

### HW3: AEM 4550 Economics of Advertising

#### PART I ANSWERS

*Objective: to analyze online advertising effectiveness.*

This question deals with the case "Air France Internet Marketing: Optimizing Google, Yahoo!, MSN, and Kayak Sponsored Search" by Mark Jeffery; Lisa Egli; Andy Gieraltowski; Jessica Lambert; Jason Miller; Liz Neely; Rakesh Sharma.

You will need the data that is posted on the course website in the spreadsheet "HW3\_spreadsheet".

When dealing with a large amount of data, such as the data on search keywords and transactions provided by Double Click, it is very beneficial to use Pivot Tables in Excel. If you have never used Pivot tables, here is a simple tutorial (it is easier than you think):

<http://office.microsoft.com/training/training.aspx?AssetID=RC102058721033&pid=CR100479681033>

1. Create and print a Pivot table of the following descriptive statistics grouped by "Publisher Name".
  - a. Sum of Number of Users Clicking
  - b. Sum of Number of User Impressions
  - c. Sum of Number of Transactions
  - d. Sum of Total Revenue
  - e. Sum of Total Cost (Click Charges)

Publisher Name	Sum of Number of Users Clicking	Sum of Number of User Impressions	Sum of Number of Transactions	Sum of Total Revenue	Sum of Total Cost (Click Charges)
Google - Global	72,895	1,808,326	797	\$929,549.80	\$120,946.71
Google - US	192,109	3,855,689	1,550	\$1,745,481.80	\$353,640.60
MSN - Global	11,217	139,979	129	\$145,524.25	\$12,160.36
MSN - US	10,808	170,120	140	\$181,549.80	\$16,098.49
Overture - Global	60,899	17,898,727	372	\$430,084.70	\$64,295.86
Overture - US	119,323	17,062,488	289	\$347,433.25	\$141,976.07
Yahoo - US	45,598	933,345	662	\$882,288.95	\$46,197.82
Grand Total	512,849	41,868,674	3,939	\$4,661,912.55	\$755,315.92

See the spreadsheet posted online to trace back calculations.

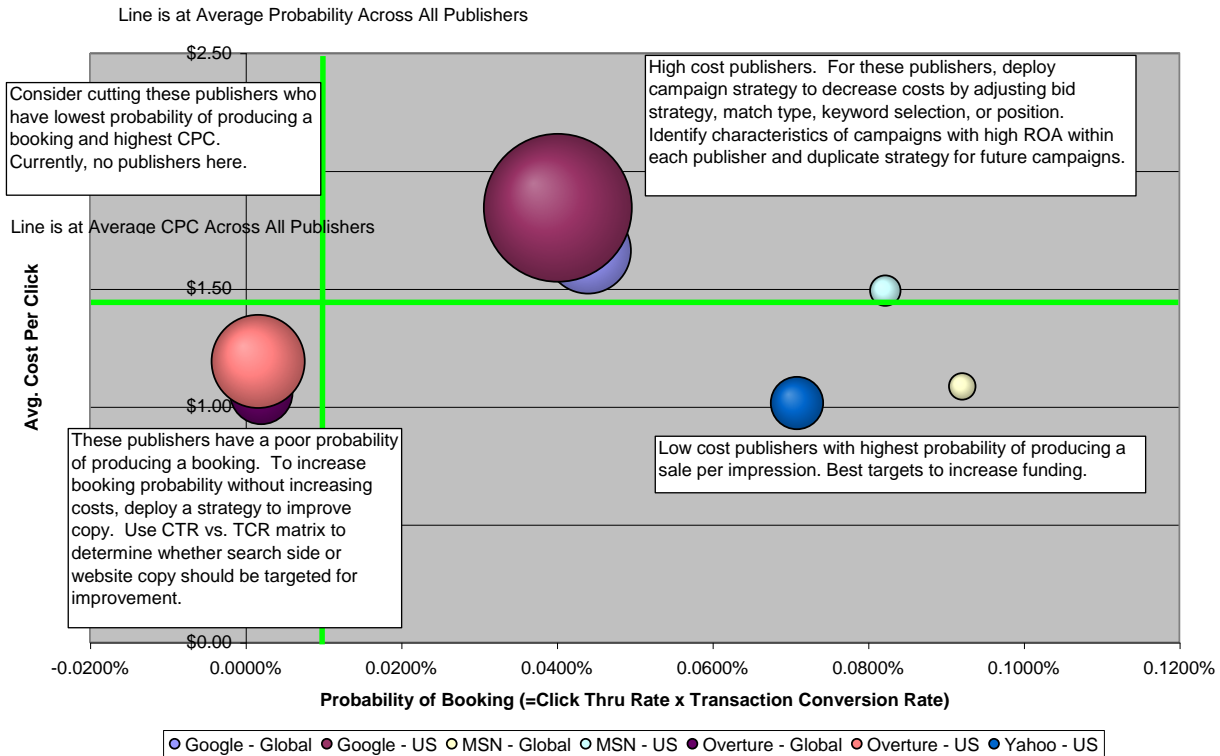
Publisher Name	Average Cost Per Click (CPC)	Click Through Rate (CTR)	Transaction Conversion Rate (CTR)	Sum of Net Revenue	ROA	Average Revenue Per Transaction	Probability of Booking	Cost/Booking
Google - Global	\$1.66	0.040	0.011	\$808,603.09	668.56%	\$1,166.31	0.0441%	\$151.75
Google - US	\$1.84	0.050	0.008	\$1,391,841.20	393.58%	\$1,126.12	0.0402%	\$228.16
MSN - Global	\$1.08	0.080	0.012	\$133,363.89	1096.71%	\$1,128.09	0.0922%	\$94.27
MSN - US	\$1.49	0.064	0.013	\$165,451.31	1027.74%	\$1,296.78	0.0823%	\$114.99
Overture - Global	\$1.06	0.003	0.006	\$365,788.84	568.92%	\$1,156.14	0.0021%	\$172.84
Overture - US	\$1.19	0.007	0.002	\$205,457.18	144.71%	\$1,202.19	0.0017%	\$491.27
Yahoo - US	\$1.01	0.049	0.015	\$836,091.13	1809.81%	\$1,332.76	0.0709%	\$69.79
Grand Total	\$1.47	0.012	0.008	\$3,906,596.63	517.21%	\$1,183.53	0.0094%	\$191.75

- CPC and probability to produce a sale differ among publishers
- Quadrant position can be used to determine optimal publisher strategy

## Results

- Quadrant 1: No publishers present.
- Quadrant 2: Google Global, Google U.S., and MSN U.S. have a high probability of booking but high CPC. Deploy strategy to reduce CPC through tactical campaign changes.
- Quadrant 3: Yahoo U.S. and MSN Global have a high probability to book and low CPC. Deploy strategy to fund these publishers more.
- Quadrant 4: Overture U.S. and Overture Global have a low probability of booking but acceptable CPC. Deploy strategy to improve CTR and/or TCR of Overture campaigns through copy improvements.

**Formulate Publisher Strategy**  
**Note: (Bubble Size=Current Funding)**



**PART II SELECTED ANSWERS**

Read the academic article “The Unfavorable Economics of Measuring the Returns to Advertising” by Lewis and Rao and answer the following questions:

**1a. What is the main finding of this study? Why is measuring the effects of advertising difficult? Why is it easier to measure the effects of online advertising than the effects of traditional TV advertising?**

The main finding in this study is that reliably detecting the effects of advertising campaigns is very difficult. Moreover, based on estimates from 25 large field experiments, it may take millions or tens of millions of observations to reliably detect the effects of advertising.

Finding advertising effects is difficult largely because the outcome variable (e.g. purchases) is very noisy. The relationship between the noisiness of the outcome variable and the likelihood of detecting effects is captured in the following definition of a t-statistic:

$$t_{\Delta\bar{y}} = \sqrt{\frac{N}{2}} \left( \frac{\Delta\bar{y}}{\hat{\sigma}} \right)$$

As the noisiness (sigma) of the outcome variable increase, the t-statistic decreases, which means the probability of rejecting the null hypothesis (that ads have no effect) decreases. On the other hand, as N and  $\Delta\bar{y}$  increase, the t-statistic increases, in effect making it easier to reject the null hypothesis.

To summarize, in order to reliably detect advertising effectiveness, a firm's ads need to have an effect, the firm needs to reach a large enough sample of consumers, and the firm needs to have the budget to run the test. The large budget can be an insurmountable hurdle for small-to-medium size firms.

It is easier to measure the effects of online advertising because it is easier to run experiments using simple digital ad systems than it is to run experiments using costly and complicated infrastructure required with cable television.

**1b. Suppose you are a consultant who helps CPG (consumer-packaged-goods) firm run advertising experiments. You are currently working with two firms.**

**Firm 1 plans to run their A/B experiment on 1000 customers. From prior experiments, you expect the average value of purchases for consumers in the treatment group (receive ad) to be \$0.30, while the average value of purchases for consumers in the control group (no ad) to be \$0.20. Assume that the standard deviation of the average purchase value for both treatment and control groups is \$5.00.**

**Firm 2's plans to run their A/B experiment 10000 customers. Firm 2's product is more expensive but purchased less frequently than Firm 1's product. Coincidentally, the average value of a purchase in the treatment groups (receive ad) and control groups is the same as it is for Firm 1. However, the standard deviation of the average purchase value for both treatment and control groups is \$25.00.**

**Which firm's ad campaign is more likely to show a positive effect? Should either firm expect to see a significant positive effect?**

Firm 1 is more likely to show a positive effect. We can do this in multiple ways. One way is to look at the estimated T-statistic for each firm. In this case, a T-statistic can be used to calculate how probable an outcome will be different than zero. A higher T-statistic tells us, if we run the same experiment many times, more of those experiments will show positive effects.

Firm 1:

$$t_{\Delta\bar{y}_1} = \sqrt{\frac{N_1}{2}} \left( \frac{\Delta\bar{y}_1}{\widehat{\sigma}_1} \right) = \sqrt{\frac{1000}{2}} \left( \frac{0.10}{5} \right) \approx 0.45$$

Firm 2:

$$t_{\Delta\bar{y}_2} = \sqrt{\frac{N_2}{2}} \left( \frac{\Delta\bar{y}_2}{\widehat{\sigma}_2} \right) = \sqrt{\frac{10000}{2}} \left( \frac{0.10}{25} \right) \approx 0.28$$

To evaluate whether either firm should expect to see a positive effect, we need to use hypothesis testing. The null hypothesis for both firms will be that advertising has no effect, and the alternative hypothesis is that advertising has an effect. To evaluate these claims, we can use the T-statistics to calculate p-values. We “reject the null” if the calculated p-values are less than or equal to a pre-defined critical value (usually  $p = 0.05$ ). The respective p-values for Firm 1 and 2 are 0.660 and 0.780, and since both are greater than 0.05, neither firm should expect to see a significant result.

**2. Read the academic article “Consumer Heterogeneity and Paid Search Effectiveness: A Large-Scale Field Experiment” by Blake, Nosko and Tadelis and answer the following questions:**

**2a. What question was the eBay team trying to answer by running a “Large-Scale Field Experiment?” How did they go about answering this question? What were their outcome variables, treatment groups, and control groups?**

**2b. Discuss the main finding of the paper, and in particular, why paid advertising might work for some firms but not for others.**

eBay was trying answer the question: does paid search advertising significantly affect outcome variables of interest, namely clicks and sales. Moreover, they were curious as to whether the effects were consistent across branded and non-branded search advertising.

#### Branded-keyword

The eBay team conducted an experiment where they stopped advertising on Yahoo! and MSN (treatment group) while still advertising on Google (control group). The outcome variables of interest were “clicks” and “sales” that could be attributed to advertisements.

#### Non-Branded-keyword

Again, eBay conducted an experiment with two groups, but this time the groups were constructed a little differently. The groups, instead of being split by search engine, were split by DMA (designated market area). The outcome variables of interest for this set of experiments were clicks sales (per DMA region) that could be attributed to non-branded search advertising.

The main finding of the paper is that it might not be in a firm's best interest to do search advertising. In the case of eBay (and companies like eBay), in the absence of paid branded-keyword ads, consumers most of the time clicked on the company's organic search link. In other words, paid search links were acting as substitutes for organic search links. A caveat was for new or "inexperienced" customers. For this group, paid-search advertising did have a small, but positive, effect. In the case of non-branded keyword advertising, "clicks" to eBay did significantly decline, but the overall sales for eBay did not. This suggests that users still found their way to eBay, albeit different means. These results are largely consistent with the informative view of advertising. In that consumers visit a site due to the advertisement informing them of the brand (or products) existence.