Solving Marketing Optimization Problems Using Genetic Algorithms

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Úvod

- Článok začína diskusiou o význame marketingovej optimalizácie, ktorej cieľom je efektívne alokovať marketingové zdroje s cieľom maximalizovať konkrétne výsledky, ako je predaj alebo podiel na trhu.
- Zdôrazňuje zložitosť marketingových problémov v dôsledku faktorov, ako sú rôzne preferencie zákazníkov a konkurenčné akcie.

Aplikácia genetických algoritmov v marketingu

- Vhodnosť: Príspevok odôvodňuje použitie GA v marketingu diskusiou o ich schopnosti zvládnuť zložité, viacrozmerné rozhodovacie procesy, ktoré sú typické pre marketingové stratégie.
- Porovnanie: GA sú v porovnávané s tradičnejšími prístupmi, pričom si všímajú ich schopnosť vyhnúť sa lokálnym optimám a poskytovať globálne optimalizované riešenia.

Problematika Site location(lokácie obchodov)

- Site location analysis – conventional model Penny a Broom, model v ktorom obrat obchodu funkčne závisí od premenných, ako sú výdavky domácností a počet obyvateľov
- GA pre optimalizáciu problému site locations

(1) Find and identify how many of the proposed sites to use, to augment and improve the existing network in terms of profitability, attractiveness to potential customers or any other suitable metric. The existing network is assumed to be static, i.e. remains unaltered, with no closure of sites.

(2) As problem (1), but here the existing network is assumed to be dynamic, i.e. existing sites may be removed from the network if this gives an improvement in overall network performance.

(3) Given an existing network of outlets, determine the best subset of these to market a particular product or service.

Reprezentácia a Fitness funkcia

Chromosome representation

Each chromosome represents a possible network consisting of existing sites and possible new sites. If there are S_e existing sites and S_p possible new sites, the length of the chromosome will be $S_e + S_p$. The individual genes within each chromosome are represented by a binary alphabet; 0 indicates that a particular site is not used in the network, whereas a 1 would indicate that a site is used. The position within the chromosome is important as this indicates the site under consideration, e.g. bit position 4 (from left to right) represents site 4. To illustrate, if we have four existing outlets and three possible new sites, then the chromosome

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represents a network where sites 1, 2, 3 and 4 are used (the existing network) and site 6 is used; sites 5 and 7 remain unused.

$$\mathrm{EXP}_{ij} = \beta_0 \left(\sum_{k=1}^{N_k} E_k H_{ik} \right) \cdot \frac{W_j e^{-\beta_1 T_{ij}}}{\sum_{m=1\,:\,m \neq j}^{N_s+N_c} W_m e^{-\beta_1 T_{im}}} \qquad (1)$$

where;

N_k is the number of household categories; $N_s = S_e + S_p$; N_c is the number of competitors; $i = 1, 2, \ldots, N_z$ (N_z is the number of zones) and $j = 1, 2, \ldots, N_s$; EXP_{ij} is the expenditure from zone i to site j. Note that only sites in the chromosome under consideration set to a 1 are used in equation (1); i.e. site j is used only if position j in the chromosome is set to 1; similarly, in the denominator term, site m is used only if position m in the chromosome is set to 1 ($m = 1, \ldots, N_s$). The competitors $m = N_s+1, \ldots, N_s + N_c$) are always included.

β_0 and β_1 are parameters;

E_k is the mean expenditure on the product/service by household category k;

H_{ik} is the number of households of category k located in zone i;

W_a is a subjective measure of attraction of existing/proposed sites ($a = 1, 2, \ldots, N_s$) and competitors ($a = N_s+1, \ldots, N_s+N_c$).

T_{ia} is the travel time from zone i to the existing/proposed sites ($a = 1, 2, \ldots, N_s$) and competitors ($a = N_s+1, \ldots, N_s+N_c$).

The actual fitness function is then

$$\sum_i \sum_j \mathrm{EXP}_{ij}. \qquad (2)$$

The genetic algorithm will then attempt to maximize this expression, i.e. find a network of sites which maximizes customer expenditure.

Výsledky a zhrnutie

Table II.
Fitness values of mean expenditure and number of households for each category

	Household category (k) 1	2	3	4
Mean expenditure	15	25	10	50
Number of households				
Zone 1	487	181	451	402
Zone 2	1,515	797	1,017	473
Zone 3	2,438	448	531	60

Table III.
Attractiveness measure of existing/potential sites and competitors, and travel times from the zones to the sites

	Existing/potential sites 1	2	3	4	5	6	7	Competitors 8	9	10	11	12
Attractiveness measure, W_a	98	37	91	81	66	1	42	10	16	15	49	77
Travel time (in minutes) from zones												
Zone 1	42	76	52	40	64	90	8	43	80	47	5	60
Zone 2	24	59	9	48	66	20	50	27	24	13	61	29
Zone 3	58	24	44	13	14	60	48	28	50	51	50	28

The advantages in using GAs are:

(1) they find an optimal or near-optimal site location in reasonable time;

(2) the "goodness" of alternative site networks can be accessed easily;

(3) poor networks can be identified and, therefore, avoided; and

(4) it is relatively easy to solve different formulations of the site location problem.

However, the limitation in using GAs is that the "goodness" of any network is relative to the fitness function used. If an inappropriate fitness function is used, the resulting network may not be as profitable as possible.

Zdroj

- https://www.researchgate.net/publication/235305426_Solving_Marketing_Optimization_Problems_Using_Genetic_Algorithms