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) × proportion of (market share).

Variables

- \( s(t) \): Sales of firm \( k \) at time \( t \)
- \( r(t) \): Market potential at time \( t \)
- \( u(t) \): Effort towards all non-customers
- \( e_1 \): Effectiveness/effort ratio towards non-customers’ customers
- \( e_2 \): Effectiveness/effort ratio towards competitors’ customers
- \( e_3 \): Effort towards market potential
- \( e_4 \): Effectiveness/effort ratio towards market potential
- \( s_k \): Sales decay rate

Nonselective Model

- \( \dot{s}_k(t) = r(t) e_1 u(t)(1 - s_k(t)) - s_k(t) \sum_{j \neq k} p_j u_j(t) \) for all \( k \neq j \), \( j = 1, \ldots, n \), \( k = 1 \) and \( j = 2 \).
- \( \dot{s}_k(t) = r(t) e_1 u(t)(1 - s_k(t)) - s_k(t) \sum_{j \neq k} p_j u_j(t) \) for all \( k \neq j \), \( j = 1, \ldots, n \), \( k = 1 \) and \( j = 2 \).

Selective Model

- \( \dot{s}_k(t) = r(t) e_1 u(t)(1 - s_k(t)) - s_k(t) \sum_{j \neq k} p_j u_j(t) \) for all \( k \neq j \), \( j = 1, \ldots, n \), \( k = 1 \) and \( j = 2 \).
- \( \dot{s}_k(t) = r(t) e_1 u(t)(1 - s_k(t)) - s_k(t) \sum_{j \neq k} p_j u_j(t) \) for all \( k \neq j \), \( j = 1, \ldots, n \), \( k = 1 \) and \( j = 2 \).

Selective 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

\[
x_1 = \frac{1}{2} \sqrt{e_1 + e_2 + 2u_1 + u_2} - \frac{1}{2} \sqrt{e_1 + e_2 + 2u_1 + u_2} - \frac{1}{2} \sqrt{e_1 - e_2 - 2u_1 - u_2}.
\]

Example: If \( e_1 = e_2 = 1 \), then \( u_1 = 0.48 \) maximizes \( s_1 \) and \( s_1 = 0.2942, \ x_2 = 0.3030 \).

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?

Beat a Nonselective Competitor

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

\[
\sqrt{1 - S_k^2 (2c + 2a_1 + v)^2 + \sqrt{S_k (1 - c)}} > 1.0.
\]

Example: If \( e_1 = e_2 = 1 \), then \( u_1 = 0.78 \) leads to steady market shares of \( s_1 = 0.2870, \ x_2 = 0.2843 \).

The curve within the shaded area indicates the value of \( u_1 \) that maximizes \( s_1 = x_2 \).

Multi-Tier Product Extension

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 fee.
- Mailings convince lowest-tier customers to upgrade are generally more effective than those directed towards middle-tier customers.
- All three tiers have the same cancellation rate.

Three Tiers with Variable Effectiveness

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- Mailings convince lowest-tier customers to upgrade are generally more effective than those directed towards middle-tier customers.
- All three tiers have the same cancellation rate.

Maximizing Rate of Increase of Sales/Market Share

Theorem: Let \( N \) represent the proportion of the market you do not hold and \( X \) represent the proportion of \( N \) that competitors hold. To maximize your current rate of increase of market share, the advertising effort \( u_1 \) satisfying

\[
u_1 = \frac{N - X}{\sqrt{(1 - X)^2 + p_1 X^2}}.
\]

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 (\( p_1/\sigma = 0.5 \)), then you should allocate 44.7% of your advertising budget towards competitors’ customers and 55.3% towards uncommitted customers.

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


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