Microsoft

Modern Supply Chain Management & Price Optimization

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Agenda

- **What is Supply Chain Management?**
- **Modern SCM (Harvard Business Review Article)**
- **Microsoft SCM Offerings**
- **What is price optimization**
- **Demo:**
  - Price elasticity – regression models
  - Price optimization – LP solver

Supply Chain Management

- **Supply-chain management has been defined as the supply-chain activities of**
  - design,
  - planning, n 1982, , a consultant at introduced the term "supply chain management" to the public domain in an interview for the .
  - execution,
  - control, and monitoring
- **with the objective of**
  - creating net value,
  - building a competitive infrastructure,
  - leveraging worldwide logistics,
  - synchronizing supply with demand and
  - measuring performance globally.
- **In 1982, Keith Oliver, a consultant at Booz Allen Hamilton introduced the term "supply chain management" to the public domain in an interview for the Financial Times.**

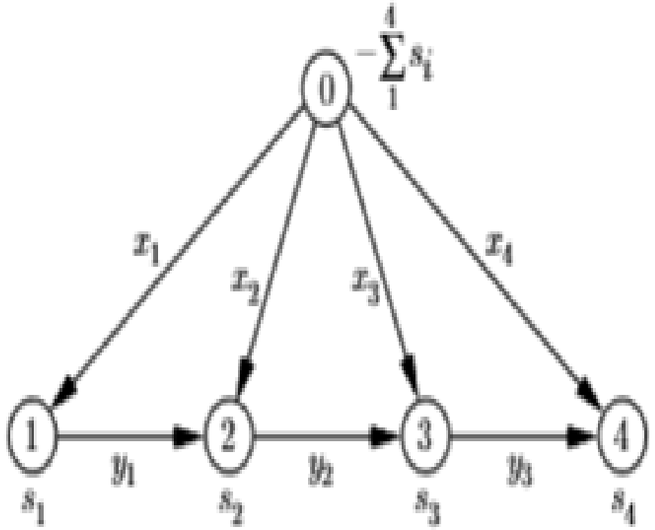
Supply Chain Management – What we learned in school

- Let x, y, and s be respectively the production, end-of-period inventory, and given demand for a single product in period i. Let c and h be respectively the costs of producing and storing x units of the product in period. We minimize

$$C(x,y) \equiv \sum_{1}^{n} [c_i(x_i) + h_i(y_i)]$$

$$x_i + y_{i-1} - y_i = s_i, i = 1, \ldots, n$$

- what products to make and what their designs should be;
- how much, when, where and from whom to buy product;
- how much, when and where to produce product;
- how much and when to ship from one facility to another;
- how much, when and where to store product;
- how much, when and where to charge for products; and
- how much, when and where to provide facility capacity.



Modern Supply Chain Management

- With a digital foundation in place, companies can capture, analyze, integrate, easily access, and interpret high quality, real-time data — data that fuels process automation, predictive analytics, artificial intelligence, and robotics, the technologies that will soon take over supply chain management.

Microsoft SCM Offerings

- https://docs.microsoft.com/en-us/dynamics365/unified-operations/supply-chain/
  - Cost accounting
  - Cost management
  - Inventory management
  - Master planning
  - Procurement and sourcing
  - Product information management
  - Production control
  - Sales and marketing
  - Service management
  - Transportation management
  - Warehouse management

Microsoft SCM Offerings – ML&AI Showcases

- **Sales Lead Scoring - Jan 30, 2019:**
  - https://www.microsoft.com/itshowcase/Article/Content/1091/Microsoft-increases-sales-by-using-AI-for-lead-qualification
- **Finance Forecasting - 2017:**
  - https://www.microsoft.com/itshowcase/blog/financial-forecasting-gets-machine-learning-boost/
- **Predictive Analytics for Sales Processes - 2016:**
  - https://www.microsoft.com/itshowcase/Article/Content/847/Using-predictive-analytics-to-improve-sales-processes-and-forecasting

What is the Price Optimization?

The Bayesian-Optimal Pricing Model

Assumptions:

- Single item and single buyer and wants to pay NO MORE than p.
- The cumulative distribution function F (p) is the probability that the buyer pay.
- Also existed function f (p) = F ′ (p) is the probability density function.

The seller's expected revenue is:

$$R(p) = p \cdot [1 - F(p)]$$

The seller would like to maximize R(p). Per the first-order condition, the optimal price is at dR(p)/dp = 0, thus

$$p^* = [1 - F(p^*)] / f(p^*)$$

What is the Price Optimization - Example

The Bayesian-Optima Price Model

The seller would like to maximize R(p). Per the first-order condition, the optimal price is at dR(p)/dp = 0, thus

$$p* = [\, 1 - F\,(\, p* \,)\,] \,/\, f\,(\, p* \,)$$

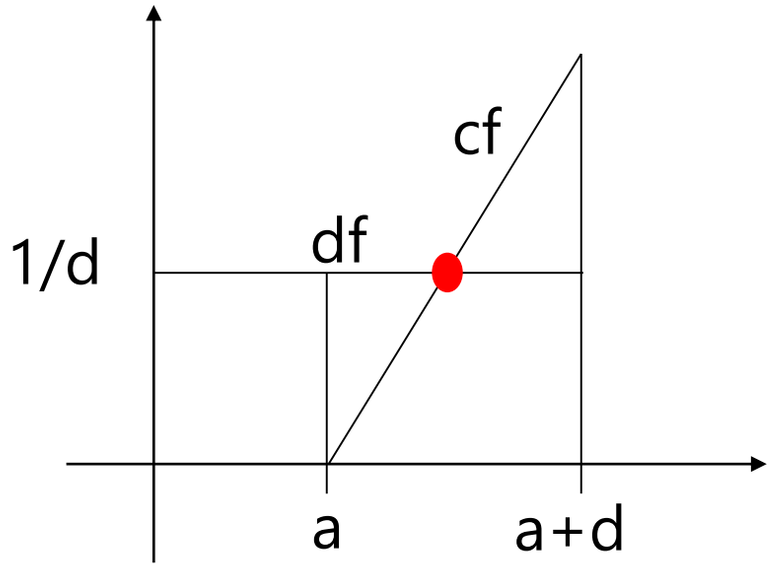
For example, if the probability distribution of the buyer's valuation is uniform in [a , a + d], then

F (v) = (v − a) / d and f (v) = 1 / d.

The first-order condition is

p∗ = (a + d − p∗), which implies

$$p* = (\, a + d \,) \,/\, 2$$



Demo

Modeling Price Elasticity - Part 1: Own-Price-Elasticity
Modeling Price Elasticity - Part 2: Cross-Price-Elasticity
Modeling Price Elasticity - Part 3: Price Elasticity with Combo and External Factors
Modeling Price Elasticity – Part 4: Price Optimizations

What is the Price Elasticity & Optimization?

Price elasticity of demand (PED or E_d) is the rate of change in quantity demanded in response to the rate of change in price.

$$E_d = d\ Q_d / dP$$

Demo 1 (own price):

Establish a linear model ln(S) = a Ln(P) + B

The price elasticity at price point p1 can be calculated as

Ed(p1) = lim (q2-q1) / (p2 – p1)

Demo 2 (cross price): Two products may impact each other's sale

Establish a linear model ln(S) = a Ln(P1) + a Ln(P2) + B

$E_{di} = \Sigma\ \partial Q_{dj} / \partial P_{dj}$, here j=1, .., n

Demo 3: Price Elasticity with Combo and External Factors

Demo 4 Optimize the price

Predictive problem: y^=f(x^). Optimization problem: Y*=f(x*)

In LP problem, R code to use LPSolveAPI to resolve LP