

Applications of Statistical Experimental Design to Improve the Performance of
Google AdWords Campaigns

Thesis

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By

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Abstract

Google AdWords are a set of self-advertising tools which are provided by Google Company. Due to the complexity of the methods, the methods provide limited information to users related to the many decisions associated with setting up an ad campaign including: daily budget, cost per click, the contents of the advertisement, and the key words selected. This thesis focuses on how to improve advertisement click numbers with lowest cost using data to support decision-making. A case study application of experimental design is included together with recommendations for future applications. The case study was based on a 12-run Plackett-Burman array. In the case study, we planned 12 individual varying 10 factors, and developed associated statistical data analysis. Results from the case study focus on so-called “covariates” and results indicate that the “day” affected the experiment result significantly as well as both daily budget and cost per click had positive effects. Another issue that was considered was the possible importance of “keywords”. The preliminary findings suggest that “keywords” and the “day” or seasonality should be considered in future experiments and should be considered in future applications of statistical design of experiments.

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1. Introduction to Google AdWords

Google AdWords is Google's main advertising product and source of revenue. Google's total advertising revenues were \$28,236 million in 2010 and \$36,151 million in 2011 (unaudited revenues). Three different advertising schemes are supported by Google AdWords: pay-per-click (PPC), cost-per-thousand (CPM), and site-targeted advertising for text, banner, and rich-media advertisements. Among the three types, text advertisement is the probably the largest in revenues and the primary focus in this thesis. A primary feature of Google's text advertisement is succinct: a text advertisement consists of one headline with 25 characters, two additional text lines with 35 characters each, and a URL line. Figure 1 illustrates a text advertisement. Furthermore, Figure 2 and 3 demonstrate a screen shot of Google AdWords Campaigns page and keywords page.

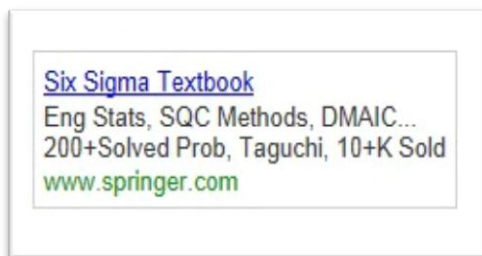


Figure 1. A Text Advertisement Example.

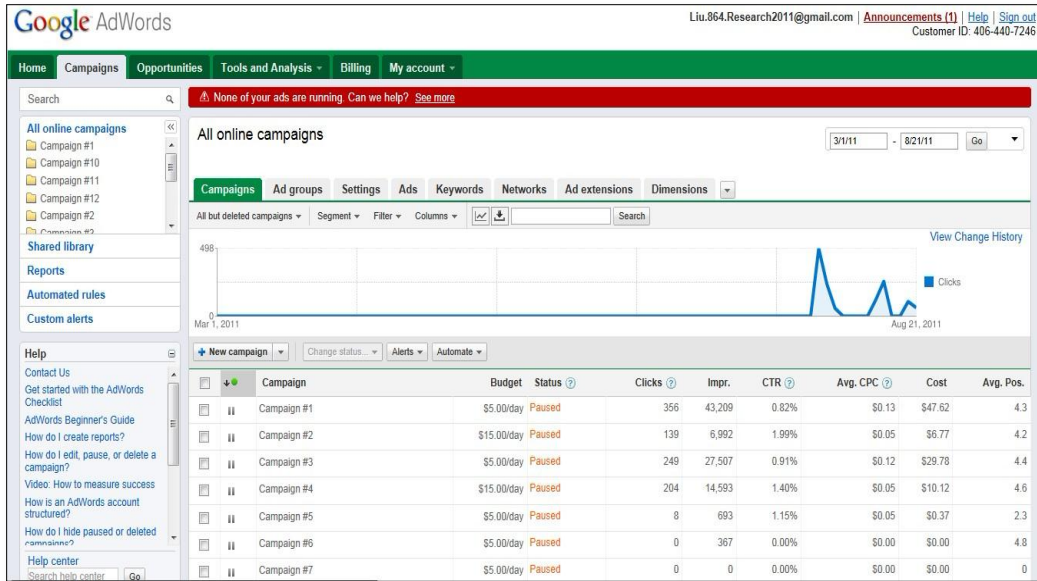


Figure 2. A display of Google AdWords user dashboard for designing campaigns

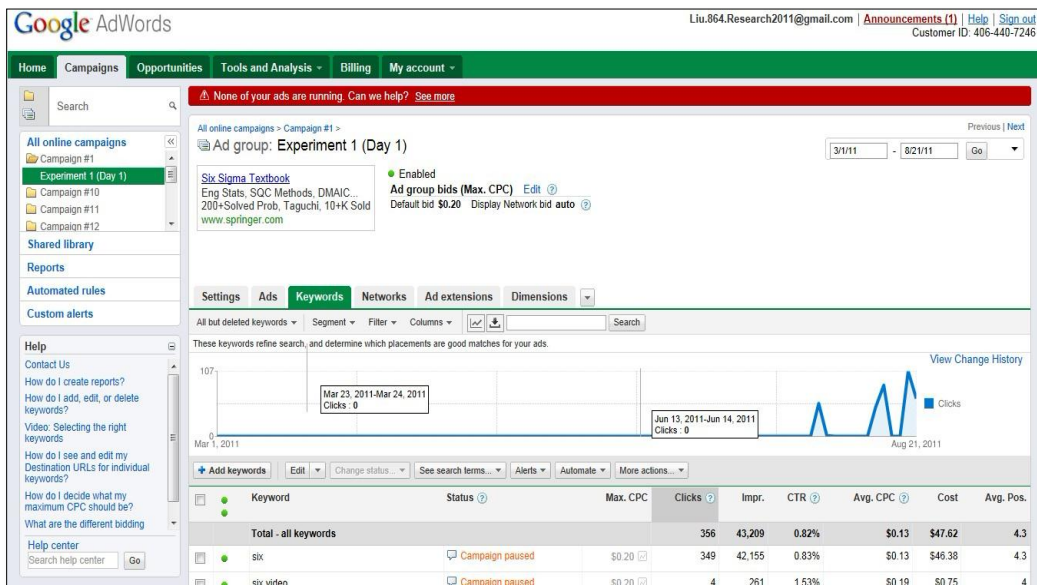


Figure 3. The keywords screen in the AdWords user page.

In Google AdWords, a campaign indicates a set of advertisement groups which includes advertisements, keywords, and bids that share one daily budget, location targeting, and other settings. With one AdWords account, a user could have one or more advertisement campaigns running. Also, some important responses in Google AdWords which are used to measure the performance of one advertisement include the numbers of clicks or impressions and click through rate (CTR). A click is when a user interacts with one advertisement by clicking on it, typically showing an intention to visit the advertised website; impression represents how often one advertisement is shown; click through rate represents the number of clicks that one advertisement receives divided by the number of times this particular advertisement is shown. In our case study, the primary response is “clicks”. Impression and CTR are also considered in the case study but not used as primary response measurements.

2. Issues and Review

Users of Google AdWords have limited decision support information relevant to the many decision problems that they face. For example, it is not obvious how to set the campaigns’ daily budget and cost per click, as well as picking the words within the an advertisement accurately. Incomplete feedback indicates that the user is not able to receive enough information to setup a suitable cost which includes daily budget and cost per click. Also, poor communication means that the potential advertisement

clickers may not be attracted by a shown advertisement because the descriptions and title are misleading or inaccurate.

In fact, in setting up an advertising campaign even for a simple product like a textbook, there are potentially hundreds of decision problems. There are purchasing decisions related to key words which when typed elicit the product. Further, there are option in general related to where the advertisement will appear in Google search results, different world regions, in affiliates, and several other options.

The literature related to supporting these decisions is small but growing. According to Joshi and Motwani's (2006), there are two ways to identify new keywords which may have lower Cost-Per-Click but be equally effective: using relevant keywords and proximity-based tools. Relevant keywords increase the possibility for finding a better description of one specific item. For example, if a customer searches "six sigma", as a relevant keyword, "six sigma textbook" or "six sigma certification" may also show on the screen so that the customer could choose a more accurate keywords which can describe the need of customer in a better way. Proximity-based tools issue queries to a search engine to get highly ranked webpages for the seed keyword and expand the seed with words found in its proximity. For instance, when a customer searches "Hawaii Vacations", a proximity-based tool could also give "Hawaii family vacations" or "Discount Hawaii Vacation" as an advance option. This keywords study provides a background in analyzing data in next step. Moreover, it also could be applied in this

research for the next stage in which keywords will take place as a factor. Fuxman, Tsaparas, Achan, and Agrawal (2008) proposed a statistical approach based on the “wisdom of crowds” for supporting key word selection. The key idea explored here is to apply statistical experimental design to support decision-making about AdWords campaign design. In Section 3, we describe a 3-day small, 12-run case study application of experimental design focusing on the design of the actual text in the advertisement and basic parameter. Then, the general implications for future applications of design of experiments methods are described in Section 4 and conclusions briefly reviewed in Section 5.

3. The Case Study Application of Experimental Design

In this section, we describe our case study application of experimental design which focuses on fostering a substantial improvement in the number of clicks and reduction in the cost per click. The application of experimental design for this purpose is, apparently, new and offers users of Google AdWords new types of decision support to set up daily budget, cost per click, title, and description of advertisement quickly and easily.

3.1 Method

A 12-run Plackett-Burman array is used as the DOE array since there are 10 factors from four different categories in total with each independent variable has two levels. Table 1 shows the independent variables corresponding with two levels respect to individual factor. Due to the limitation of characters of title line and description line, some factors are nested or the levels are dropped if spacing does not allow them. The experiments were released 4-at-a-time which was arbitrarily chosen for the initial experimental design. Table 2 is a complete version of 12-run Plackett-Burman Array.

Table 1. Factors and levels for the case study.

	Factor	Level 1	Level 2
1	Title line	Six Sigma Textbook	Lean Six Sigma Book
2	Field	Eng. Stat	Lean Eng.
3	DOE	DOE	Taguchi
4	SPC	SPC	SQC
5	Feature	Definitions & Cases	200+ Solved Probs
6	DFSS	DMAIC...	DMIAC, DFSS
7	Emphasis	SPC Charts	SQC Methods
8	Legitimation	2nd Ed.	10+K Sold
9	Daily Budget	\$5.00	\$15.00
10	Cost Per Click	\$0.05	\$0.20

Table 2. The experimental design for the case study which is based on a 12 run Plackett-Burman design.

Day	Title line	Field	DOE	SQC	Feature	DFSS	Emphasis	Legitimation	Daily Budget	Default Bid	Clicks
1	Six Sigma Textbook	Eng. Stats.	Taguch i	SQC	200+ Solved Probs	DMAIC...	Methods	10+K Sold	5	0.2	55
1	Six Sigma Textbook	Lean Eng.	Taguch i	SQC	Definitions & Cases	DMAIC, DFSS	Methods	2nd Ed.	15	0.05	134
1	Six Sigma Textbook	Lean Eng.	DOE	SPC	Definitions & Cases	DMAIC, DFSS	Methods	10+K Sold	5	0.2	106
1	Lean Sigma Textbook	Eng. Stats.	Taguch i	SPC	Definitions & Cases	DMAIC...	Methods	10+K Sold	15	0.05	204
2	Six Sigma Textbook	Eng. Stats.	DOE	SPC	Definitions & Cases	DMAIC...	Charts	2nd Ed.	5	0.05	7
2	Lean Sigma Textbook	Eng. Stats.	Taguch i	SQC	Definitions & Cases	DMAIC, DFSS	Charts	2nd Ed.	5	0.2	0
2	Lean Sigma Textbook	Lean Eng.	Taguch i	SPC	200+ Solved Probs	DMAIC, DFSS	Charts	10+K Sold	5	0.05	0
2	Lean Sigma Textbook	Lean Eng.	DOE	SQC	Definitions & Cases	DMAIC...	Charts	10+K Sold	15	0.2	53
3	Lean Sigma Textbook	Lean Eng.	DOE	SQC	200+ Solved Probs	DMAIC...	Methods	2nd Ed.	5	0.05	1
3	Six Sigma Textbook	Lean Eng.	Taguch i	SPC	200+ Solved Probs	DMAIC...	Charts	2nd Ed.	15	0.2	218
3	Lean Sigma Textbook	Eng. Stats.	DOE	SPC	200+ Solved Probs	DMAIC, DFSS	Methods	2nd Ed.	15	0.2	14
3	Six Sigma Textbook	Eng. Stats.	DOE	SQC	200+ Solved Probs	DMAIC, DFSS	Charts	10+K Sold	15	0.05	0

3.2 Results and Analysis

After ran the experiments from July 28, 2011 to August 12, 2011, a result matrix with responses which includes clicks, impressions, CTR, average cost per click, cost, and average positions is given by Table 3. Notice that substantial variations are shown in all the responses.

Table 3. Response data for the 12 campaigns.

Campaign	Cost Per Click	Clicks	Impr.	CTR	Ave. CPC	Cost	Avg. Pos.
1	0.2	55	1907	2.88%	\$0.11	\$5.28	3.7
2	0.05	134	5186	2.58%	\$0.05	\$6.52	4.5
3	0.2	106	8067	1.31%	\$0.11	\$12.00	4.1
4	0.05	204	14593	1.40%	\$0.05	\$10.12	4.6
5	0.05	7	662	1.06%	\$0.05	\$0.33	2.3
6	0.2	0	352	0.00%	\$0.00	\$0.00	4.7
7	0.05	0	0	0.00%	\$0.00	\$0.00	0
8	0.2	53	14538	0.36%	\$0.09	\$4.80	5.5
9	0.05	1	190	0.53%	\$0.05	\$0.05	5.3
10	0.2	218	21518	1.01%	\$0.11	\$24.47	4.3
11	0.2	14	3198	0.44%	\$0.19	\$2.63	5.2
12	0.05	0	0	0.00%	\$0.00	\$0.00	0

With the aim of analyze the data, a normal probability plot of the standardized effects (Figure 4) is generated. However, there is no factor had a significant effect on any response. As well, a Main Effects Plot for Clicks is also given as Figure 5. The noise level is too high to make a conclusion. With the intention of making more precise analysis, it is indispensable to run the experiment mutiple times to gather more data. The only thing can be hypothesized with some level of confidence is that daily budget affects clicks positively, which is which is the higher set daily budget, the more clicks it generates. This is obvious intuitively because when the budget is reached the advertisement stops being displayed so no

clicks are possible. Additionally, a screen shot of results from Google AdWords application is shown as Figure 6.

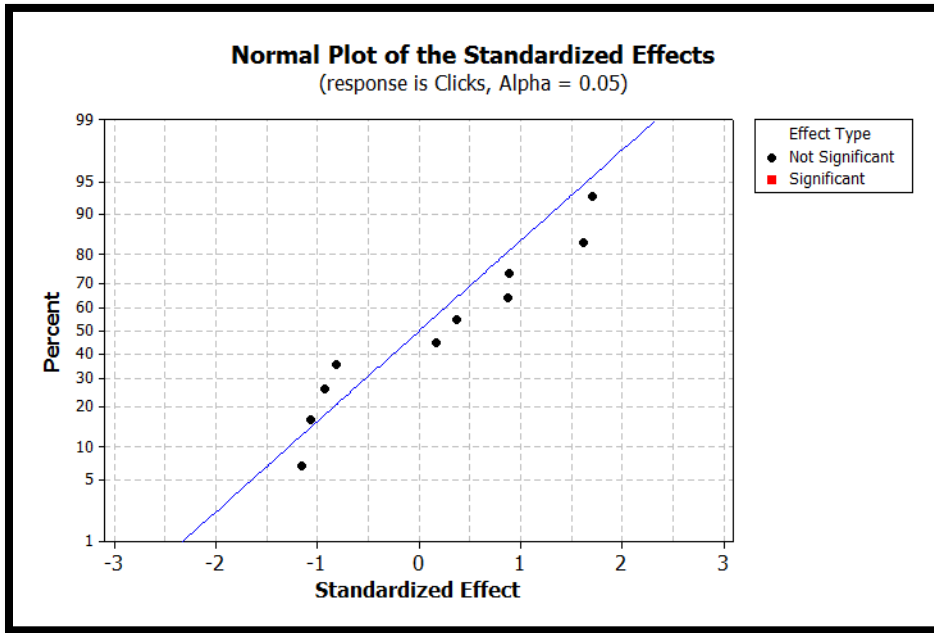


Figure 4. Normal probability plot of standardized effects for the click responses indicating no significant effects.

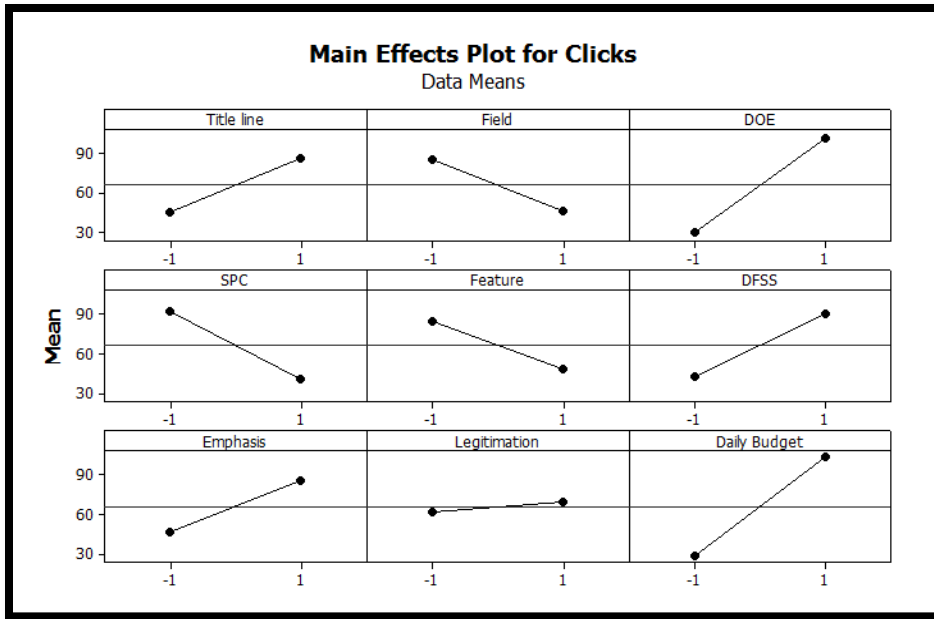


Figure 5. Main effects plot for the clicks response.

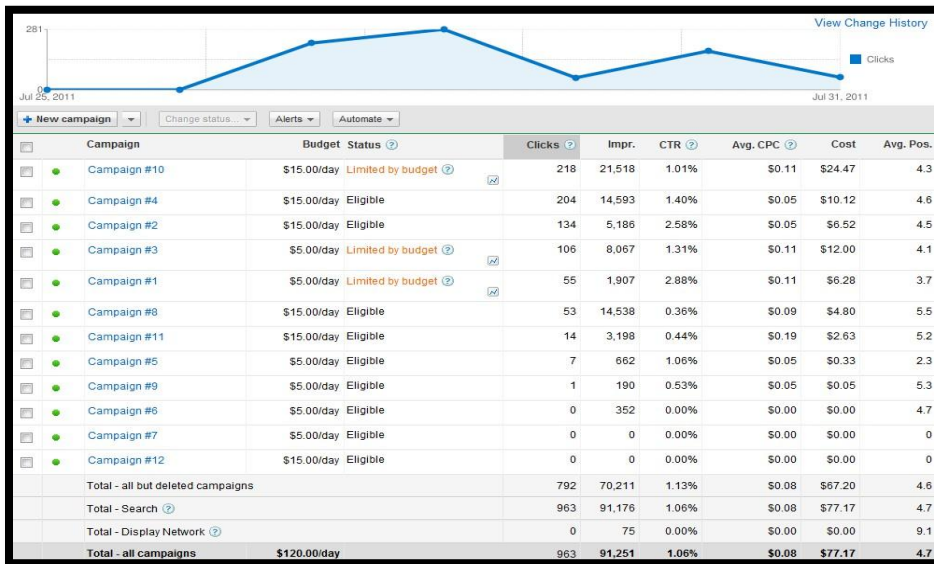


Figure 6. Summary data for the 12 campaigns in the case study.

We then explored analysis of the covariates including the “day” which was shown to play an important role in this case study. It had significant affects from ANOVA. Figure 7 represents the relationship between Clicks and Day in a boxplot whereas Figure 8 represents the relationship between CTR and Day in a boxplot respectfully. In this special case, it is reasonable that people less likely to search a textbook during weekends. However, if advertising other type of products (for example, a ski board), people may likely to search it without a date preference.

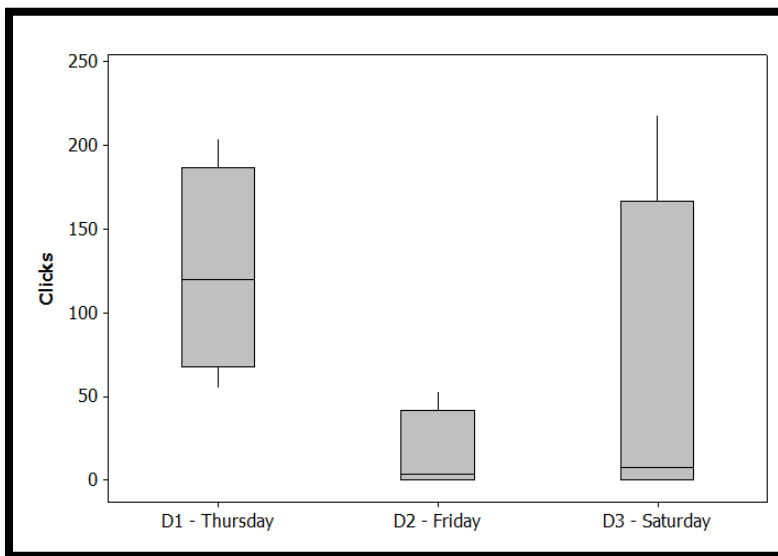


Figure 7. A Boxplot of the clicks for different days in the experiment.

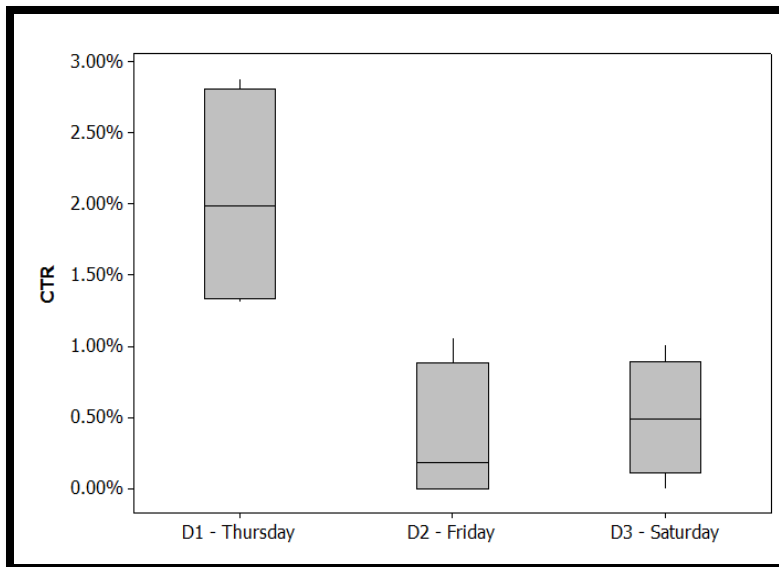


Figure 8. A box plot of the click through rate for the different days in the experiment.

4. Discussion

In our case study, we failed to find any significant effect for the factors varied. Yet, analysis of the covariates provided insights relevant to future experimentation. , There is no significant effect showed in this experiment besides the Day covariate despite rather large response ranges. One possibility is Title and descriptions are not important factors. Other responses can be considered.

Yet, inspecting the case study results, offers some findings potentially relevant to future application of experimental design to web ad campaigns.

1. It is important to spread campaigns over multiple days because the effect of day in the week or years are likely larger than the advertisement contents.

Moreover, a longer running time is needed in the next step research with the purpose of analyzing the covariate day.

2. Other factors besides clicks might be preferable for statistical reasons. In our study, we found no significant factors but other responses such as click through rate might be important and merit further investigation.
3. The selection of key words via experimental design is likely important. Related factors relate directly to CTR, which means customers should type keyword into the system and several ads show up, then customer decides click which one. This means the current independent variables only affect whether the customer click it or not after the true advertisement shows on the screen. Also, none of the factors affects whether the advertisement is selected to show on the screen but Keywords. Thus, it is necessary to add Keywords as an independent variable as well as eliminate some not-so-important factors such as specific description words.
4. It is likely desirable to separate campaigns using different time periods and/or different login identification. This is because when multiple ads run on the same account Google provides automatic modulation of frequencies based on what is currently a hidden algorithm. With some ads being given negligible impressions as in Figure 4, results are somewhat suspect. Each unique experiment should be run individually so that the competition with similar advertisements would decrease.

5. Conclusions

We provided an application of design of experiments to the important new problem of setting up Google AdwWrds campaigns. Although the initial objects are not met in the primary stage of research, an advanced research with appropriate changes of DOE array could also make significant achievements in the future. This initial attempt points out a better direction to analyze Google AdWords. In the next stage, the researcher will focus on different factors such as Keywords and experiments over multiple days Day.

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