, cost and CPC in Christchurch

Parameter	Auckland	Queenstown
Number of Auctions	99	99
Proportion of auctions that Mitre 10 won	3.3%	20.4%
Mitre 10's average position	1.5	1
Number of advertisers that appeared	109	17
Mitre 10's rank based on number of auctions won	8	2

Table 1. Comparison of Scraping Experiment outcome in Auckland and Queenstown

3 Conclusion

The experiments that we have conducted so far help us demonstrate the variability in the distribution of cost per click, impressions, clicks and the actual amount paid by Mitre 10 in reaction to changes in the bid amount. The impact of changing the budget amount is currently being studied. One unknown quantity in the scraping experiment conducted in both the locations is the number of auctions for which Mitre 10 was invited.

Once we understand the interaction between bids and budgets on impressions and clicks we will be able to proceed with developing an algorithm to maximise clicks for Mitre 10.

4 Future Work

We plan to hypothesise on how Google optimizes and test for their significance by collecting empirical data. Some of the preliminary hypothesis that we have developed include

- 1) Different locations should be allocated different budgets
- 2) Population and competition density should be used to define budgets

We also plan to experiment with simple manual bidding to understand if it is better than Google's ECPC strategy in maximising impressions and clicks.

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