Revenue Management With Product Retirements And Customer Selection

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Motivation

IBM servers: largely sold B2B

To maximize revenue, sellers must decide when to stop selling products.

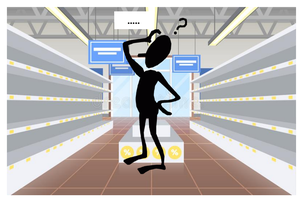
In B2B businesses, a majority of the sales come from proactively promoting products to potential customers.

Questions:

What customers to visit? In what order?
And when to stop offering a particular product to the customers?

The Trade-Off

Low revenue products cannibalize sales of high revenue products if not retired



Cannot retire too early due to limited inventories

Model

Products: price r_i, initial inventory c_i

Customer Types: b_j customers of each type

Choice Model: Multinomial Logit (MNL)

MNL Choice Model

Probability of purchase — Attractiveness of product

$$\pi_i(S) = \frac{u_i}{1 + \sum_{k \in S} u_k}$$

Products available

Contributions

Simple policies using **static retirement times** with provable performance guarantees in the settings with a **single customer type** and **multiple customer types.**

Single Customer Type

$$\begin{aligned} z_1^* := \max_{q_i} \quad & \sum_{i=1}^{n} r_i q_i \\ \text{s.t.} \quad & \sum_{i=1}^{n} q_i + q_0 = T, \\ & q_i \le c_i, \\ & q_i \le u_i q_0 \\ & q_i \ge 0. \end{aligned}$$

LP relaxation upper bound: Single MNL customer type

Policy (ALG1)

Key Idea: Linear program is a fluid deterministic relaxation which also retires products

Step 1: Compute optimal solution to the linear program

Step 2: Retire products at the same time that the LP would have

Theorem

For any $\epsilon \in (0,1)$, for large enough time horizon T and inventories c_i, $\mathbb{E}[ALG1] \geq (1 - \epsilon) z_1^*$.

Multiple Customer Types

$$\begin{aligned} z_2^* := \max_{q_i^j} \quad & \sum_{j=1}^{m} \sum_{i=1}^{n} r_i q_i^j \\ \text{s.t.} \quad & \sum_{j=1}^{m} \sum_{i=1}^{n} q_i^j + q_0^j = T, \\ & \sum_{i=1}^{n} q_i^j + q_0^j \le b_j, \\ & \sum_{j=1}^{m} q_i^j \le c_i, \\ & q_i^j \le u_i^j q_0^j \\ & q_i^j \ge 0. \end{aligned}$$

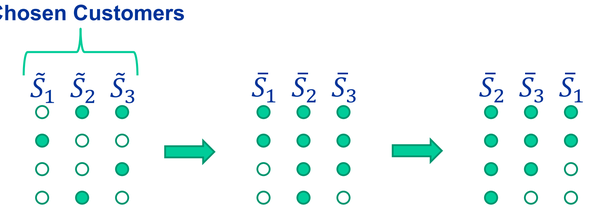
LP relaxation upper bound: multiple MNL customer types

Policy (ALG2)

Step 1: Customer Selection

Construct feasible solution to LP relaxation by choosing customers and assortments greedily

Chosen Customers



Step 2: Customer Sequencing

- Fill all "holes" in assortments chosen in Step 1
- Sequence customers in decreasing order of size of assortments

Theorem

$ALG2$ has a $\left(\frac{1}{4} - \epsilon\right)$ - factor performance guarantee for multiple customer types.