Overview

- Objective: to model a competitive advertising situation where a firm gains customers from advertising effort and loses customers to competitors’ advertising efforts and sales decay, leading to a method to determine the best allocation of advertising expenditures if competitors’ customers are identifiable.
- We construct two differential equation models of advertising competition:
  - Nonselective: Firms advertise equally towards all current non-customers.
  - Selective: Firms can allocate different expenditures towards customers of other firms and uncommitted customers.
- Example application: Is it better for a political candidate to advertise more heavily towards supporters of an opponent or undecided voters?

Introduction

- Firms are gaining the capability to discern competitors’ customers from the market share.
- Firms must determine the best way to allocate advertising expenditures.
- Oligopoly setting: small number of firms $k=1,\ldots,n$.
- Basic idea:
  - Change in market share
  - Advertising effectiveness/effort ratio
  - Proportion of market share

Variables

- $s_k(t)$: Sales of firm $k$ at time $t$.
- $c_k(t)$: Market potential at time $t$.
- $u_k(t)$: Effort towards all non-customers.
- $\xi_k(t)$: Effectiveness/effort ratio towards non-customers.
- $\eta_k(t)$: Effort towards competitors’ customers.
- $\xi(t)$: Effectiveness/effort ratio towards competitors’ customers.
- $s_n(t)$: Sales decay rate.

Nonselective Model

- $\Delta s_k(t) = \xi_k(t) c_k(t) (s_k(t) - s_{k+1}(t)) - \eta_k(t) \sum_{j=1}^{k} u_j(t) + \xi k(t) s_n(t)$.
- $\Delta c_k(t) = \eta_k(t) u_k(t) - \xi_k(t) c_k(t) s_n(t)$.

Selective Model

- $\Delta s_k(t) = \xi_k(t) c_k(t) (s_k(t) - s_{k+1}(t)) - \eta_k(t) \sum_{j=1}^{k} u_j(t)$.
- $\Delta c_k(t) = \eta_k(t) u_k(t) + \xi k(t) s_n(t)$.

Select vs. Nonselective

Given a single competitor with a nonselective advertising policy, which allocation of effort will maximize steady state market share?

Maximizing Market Share in a Duopoly

Theorem: When effectiveness/effort ratios and budgets are the same for both firms, the maximum market share for firm $1$ is

$$s_1 = \frac{1}{\xi_1 + \xi_2 + \eta_1} \left( \frac{c_1 + c_2}{\sqrt{1 + \xi_1}} \right) + \eta_1 \sum_{j=1}^{n} \left( \frac{1}{\xi_j} \right) s_j$$

Example: If $c_1 = c_2 = 1$, then $u_1 = 0.48$ maximizes $s_1$ and $s_1 = 0.2942$, $s_2 = 0.3030$.

The selective strategy that maximizes sales rate/market share does not necessarily lead to higher sales than a competitor practicing nonselective advertising.

Under what conditions will a selective advertising policy result in an equilibrium market share larger than a nonselective competitor?

Beating a Nonselective Competitor

Theorem: When effectiveness/effort ratios and cancellation rates are the same for both firms, firm 1 (selective) will have a larger market share than firm 2 (nonselective) whenever

$$\frac{1}{c_1} + \frac{1}{c_2} > 1.$$

Example: If $c_1 = c_2 = 1$, then $u_1 = 0.78$ leads to steady market shares of $s_1 = 0.2870$, $s_2 = 0.2843$.

The curve within the shaded area indicates the value of $u_1$ that maximizes $s_1 > s_2$.

Multi-Tier Product Extension

Scenario: A single firm offers a product/service at $n$ levels or tiers. Let $k = 1,2,\ldots,n$ represent the $n$ tiers of product/service, with $k = 1$ representing the highest tier and $k = n$ the entry-level tier.

Assumptions:
- The customers of each tier are mutually exclusive.
- Profit margins are larger for higher tiers.
- Uniform advertising effort $u(t)$ towards non-customers.
- The firm wishes to prevent downgrades in level, so higher tiers consider customers of lower tiers as potential customers, but not vice-versa.

The dynamics of the market share $s_k$ of tier $k$ are:

$$s_k(t) = \frac{\theta_k c_k(t) (s_k(t) - s_{k+1}(t))}{\sum_{j=1}^{k} \eta_j(t) + \xi_k(t) s_n(t)} + \xi k(t) s_n(t)$$

Example: If your competitors currently hold a 50% share of your non-customers, and your advertising towards the market potential is twice as effective as your advertising towards competitors’ customers ($\theta_1/\theta_2 = 0.5$), then you should allocate 44.7% of your advertising budget towards competitors’ customers and 55.3% towards uncommitted customers.

Three Tiers with Variable Effectiveness

Scenario: A firm offers three tiers of service and the primary advertising mechanism is accomplished through targeted mailings. Existing customers who upgrade their service only do so one level at a time.

Assumptions:
- New customers are more likely to sign up for the lowest-tier service than the middle tier, with the highest tier receiving the fewest new sign-ups.
- Mailings convincing lowest-tier customers to upgrade are generally more effective than those directed towards middle-tier customers.
- All three tiers have the same cancellation rate.

Conclusions and Future Work

- Extended the work in [1] and [2] to allow for differing allocation of effort towards market potential and competitors’ customers.
- Optimal choices of allocation of advertising expenditures depend on sales decay rates and current market share.
- Maximizing your market share may not lead to a greater market share than competitors and vice versa.
- Future work: allow different allocations for multiple competitors, incorporate advertising cost and profit components for tiered products.

References


Acknowledgements

This work supported in part the Undergraduate Research and Creative Activities Program at the College of the College of Charleston.

Contact Information

Email: flethercacg.s.cofc.edu, howellsjc@gmail.com
Web: http://howells.people.cofc.edu