Optimization of Digital Advertisements of Huawei Platform

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Problem Definition:

What is your problem?

Marketing team does not currently use any proper optimization approach and uses some intuition to improve impression and conversion rates of the digital advertisements. It has been observed that the only parameter they focused on is CTR (**C**lick **T**hrough **R**ate) which does not guarantee an optimal solution.

How did you model it? Why did you choose this approach?

It was aimed to maximize the total click count for the digital advertising campaign. Click counts, which are the coefficients of the decision variables, were determined by calculating the average values in the data set.

Constraints are, total budget as 15.000$ and total budget is needed to be split into campaign slot count. There must be 3 campaigns at the same time. Campaign 1 can consume at most %60 of the total budget. Each campaign must have at least 20 slots. Campaign 2 must not cost more than Campaign 3. One slot can be used by only 1 campaign at the same time.

$$Maximize \sum_{j=1}^{3} \sum_{n=1}^{122} x_{jn} * C_n$$

Subject to**:**

$$\sum_{j=1}^{3} \sum_{n=1}^{122} x_{jn} * C_n * CPC_n = \$\,15{,}000 \quad (Budget\ constraint)$$

$$\sum_{n=1}^{122} x_{1n} * C_n * CPC_n \leq \$\,15{,}000 * 0.6 \;\; (Campaign\ 1\ budget\ constraint)$$

$$\sum_{n=1}^{122} x_{3n} * C_n * CPC_n - \sum_{n=1}^{122} x_{2n} * C_n * CPC_n \;\; \geq 0 \;\; (Campaign\ 2\ and\ 3\ budget\ constraint)$$

$$\sum_{j=1}^{3} x_{jn} \leq 1\,, \qquad n = 1,2,3..122\ (Single\ slot\ usage\ constraint)$$

$$\sum_{n=1}^{122} x_{jn} \geq 20\,, \qquad j = 1,2,3\ (Having\ minimum\ 20\ slots\ constraint)$$

$$x_{jn} \in \{0,1\}\ (Decision\ variable)$$

CPC_n : Cost Per Click associated with slot n

x_{jn} : Binary decision variable associated with slot n and campaigns, j = 1, 2, 3

C_n : Avg. click count associated with slot n

What are your assumptions?

Assumption 1: The click through coefficients associated with the slots will remain the same in the future.

Assumption 2: The other advertisements on the website have no effect on our brand's advertisements.

Assumption 3: The campaigns are going to be online for 1 month.

How are you (or the problem owner) going to utilize the project outputs?

The slots would be determined in the solution, will be activated in the next campaign period. By means of this solution, the number of clicks will be maximized in the next campaign period with a limited budget.

Data Set Description:

What are your inputs (cost, profit, resources, distances, etc..)? What is the data set size? Where does the data come from?

Data consist of 122 slots. Data is provided by Huawei marketing department.

- **Slot:** Place for the advertisement to be displayed. (string)
- **Campaign Name:** Campaign associated with slot. (string)
- **Impression:** Number of exposure. (integer)
- **Click:** Count of the click. (integer)
- **CPC:** Cost per Click (float)
- **Cost:** (Click * CPC) (float)
- **CTR:** Click Through Rate (float)
- **Date:** Period of campaigns. (string)

Approaches:

What is the reasoning behind your algorithm/approach choice?

Preferred integer algorithm approach rather than heuristic approach, because it is possible to reach the optimal solution of the problem with optimization tools (Gurobi).

Which algorithms did you use? How did you select parameters?

Simplex algorithm is used by Gurobi. In this problem, slots will be either selected or not. Slots cannot be selected partially. In other words, the values of the decision variables can take 0 and 1. This requires solving the problem with integer programming.

Results:

What results did you obtain?

The slots to invest under the given restrictions by maximizing click count have been found. The total click count with improved slot selections have been increased. Based on optimal solution, **total clicks have been increased by 13%** compared to previous intuitive approach.

How do you interpret them?

Out of 122 slots, 74 were of them have been selected. As expected, these slots consisted of slots with low cost and high traffic.

How are your performance metrics related to the problem and/or data set? How do they compare to the existing practices if any?

The performance of existing campaigns have been evaluated with CTR metric. A slot with very few views could get high CTR. It was not a correctly chosen metric. Instead, the optimal solution was found by maximizing the number of clicks.

* In this report all the values are changed due to data privacy.