

Marketing Mix Optimization

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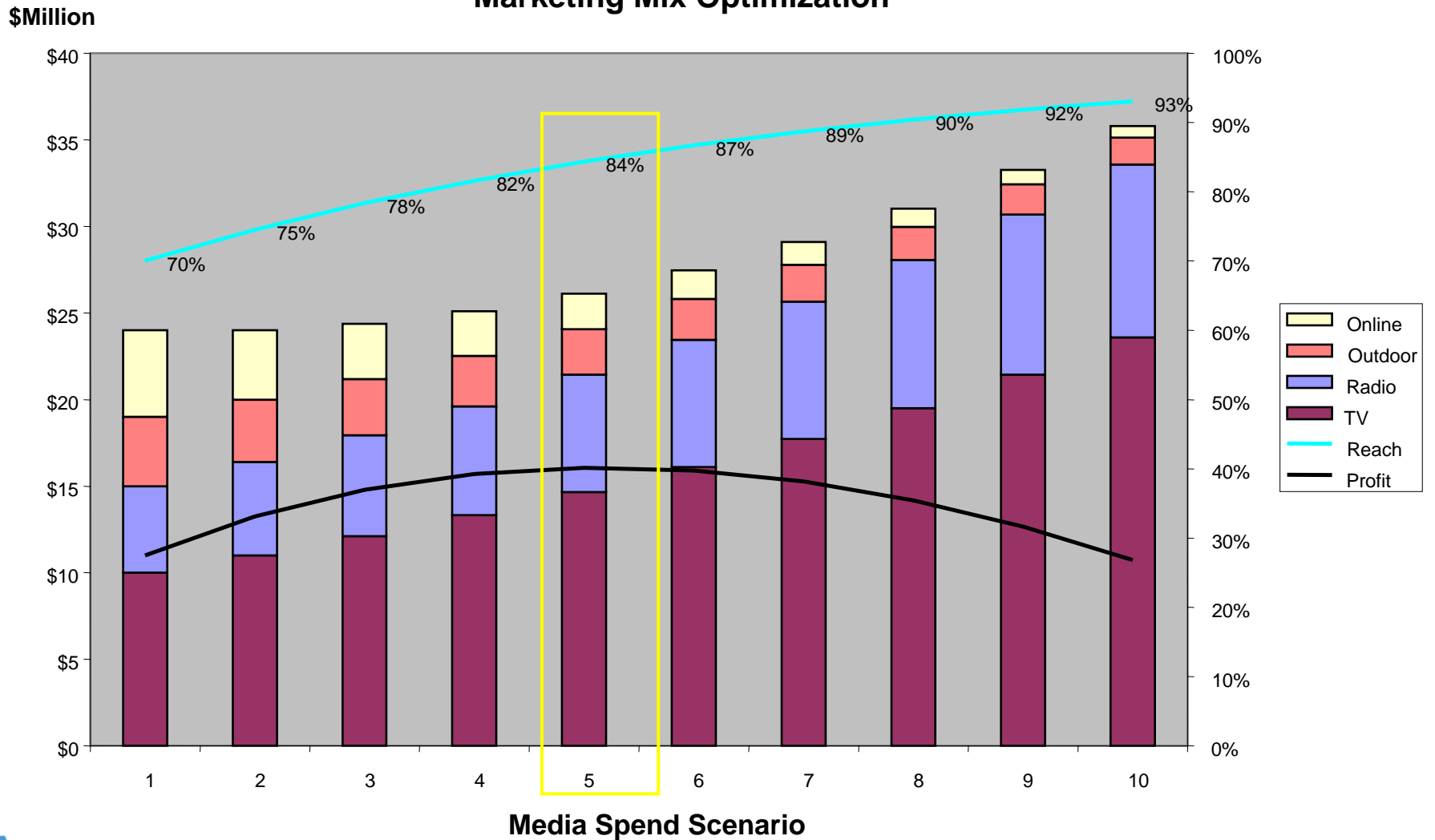
Marketing Mix Optimization

- ☞ *Marketing Mix Optimization* (MMO) refers to the process of generating a set of pricing, packaging, advertising, merchandising, distribution and marketing budget schedule that best achieves a set of marketing goals.
- ☞ Focus of MMO for most retailers is to determine a *pricing* scheme, an *advertisement* schedule and an advertisement *budget* that maximizes revenue or profit while satisfying certain *business rules*.



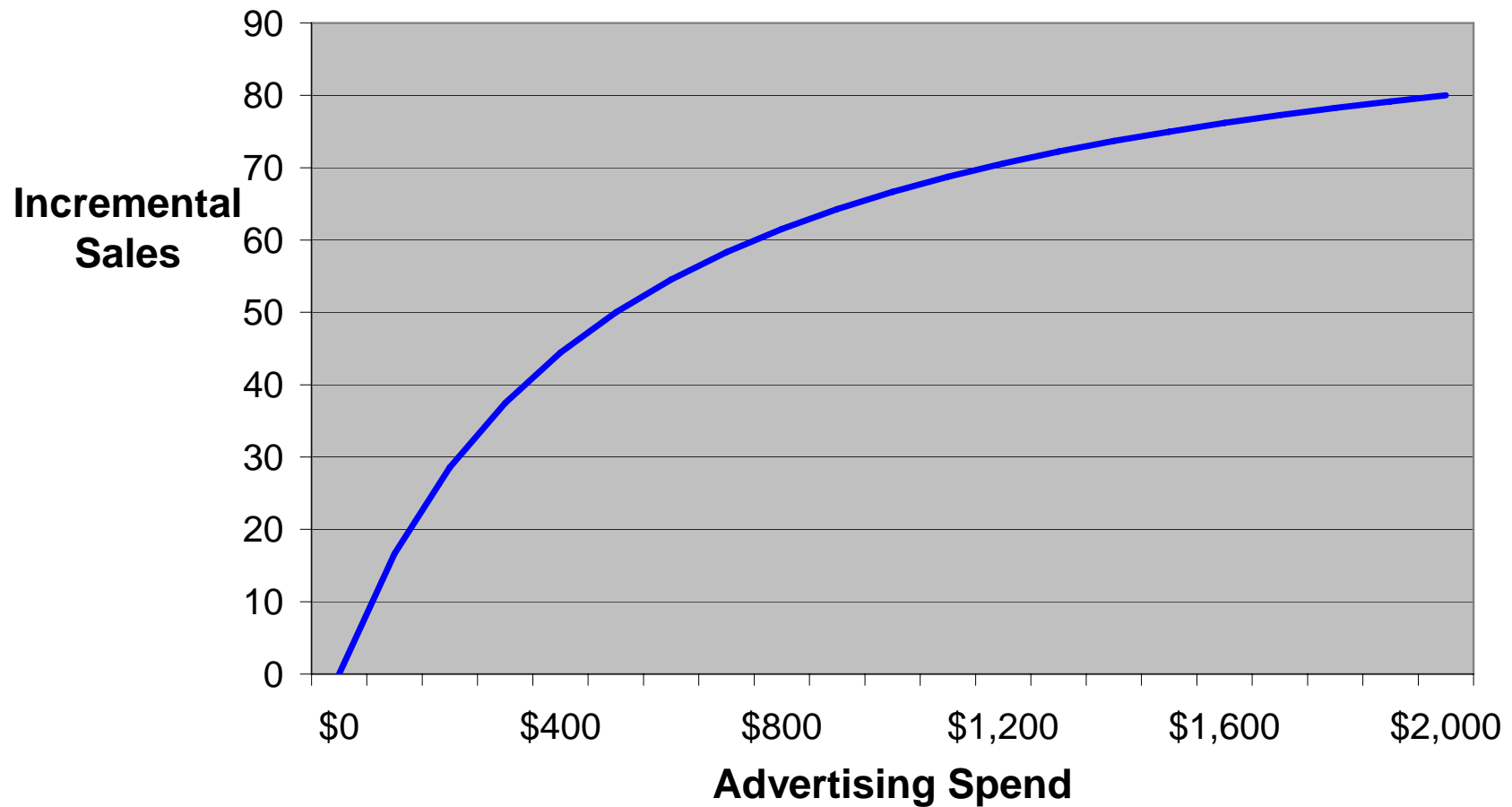
Optimal Spending by Media

Marketing Mix Optimization



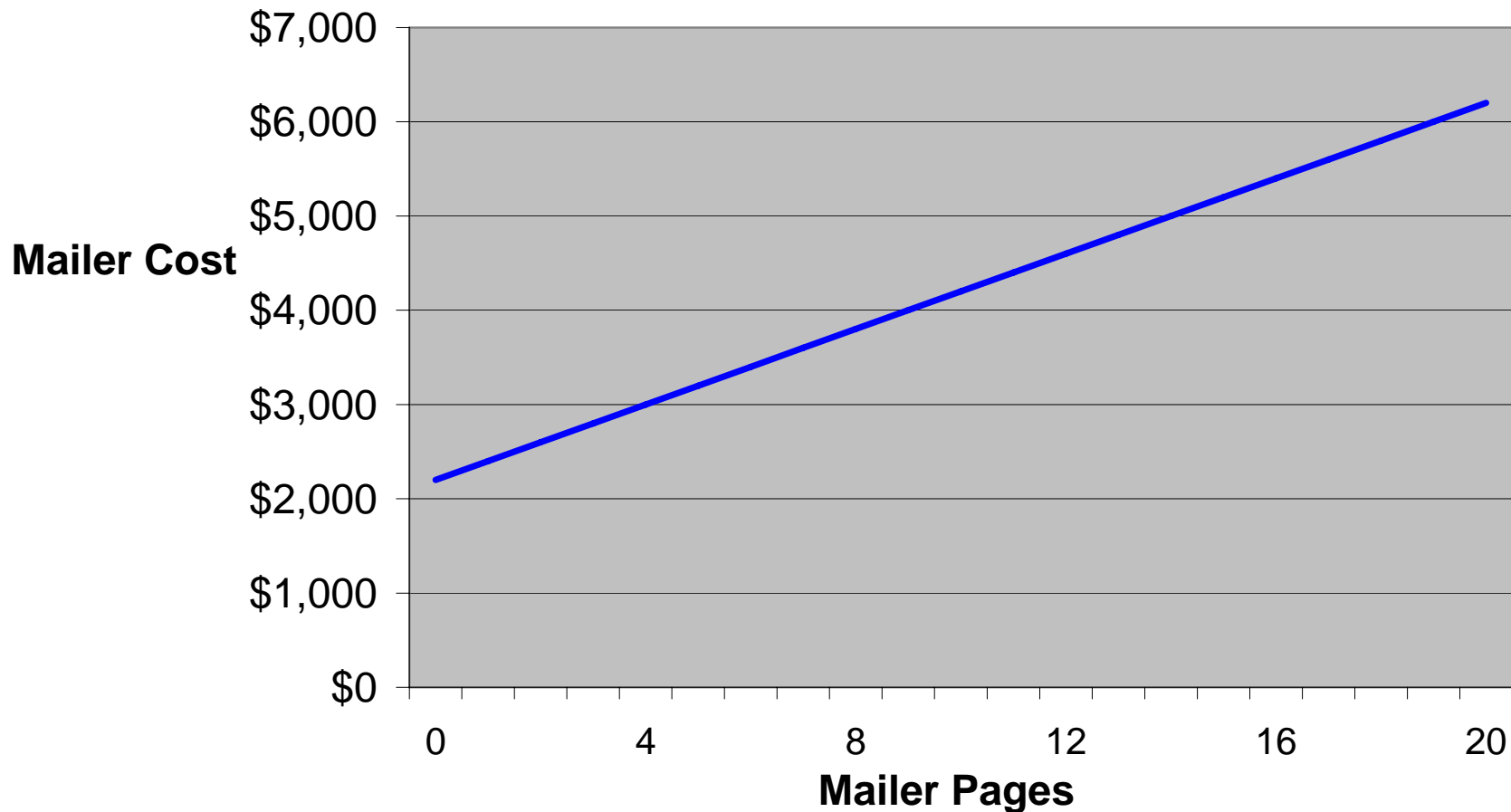
Diminishing Marginal Returns

Incremental Sales from Advertising



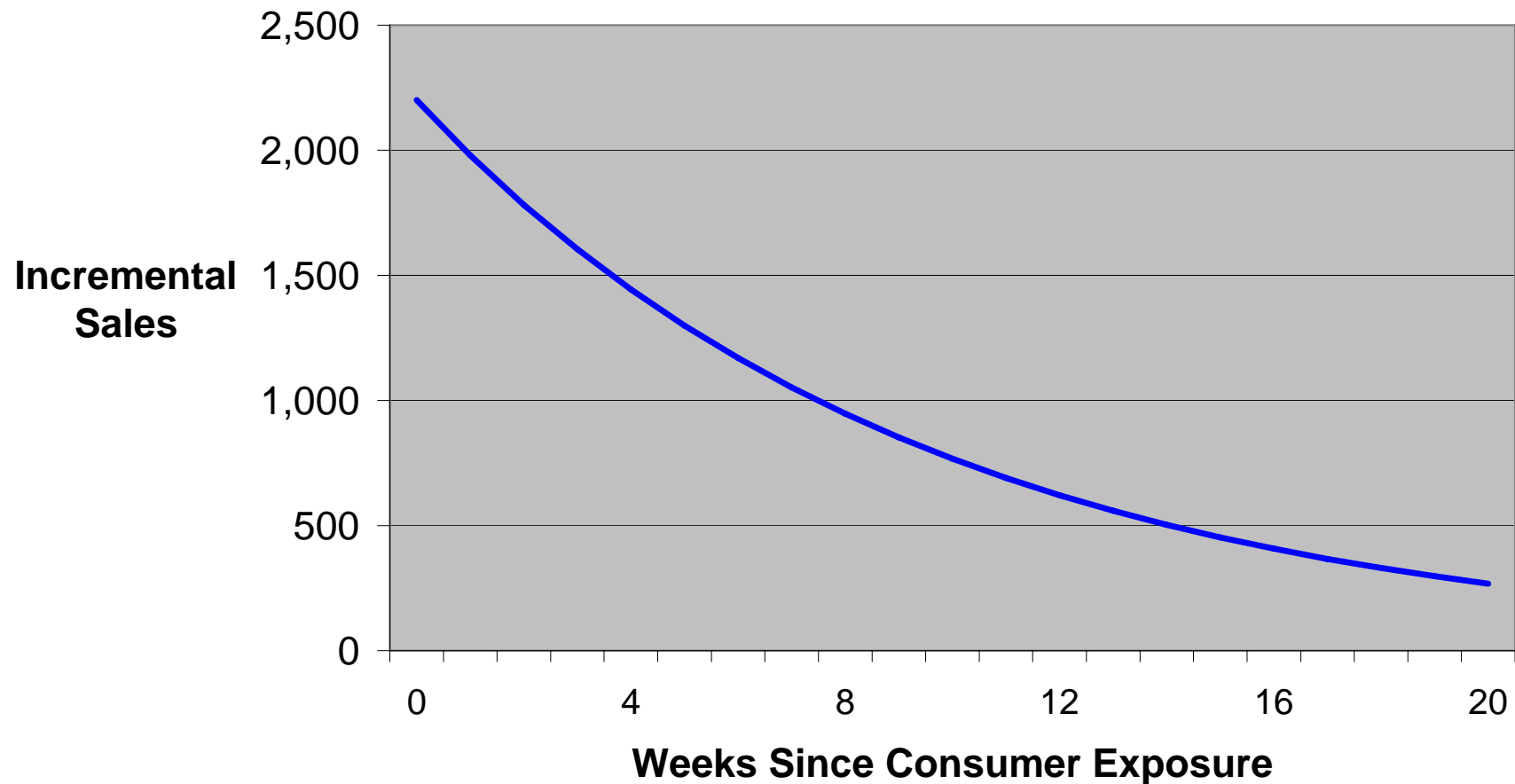
Some Advertising Has Fixed Costs

Total Cost of Mailer Vs. Mailer Pages



Advertising Has Effect Over Time

Incremental Sales from Advertising Over Time



Advertising Can Create Cross-Selling

Advertise



Sell



Advertising Can Have “Halo” Effect

Advertise



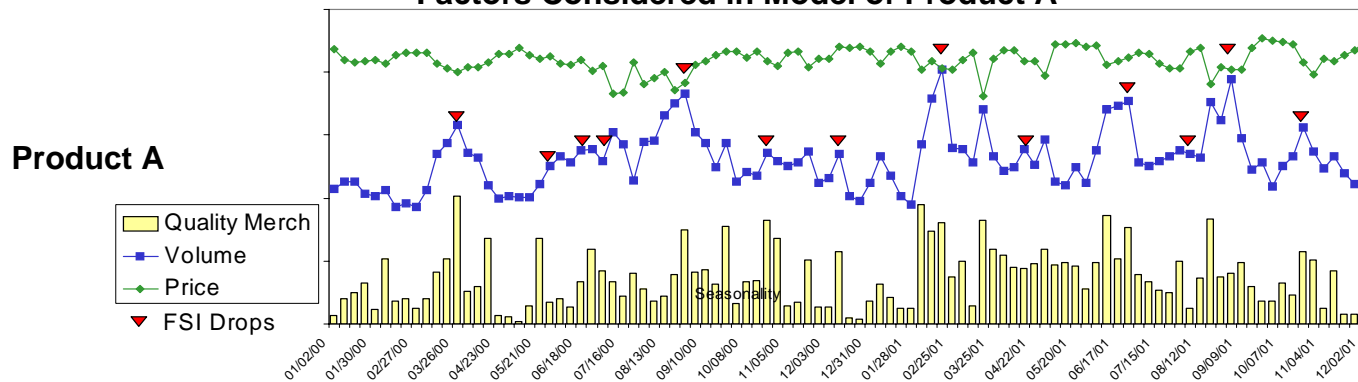
Sell



Marketing Mix Optimization: Statistics

Marketing Mix Regression / Bayesian Model

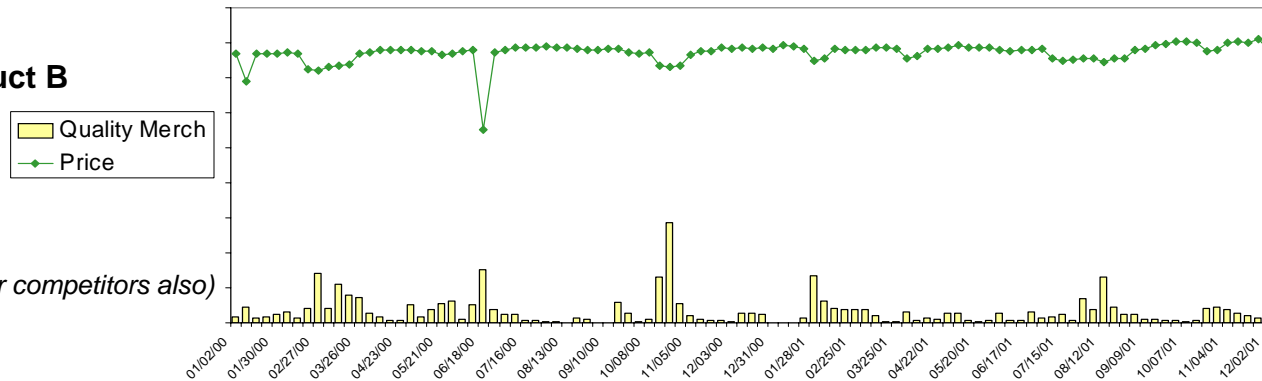
Factors Considered in Model of Product A



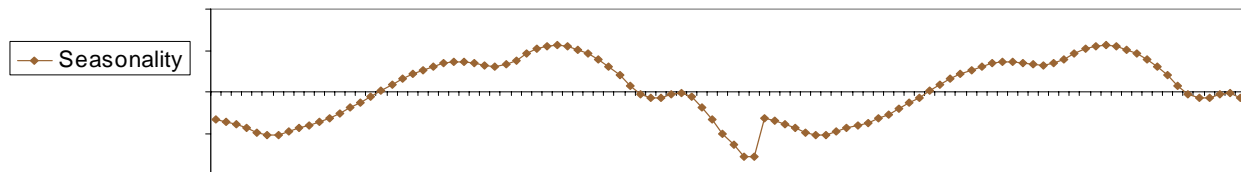
Variables in Product A
StoreGroup Price Model

*Own Price
Own Features
Own Displays
Own FSIs*

Product B



*Competitive Price
Competitive Features
Competitive Displays*

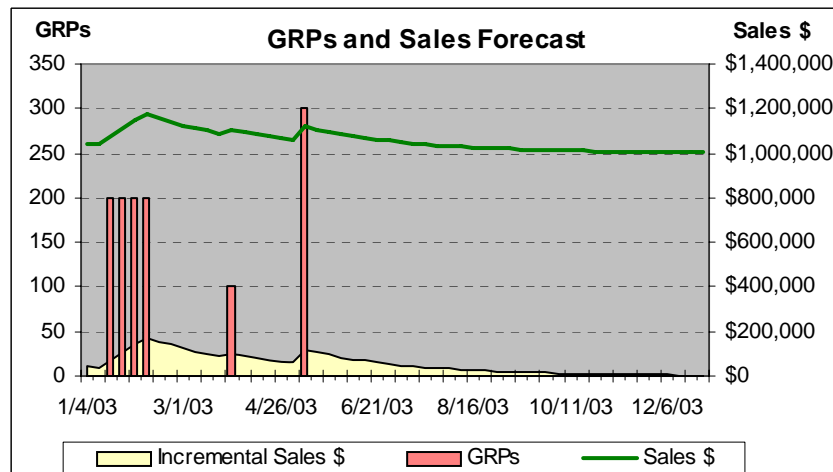
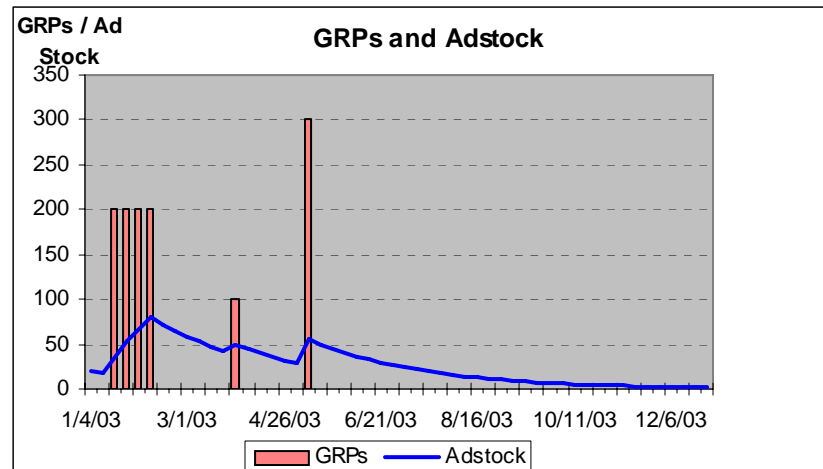


*Seasonality
Holidays
Trend*



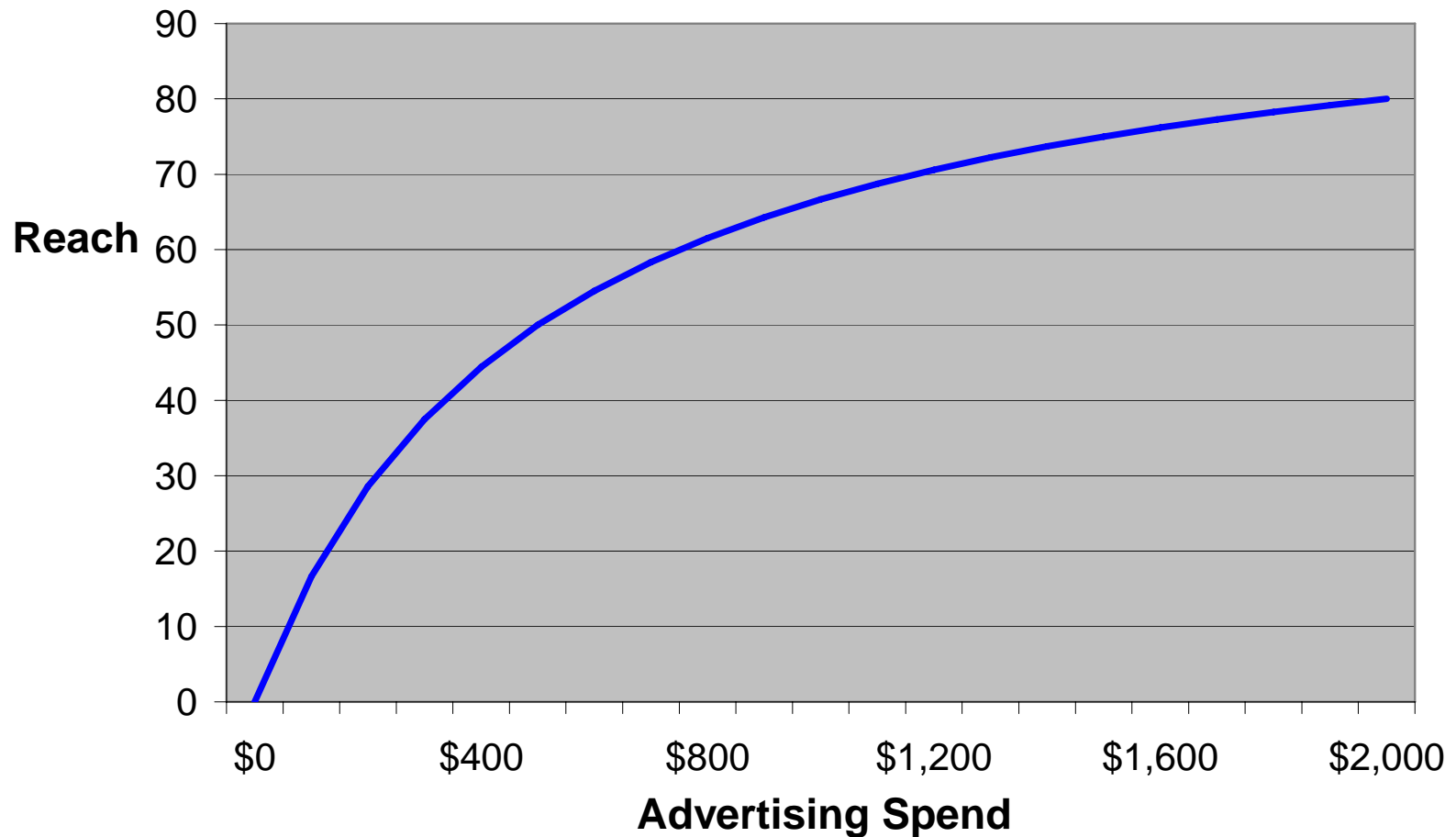
Marketing Mix Optimization: Statistics

Adstock in Marketing Mix Regression



Marketing Mix Optimization: Statistics

Reach or Percent of Audience Seeing Ad Once



Marketing Mix Optimization: Statistics

Diminishing Marginal Returns



**Reach Curves (Regression)
On Household Sample TV Meter Data**

Fixed Costs



**Cost Model (Regression)
On Actual Aggregate Cost Data**

**Sales Effect Over Time
(All Marketing)**



**Bayesian Regression With Adstock
On Store+ Level Data**

Cross Selling



**Market Basket Analysis
On Transaction Data**

Halo Effects



**Bayesian Regression With Adstock
On Store+ Level Data**

Exogenous Base Sales Forecast



**ARIMA on “Baselined” (Smoothed
Depromoted) Sales**

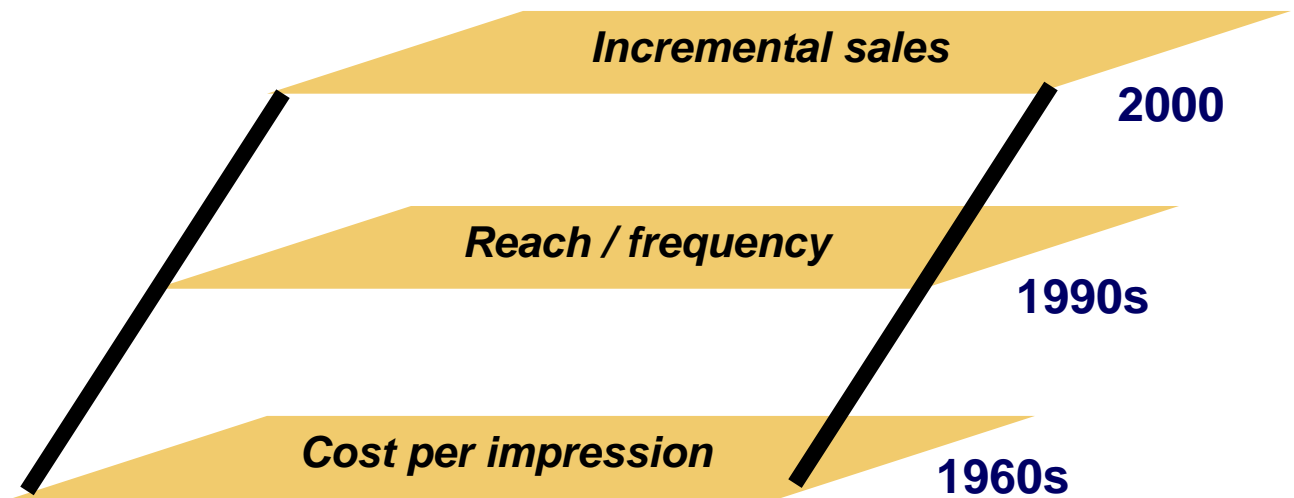
Cost Forecast



Management Judgement

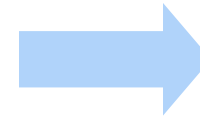


Advertising Optimization Objectives



Integrating 1990s and 2000 Advertising Optimization Objectives

What it Takes to Have Effective Advertising



- 1) You want a big market segment
- 2) They have to see the ad
- 3) They have to respond to the ad

Our approach for integrating media planning (reach) and marketing mix (sales response) optimization is based on this simple fact: you have to see an ad to respond to it



Elements of Retail MMO

☞ Pricing Scheme

Using price elasticity of demand, determine a discount on MSRP for each product in each week.

☞ Advertisement Schedule

Using advertisement elasticity of demand, determine an advertisement schedule for each product/business in each week.

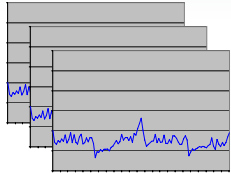
☞ Advertisement Budget

The amount of advertising resources available for use in the MMO. It is a common practice to perform a sensitivity analysis of revenue/profit with respect to the budget.

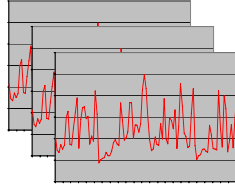


The MMO Process

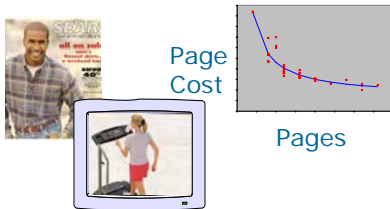
Baselines



Lift Models



Ad Costs



Product Information

Optimization



- *Allocate Print Pages*
- *Set Broadcast Support*
- *Set Promoted Prices*
- *...so as to Maximize Expected Revenue/Profit*

Optimized Marketing Plan

Print



Broadcast

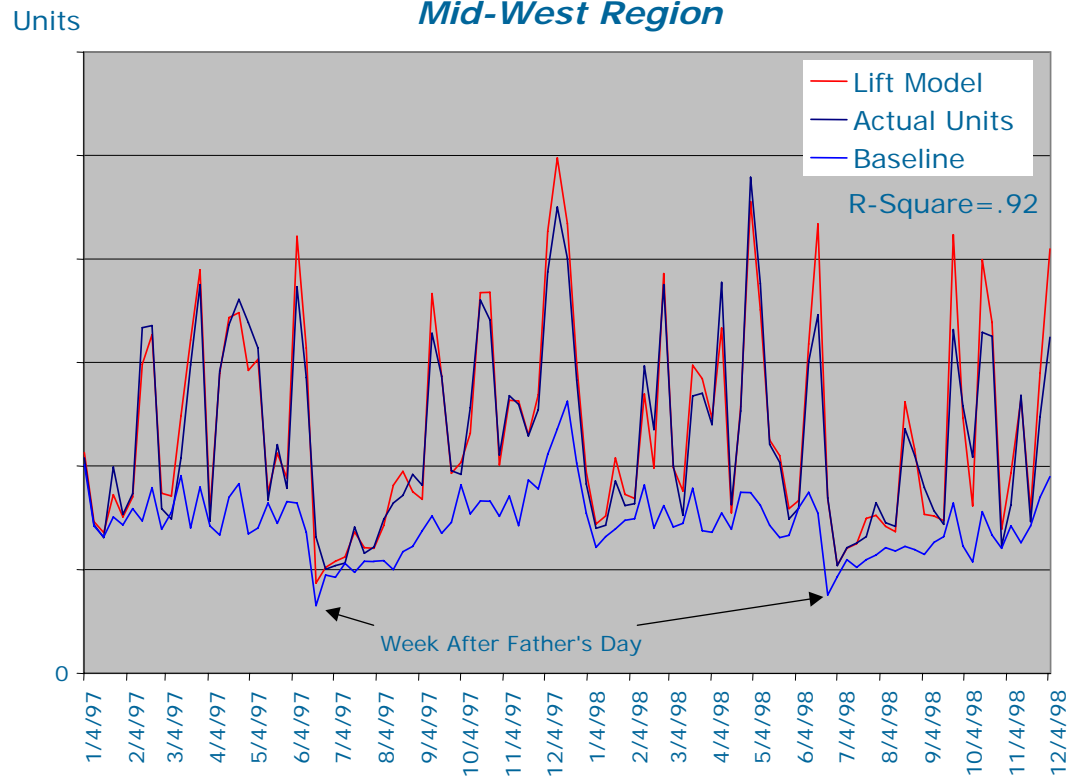


Promotions



Baselines and Lift Models

Product 123-883762 (Men's Dress Shirt)
Mid-West Region



Factors Considered in Model

Lift Model \Rightarrow Incremental Sales

- Discount Depth
- Print Space
- Promotional TV

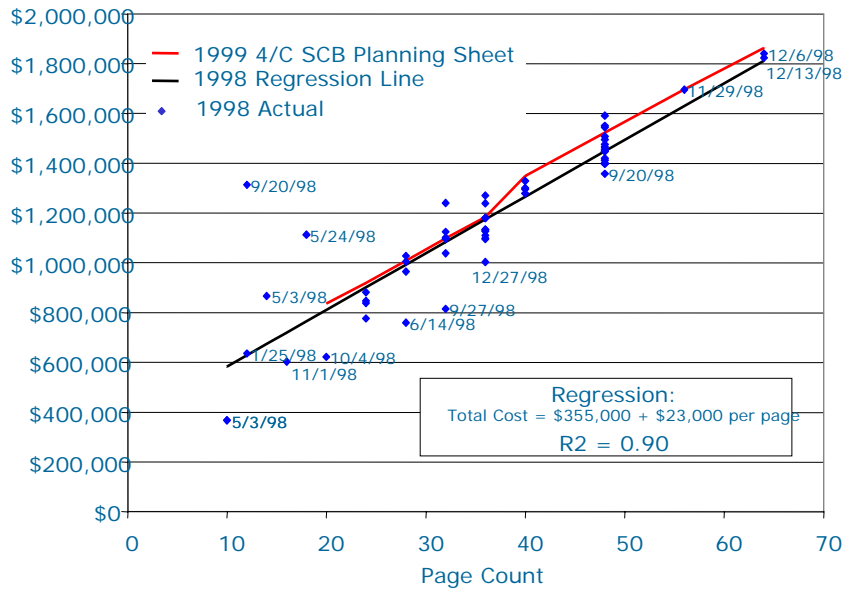
Baseline \Rightarrow Base Sales

- Sales rate when not promoted
- Sales rate that week for non-promoted items in line/division

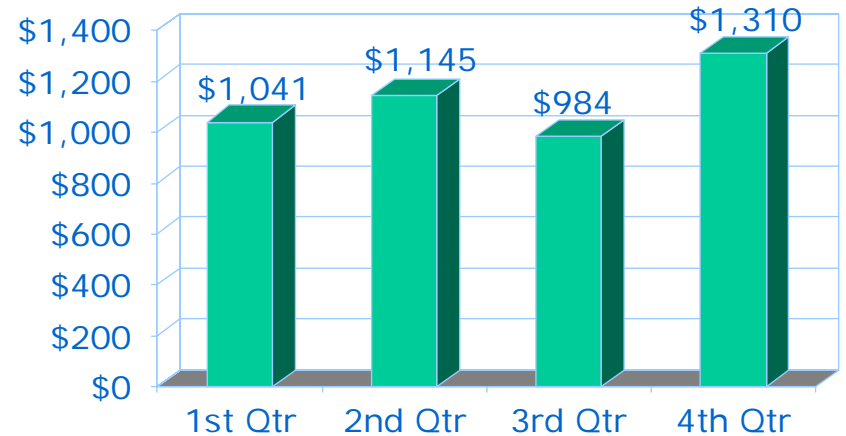


Cost Estimation

Total Cost of Drop

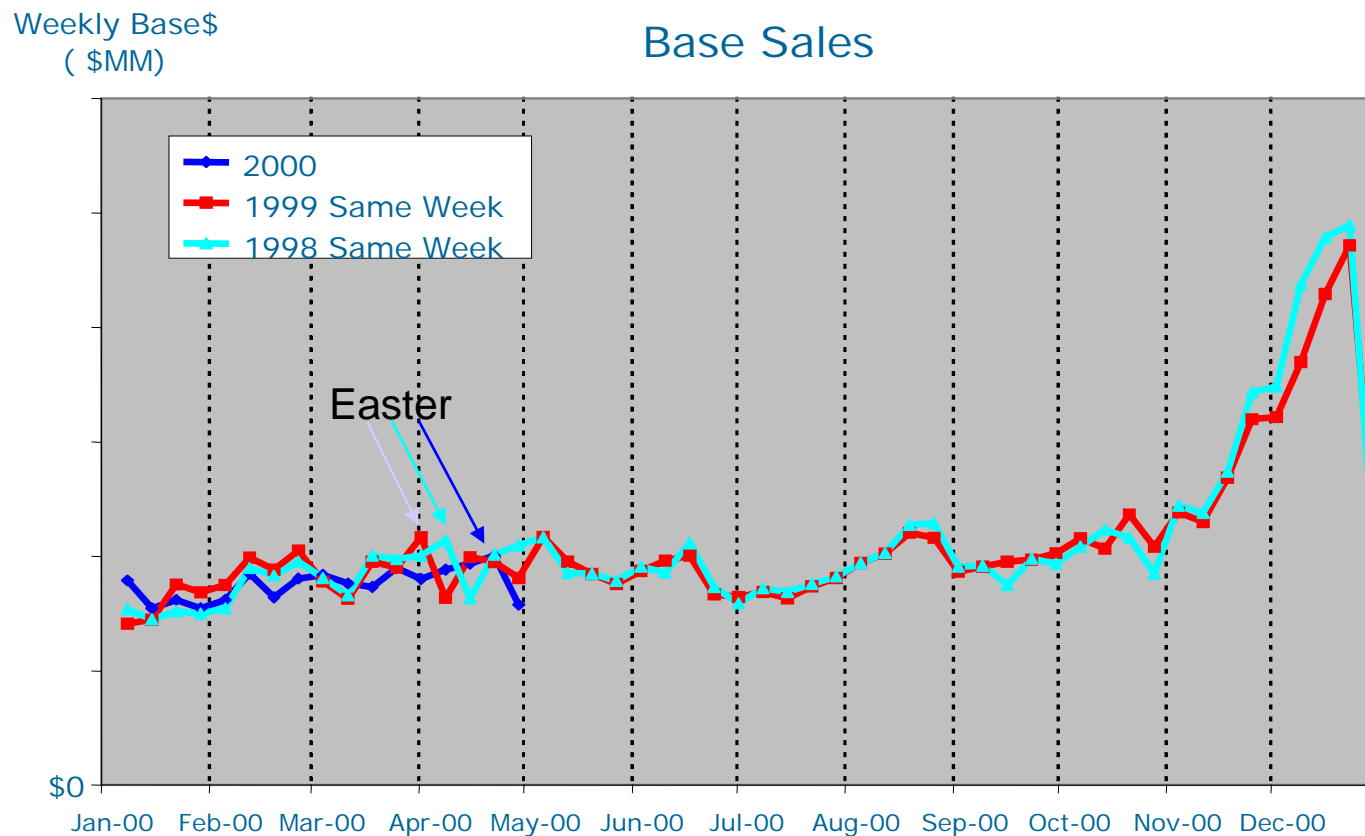


2001 C1 TV Cost Per GRP



Optimization Strategy

A fundamental strategy of the optimization is to time advertising with seasonality (i.e. base volume) in an effort to get a big share of the pie when the pie is biggest



Decision Variables

d_{iw} - % discount on product $i \in I$ on week $w \in W$

x_{ajw} - amount of ad $a \in P \cup B$ for business $j \in J$
on week $w \in W$

y_{aw} - binary variable indicating the use of ad
 $a \in P \cup B$ on week $w \in W$

where

W - the set of weeks

P - the set of promotional advertisements

B - the set of branding advertisements

J - the set of businesses

I - the set of products



Inputs

u_{iw} - estimated *base units* of demand for product $i \in I$ in week $w \in W$

p_{iw} - estimated *base unit price* of product $i \in I$ in week $w \in W$

c_{iw} - estimated *unit cost* of product $i \in I$ in week $w \in W$

ε_{iw} - estimated *price elasticity* of demand on product $i \in I$ in week $w \in W$

β_{aiw} - estimated *ad elasticity* of demand (due to ad $a \in P \cup B$) on product $i \in I$ in week $w \in W$

Note :

1. Estimating u_{iw} , p_{iw} and c_{iw} is by itself an interesting and difficult problem.
2. Elasticities ε_{iw} and β_{aiw} are produced with Marketing Analytics' Coefficient Generator™ using a Bayesian shrinkage method.



More Inputs

h_{mn} - estimated units of product $n \in I$ sold whenever one unit of product $m \in I$ is sold [*Halo Effect*]

s_{aw} - estimated *setup cost* for ad $a \in A$ in week $w \in W$

v_{aw} - estimated *unit incremental cost* for ad $a \in A$ in week $w \in W$

t_{ji} - indicates whether or not business $j \in J$ includes product $i \in I$
[*Product Table*]

α_a - estimated *decay parameter* for branding ad $a \in B$

R - estimated *advertisement budget*

$F_{aw}(\cdot)$ - effective advertisement functional transform; maps print ad pages to *effective pages*, electronic ad GRPs to *reach points*



Goals / Objectives

Revenue :

$$\sum_{\substack{i \in I \\ w \in W}} p_{iw} (1 - d_{iw}) \left(u_{iw} + \sum_{m \in I} g_{mi} u_{mw} \left(\begin{array}{l} 100 \varepsilon_{mw} d_{mw} + \sum_{\substack{a \in P \\ j \in J}} \beta_{amw} t_{jm} F_{aw}(x_{ajw}) \\ + \sum_{\substack{a \in B \\ j \in J \\ k \in W}} (1 - \alpha_a)^{((k-w) \bmod |W|)} \beta_{aiw} t_{jm} F_{aw}(x_{ajw}) \end{array} \right) \right)$$

where

$$g_{mi} = \begin{cases} 1, & \text{if } m = i, \\ h_{mi}, & \text{otherwise.} \end{cases}$$



More Goals / Objectives

Profit :

$$\sum_{\substack{i \in I \\ w \in W}} (p_{iw}(1 - d_{iw}) - c_{iw}) \left(u_{iw} + \sum_{m \in I} g_{mi} u_{mw} \left(\begin{array}{l} 100\varepsilon_{mw} d_{mw} + \sum_{\substack{a \in P \\ j \in J}} \beta_{amw} t_{jm} F_{aw}(x_{ajw}) \\ + \sum_{\substack{a \in B \\ j \in J \\ k \in W}} (1 - \alpha_a)^{((k-w) \bmod |W|)} \beta_{aiw} t_{jm} F_{aw}(x_{ajw}) \end{array} \right) \right)$$

Net Profit :

$$\text{Profit} - \left(\sum_{\substack{a \in P \cup B \\ w \in W}} s_{aw} y_{aw} + \sum_{\substack{a \in P \cup B \\ w \in W \\ j \in J}} v_{aw} x_{ajw} \right)$$



Business Rules

- ☞ Capture business insights not otherwise modeled in the MMO
- ☞ Make MMO results more realistic to be implement
- ☞ Examples include:
 - o Limits on discount percentage
 - o Limits on discounted price
 - o Limits on deviation from historical advertisement schedule
 - o Limits on the number of businesses/products per ad type per week
 - o Limits on the sizes of advertisements each week



The MMO Model

Maximize *Revenue or Profit or NetProfit,*

subject to *specified business rules,*

$$\sum_{\substack{a \in P \cup B \\ w \in W}} s_{aw} y_{aw} + \sum_{\substack{a \in P \cup B \\ w \in W \\ j \in J}} v_{aw} x_{ajw} \leq R,$$

$$x_{ajw} \leq y_{aw} x_{ajw}, \quad \text{for all } a \in P \cup B, j \in J, w \in W,$$

$$0 \leq d_{iw} \leq 1, \quad \text{for all } i \in I, w \in W,$$

$$x_{ajw} \geq 0, \quad \text{for all } a \in P \cup B, j \in J, w \in W,$$

$$y_{aw} \in \{0, 1\}, \quad \text{for all } a \in P \cup B, w \in W.$$



Characteristics of the MMO Model

- ❑ Nonlinear objective function.
- ❑ Continuous and integer/binary variables.
- ❑ Linear and nonlinear constraints
- ❑ Large scale MINLP: smallest instance has ~400,000 variables (~1,000 integer) and ~500,000 constraints. Not easy to solve!
- ❑ Piecewise linear approximation of the convex $F_{aw}(\cdot)$ leads to a more manageable MIQP.



Numerical Example

☞ Problem Information:

- 300 products
- 326 business groups
- 52 weeks
- 15 advertisement vehicles
- 5 business rules

☞ Reformulated Model has:

- ~600,000 variables (~1,000 integer)
- ~1,200,000 constraints (all linear)
- quadratic objective function



Numerical Results

Max Revenue (MM\$)	Plan	Optimal	Change
Revenue	5312	5710	8%
Profit	2567	2695	5%
Net Profit	2402	2530	5%
Ad Cost	165	165	0%

Max NetProfit (MM\$)	Plan	Optimal	Change
Revenue	5312	5645	6%
Profit	2567	2811	9%
Net Profit	2402	2654	10%
Ad Cost	165	157	-12%



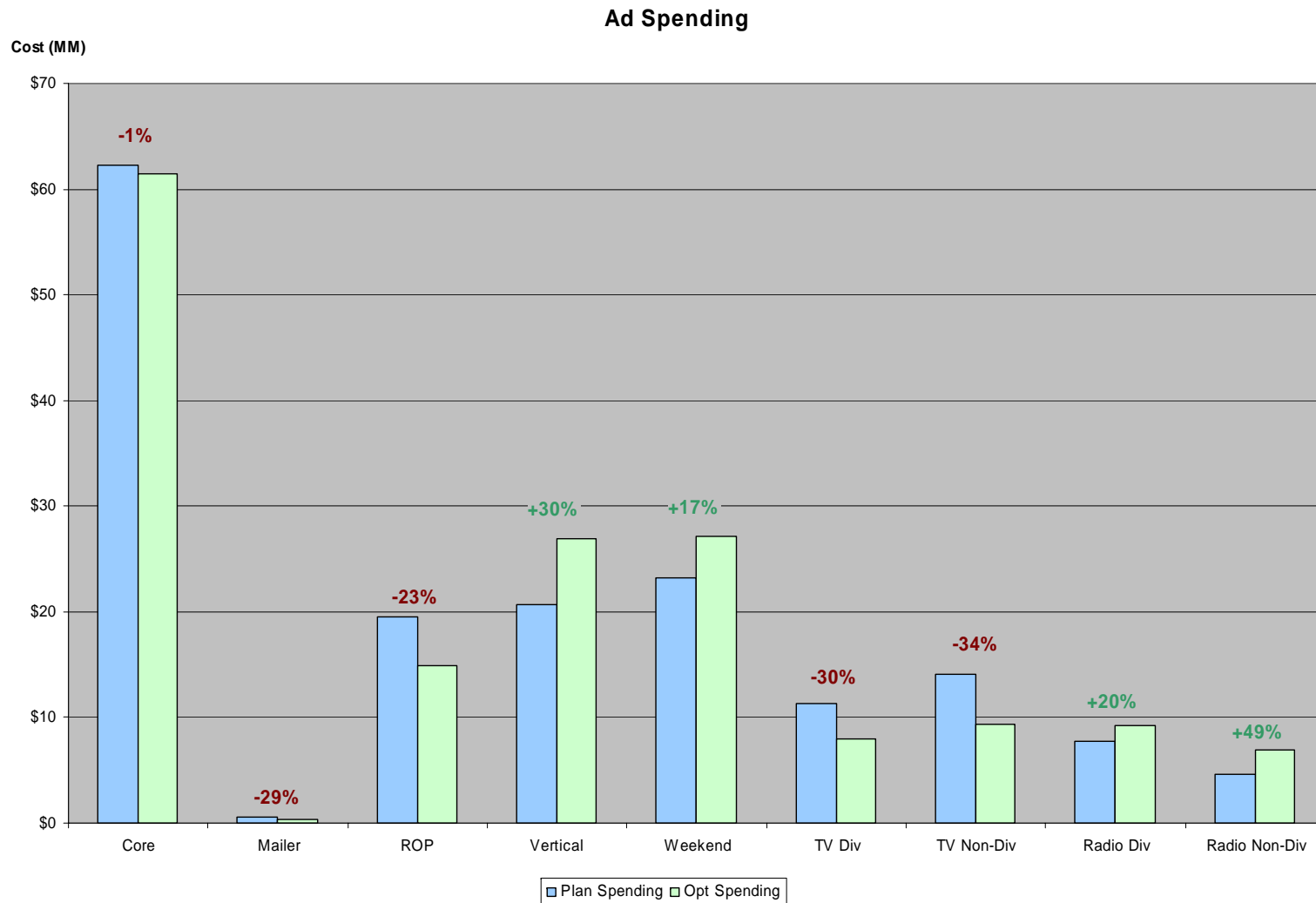
Sample Output – Feature Pages

Product Code / Week	14/2003	11/2003	1/8/2003	1/25/2003	2/1/2003	2/8/2003	2/15/2003	2/22/2003	3/1/2003	3/8/2003	3/15/2003	3/22/2003	3/29/2003	4/5/2003	4/12/2003	4/19/2003	4/26/2003	5/3/2003	5/10/2003	5/17/2003	5/24/2003	5/31/2003	6/7/2003	6/14/2003	6/21/2003	6/28/2003	7/5/2003	7/12/2003	7/19/2003	7/26/2003	8/2/2003	8/9/2003	8/16/2003	8/23/2003	8/30/2003	9/6/2003	9/13/2003	9/20/2003	9/27/2003	10/4/2003	10/11/2003	10/18/2003	10/25/2003	11/1/2003	11/8/2003	11/15/2003	11/22/2003	11/29/2003	12/6/2003	12/13/2003	12/20/2003	12/27/2003	Total
123-212580	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.2	0.3	0.2	0.3	0.0	0.8	0.0	0.0	0.0	0.9	0.0	0.0	0.4	0.2	0.2	0.7	0.2	0.1	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.8	0.4	0.0	0.3	0.4	0.4	0.1	0.9	0.0	0.0	0.0	0.3	0.2	0.6	0.0	0.0	0.0	0.0	0.0	11	
123-166582	0.6	0.1	0.0	0.0	0.6	0.9	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.4	0.3	0.5	0.7	0.1	0.0	0.3	0.0	0.9	0.8	0.0	0.0	0.8	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.9	0.6	0.2	0.0	0.7	0.0	0.0	0.5	0.0	0.8	0.3	0.0	0.0	13		
123-888398	0.3	0.0	0.3	0.0	0.4	0.0	0.7	0.0	0.0	0.4	0.6	0.0	0.0	0.4	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.9	0.0	1.0	0.0	0.0	0.0	0.0	0.8	0.7	0.0	0.6	0.0	0.0	0.9	0.0	0.9	0.7	0.1	0.7	0.2	0.0	0.0	0.0	1.0	0.0	0.0	0.3	0.0	0.0	13		
123-139871	0.2	0.0	0.4	1.0	0.8	0.0	0.0	0.4	0.0	0.0	0.2	0.5	0.0	0.4	0.4	0.0	0.0	1.0	0.3	0.0	1.0	0.0	0.7	0.0	0.9	0.0	0.2	0.0	0.7	0.3	0.8	0.8	0.0	0.0	0.0	0.0	0.9	0.9	0.0	0.0	0.9	0.0	0.0	0.2	0.9	0.0	0.8	0.0	0.3	0.5	15		
123-603639	0.0	0.0	0.0	0.6	0.2	0.1	0.0	0.8	0.0	0.8	0.0	0.9	0.0	0.0	0.0	0.3	0.2	0.5	0.7	0.3	0.0	0.0	0.0	0.1	0.5	0.2	0.7	0.0	0.4	0.1	0.5	0.0	0.1	0.5	0.0	0.0	0.0	0.0	0.7	0.4	0.1	0.0	1.0	0.2	0.6	0.9	0.0	1.0	0.0	0.6	14		
123-536442	0.0	0.0	1.0	0.2	0.8	0.2	0.2	0.4	0.1	0.0	0.0	0.8	0.0	0.8	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.8	0.0	0.0	0.4	0.0	0.4	0.0	0.0	0.6	0.0	0.6	0.0	0.4	0.0	0.8	0.9	0.9	0.0	0.7	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	12				
123-096866	0.9	0.7	0.0	0.0	0.0	0.6	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.3	0.1	0.2	0.0	0.0	0.2	0.0	0.3	0.5	0.0	0.8	1.0	0.5	0.3	0.0	0.2	0.3	0.0	0.6	0.8	0.0	0.5	0.0	0.0	0.0	0.7	0.3	0.4	0.1	0.0	0.0	0.0	0.3	0.3	0.9	0.2	13			
123-195005	0.5	0.6	0.0	0.3	0.0	1.0	0.0	1.0	1.0	0.9	0.6	0.0	0.0	0.6	0.5	0.6	0.0	0.5	0.0	0.6	0.3	0.4	0.0	0.0	0.5	0.0	0.9	0.2	0.3	0.0	0.0	0.2	0.7	0.0	0.7	0.3	0.4	0.8	0.9	0.9	0.0	0.0	0.0	0.9	0.6	0.0	0.2	0.0	0.0	18			
123-653897	0.2	0.8	0.7	0.9	0.3	0.8	0.0	0.6	0.0	0.9	0.5	0.3	0.2	0.4	0.6	0.2	0.6	0.0	0.1	0.7	0.0	0.6	0.6	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.6	0.0	0.0	13			
123-273032	0.6	0.8	0.3	0.2	0.8	0.1	0.7	0.2	0.0	0.8	0.0	0.3	0.5	0.9	0.0	0.0	0.9	0.7	0.0	0.0	1.0	0.0	0.1	0.9	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.1	0.0	0.0	0.1	0.0	0.0	1.0	0.8	0.8	0.0	0.6	0.1	0.7	0.3	0.0	16			
123-508305	0.2	0.0	0.2	0.0	0.6	0.0	0.0	0.9	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.1	0.9	0.9	0.1	0.5	0.1	0.0	0.0	0.9	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.9	10		
123-811047	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.4	0.3	0.0	0.9	0.2	0.0	0.5	1.0	0.9	0.0	0.0	0.0	0.7	0.5	0.1	0.0	0.9	0.3	0.4	0.0	0.0	0.0	0.0	0.6	0.9	0.3	0.9	0.0	0.9	0.0	0.9	0.0	0.0	0.0	0.1	0.5	0.0	0.7	0.1	0.0	0.0	0.0	13			
123-315508	0.0	0.6	0.4	0.0	0.8	0.0	0.6	0.0	0.0	0.8	0.0	0.0	0.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.3	0.0	8			
123-404450	0.3	0.4	0.0	0.1	1.0	0.0	0.0	0.7	0.3	0.0	0.0	0.1	0.0	0.4	0.6	0.0	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.0	0.0	0.7	0.0	0.0	0.3	0.0	0.2	0.0	0.5	1.0	0.1	0.4	0.9	0.0	0.0	0.4	0.1	0.0	0.3	0.0	0.0	11			
123-937195	0.7	0.5	0.3	0.0	0.0	0.0	0.0	0.9	0.1	0.7	0.0	0.2	0.0	0.1	0.6	0.6	0.3	0.6	0.0	0.7	0.0	0.6	0.9	0.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.5	0.7	0.7	0.0	0.0	0.5	0.0	0.2	0.7	0.0	0.4	14		
123-313586	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.7	0.0	0.9	0.2	0.0	0.7	0.5	0.8	0.0	0.5	0.0	0.3	0.8	0.9	0.0	0.6	0.0	0.0	0.9	0.1	0.0	0.0	0.1	0.0	0.9	0.0	0.0	0.1	0.0	0.9	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.4	0.0	0.1	0.0	0.4	0.0	10	
123-749425	0.0	0.2	0.0	0.0	0.9	0.0	0.5	0.2	0.0	0.0	0.4	0.0	0.0	0.2	0.0	0.0	0.0	0.7	0.0	0.2	1.0	0.1	0.0	0.3	1.0	0.7	0.9	0.2	0.4	0.0	0.2	0.7	0.2	0.9	0.6	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.9	0.3	0.2	0.0	0.3	0.4	0.0	0.0	13	
123-235469	0.0	0.0	0.0	0.0	0.7	0.0	0.1	0.0	0.9	0.0	0.0	0.6	0.0	0.0	0.0	0.0	1.0	0.5	0.2	0.7	0.0	0.0	0.9	0.9	0.0	0.8	0.0	0.4	0.8	0.0	0.1	0.9	0.9	0.4	0.3	0.2	0.1	0.0	0.8	0.0	0.5	0.0	0.1	0.2	0.0	0.9	0.0	0.4	0.0	0.8	15		
123-713779	0.9	0.0	0.0	0.0	0.5	0.3	0.2	0.6	0.0	0.0	0.8	0.3	0.1	0.0	0.4	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.6	0.7	0.0	0.5	0.5	0.0	0.0	0.8	0.5	0.7	0.0	0.0	0.8	0.0	0.0	1.0	0.0	0.8	0.0	0.8	0.0	0.8	0.9	0.7	14					
123-700591	0.0	0.0	0.0	0.0	0.7	0.9	0.0	0.3	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.6	0.4	0.7	0.0	0.0	0.0	0.4	0.9	0.5	0.0	0.4	0.0	0.5	0.0	0.0	0.0	0.1	0.6	0.0	0.0	0.0	0.6	0.5	0.6	0.0	0.6	0.4	0.5	0.8	12				
123-694073	0.6	0.8	0.0	0.0	0.3	0.6	0.0	1.0	0.3	0.0	0.6	0.0	0.7	0.0	0.6	0.2	0.0	0.0	0.2	0.6	0.4	0.7	0.8	0.0	0.4	0.4	0.6	0.0	0.5	0.7	0.8	0.9	0.0	0.8	0.7	0.0	0.0	0.6	0.0	0.6	0.0	0.0	0.2	0.7	0.0	0.3	0.0	0.0	0.6	16			
123-876640	0.0	0.0	0.0	0.0	0.6	0.4	0.4	0.0	0.8	0.5	0.2	0.0	0.0	0.4	0.0	0.5	0.7	0.0	0.3	0.8	0.7	0.0	0.3	0.8	0.0	0.0	0.3	0.8	0.0	0.0	0.6	0.7	0.0	0.5	0.0	0.0	0.3	0.2	0.5	0.0	0.0	0.1	0.2	0.3	0.6	0.7	0.2	0.4	0.0	12			
123-436072	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.8	0.2	0.5	0.0	0.9	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.9	0.7	0.6	0.0	0.0	0.0	0.7	0.5	0.7	0.0	0.0	0.1	0.0	0.8	0.0	0.0	0.0	0.0	0.0	1.0	0.9	0.9	0.7	0.3	0.0	0.7	0.5	0.9	0.0	0.0	0.0	14		
123-108362	0.0	0.8	0.0	0.1	0.8	0.1	0.0	0.6	0.0	0.0	0.7	0.0	1.0	0.7	0.1	0.1	0.0	0.1	0.9	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.9	0.3	0.3	0.0	0.0	0.0	0.6	0.9	0.4	0.0	0.0	12		
123-052632	0.9	0.5	0.0	0.4	0.0	0.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.2	0.6	1.0	0.7	0.2	0.0	0.0	0.5	0.0	0.0	0.2	0.7	0.0	0.0	0.8	0.8	0.6	0.4	0.0	0.8	0.0	0.6	0.4	0.0	0.0	0.2	0.0	0.9	1.0	0.0	0.8	0.0	15			
123-842159	0.0	0.9	0.0	0.3	0.9	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.6	0.0	0.0	0.4	0.6	0.5	1.0	0.5	0.7	0.5	0.8	0.7	0.8	0.2	0.9	0.0	0.0	0.0	0.0	0.8	0.0	0.6	0.4	0.4	0.0	0.5	0.5	0.1	0.0	0.0	0.4	0.2	15			
123-485045	0.0	0.9	0.5	0.7	0.0	0.6	0.0	0.9	0.0	0.0	0.3	0.0	0.0	0.9	0.8	0.5	0.8	0.0	0.0	0.2	0.7	0.6	0.6	0.0	0.3	0.7	0.6	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.8	0.0	0.3	0.9	0.0	0.7	0.4	0.6	0.0	0.6	0.8	0.0	0.0	0.4	17				
123-453444	0.0	0.0	0.6	0.5	0.0	0.0	0.0	0.0	0.1	0.0	0.0</																																										

Sample Output – Discount Rate

Product Code / Week	1/4/2003	1/11/2003	1/18/2003	1/25/2003	2/1/2003	2/8/2003	2/15/2003	2/22/2003	3/1/2003	3/8/2003	3/15/2003	3/22/2003	3/29/2003	4/5/2003	4/12/2003	4/19/2003	4/26/2003	5/3/2003	5/10/2003	5/17/2003	5/24/2003	5/31/2003	6/7/2003	6/14/2003	6/21/2003	6/28/2003	7/5/2003	7/12/2003	7/19/2003	7/26/2003	8/2/2003	8/9/2003	8/16/2003	8/23/2003	8/30/2003	9/6/2003	9/13/2003	9/20/2003	9/27/2003	10/4/2003	10/11/2003	10/18/2003	10/25/2003	11/1/2003	11/8/2003	11/15/2003	11/22/2003	11/29/2003	12/6/2003	12/13/2003	12/20/2003	12/27/2003		
123-212580	0	40	30	40	15	30	0	10	40	25	0	0	0	0	0	40	20	5	20	0	30	10	5	30	25	10	10	45	10	5	0	0	25	0	10	5	0	45	45	10	0	25	35	35	0	0	20	0	20	10	0	5		
123-166582	30	5	10	15	15	0	35	0	40	0	0	35	0	0	45	15	0	10	0	25	0	0	15	0	10	40	25	0	0	0	0	0	0	0	35	0	35	5	25	25	10	30	25	35	0	0	50	30	10	0	0	25		
123-888398	0	0	5	0	0	25	0	0	0	20	0	0	0	25	0	15	10	10	0	35	0	0	0	20	0	45	0	0	0	0	0	0	0	25	20	0	0	50	0	5	15	0	0	30	10	35	25	35	20	0	0	0		
123-139871	0	0	0	45	0	50	0	20	5	0	20	0	0	10	0	15	0	30	0	40	25	0	40	0	0	45	40	0	40	0	0	45	0	45	0	20	5	0	30	15	20	0	25	30	0	0	0	45	0	10	0	30		
123-603699	15	0	0	0	25	0	0	5	5	0	0	20	35	0	40	40	10	30	45	0	20	35	0	0	0	30	20	0	0	0	0	25	20	20	0	0	5	0	5	0	45	0	5	30	0	0	15	25	0	0				
123-536442	35	0	0	5	30	0	10	10	25	0	0	30	0	20	0	10	0	30	20	0	0	40	0	45	0	0	0	0	45	25	5	35	0	0	15	0	10	0	10	5	40	40	50	0	40	30	35	0	0	0	0			
123-096866	35	0	0	45	0	10	0	30	15	10	35	10	0	0	20	30	45	35	20	0	0	20	0	10	0	0	20	50	0	40	0	0	0	5	0	0	0	25	30	0	10	0	0	15	0	40	40	0	15	5				
123-135005	0	0	0	35	0	40	0	0	0	0	0	5	0	50	20	45	0	30	0	0	10	0	25	0	0	0	0	0	0	0	0	10	0	0	0	0	45	0	25	45	0	10	15	0	0	45	40	5	45	30				
123-653897	0	0	0	45	0	50	0	0	0	20	0	50	10	5	0	0	0	0	35	50	10	25	0	0	0	0	0	0	0	45	0	0	0	0	25	0	0	15	0	0	45	0	35	0	5	0	0	0	35	45				
123-273032	20	5	0	0	0	30	0	15	0	0	0	0	0	35	5	0	50	25	30	5	0	0	0	10	30	0	20	35	0	25	0	0	40	0	20	10	40	15	15	50	0	15	5	35	0	0	25	0	40	20	0	0		
123-508305	0	20	0	40	25	0	40	0	0	0	50	10	5	45	0	0	45	0	0	25	0	35	10	25	45	0	0	30	0	40	35	0	0	5	0	0	15	0	0	25	0	10	0	30	0	35	10	10	15					
123-811047	50	20	0	0	5	0	0	0	0	0	0	0	0	35	15	0	0	0	0	0	0	0	0	0	0	0	10	0	10	0	0	10	0	0	40	25	0	40	50	0	30	0	0	20	0	40	5	0	0	45				
123-315508	0	25	0	0	45	0	45	0	5	20	0	30	0	0	0	50	0	15	0	0	0	0	0	20	10	5	0	0	0	0	0	0	0	0	40	45	0	0	20	0	50	0	40	15	0	35	45	0	35	0	0			
123-404450	0	0	5	0	0	0	20	30	0	0	10	20	50	0	0	0	20	10	0	0	10	0	0	0	0	0	0	15	0	0	0	15	0	25	0	5	10	25	0	15	0	15	20	15	0	15	15	0	45	0	35	0	0	
123-937195	35	50	0	0	40	0	0	5	5	0	0	0	0	45	40	0	35	5	0	0	0	0	40	20	50	10	20	15	0	20	15	0	35	0	40	20	0	30	0	0	25	0	20	0	10	0	5	25	5	40				
123-313586	0	5	5	0	0	0	25	0	0	15	0	0	0	40	20	25	15	5	40	0	0	0	0	50	0	0	0	25	0	0	0	35	20	30	0	10	10	0	0	10	30	0	50	30	0	40	20	0	5	25	0	0		
123-749425	40	0	0	50	0	20	0	20	30	30	5	0	0	0	30	0	40	0	0	50	0	0	50	40	0	0	0	35	0	0	0	30	15	25	30	0	0	5	50	15	0	35	30	50	0	0	35	0	0	35	45			
123-235469	0	0	0	15	45	50	0	10	15	20	35	0	0	0	0	25	0	0	0	0	0	20	25	0	0	0	0	0	0	0	0	20	10	0	0	45	0	0	15	0	20	25	0	0	5	5	0	40	25	0	0			
123-713779	0	20	0	0	0	35	0	0	20	0	0	45	0	0	10	0	0	45	10	0	0	10	0	45	0	0	10	0	45	0	0	10	0	50	40	40	35	20	0	15	0	5	0	5	0	0	15	0	40	50	10	0	0	0
123-700591	0	0	0	10	35	0	0	0	0	5	30	0	0	0	25	25	25	35	0	0	0	20	25	0	0	40	0	0	0	25	0	0	0	0	30	0	0	0	0	40	0	15	45	0	0	20	0	25	5	45				
123-694073	0	0	0	35	25	45	5	25	0	35	0	0	15	0	0	15	0	45	0	0	0	10	0	45	40	5	0	0	10	0	0	20	0	0	10	0	10	15	0	35	30	0	50	0	0	0	0	0	5	30				
123-876640	0	5	0	40	0	10	0	0	0	50	0	0	50	0	15	10	20	0	0	0	0	5	0	0	0	0	45	20	0	25	0	0	0	30	5	15	35	20	40	5	5	15	40	45	0	45	25	45	30	0	0			
123-436072	0	0	0	0	0	0	5	0	0	40	25	0	50	20	0	0	0	0	10	45	0	15	0	5	30	0	30	35	45	0	15	0	25	0	0	0	35	35	35	30	0	10	0	15	0	30	20	0	25	0	0			
123-108362	0	0	25	15	30	30	0	0	20	40	0	30	30	0	5	15	5	0	0	5	0	25	50	5	15	0	0	0	50	0	40	0	30	0	0	0	0	0	0	0	0	0	40	0	35	0	20	0	35	0	0			
123-052632	0	30	35	0	40	15	0	0	0	0	0	10	0	15	10	10	35	45	0	0	50	0	15	0	25	0	10	10	40	30	30	30	0	0	30	0	0	15	40	0	25	0	30	30	10	5	5	40	15	50	0	0		
123-842159	0	25	0	0	0	10	0	0	35	0	0	0	0	0	5	40	35	0	45	20	10	0	0	0	30	0	20	15	0	30	15	10	20	5	45	5	0	10	0	20	30	20	0	0	15	30	5	20	0	0				
123-485045	5	0	15	0	35	25	10	0	0	0	0	0	0	0	0	0	0	0	0	15	0	20	0	10	0	0	0	20	45	40	0	0	35	35	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	15		
123-453444	50	40	5	40	0	0	0	0	45	45	0	0	0	0	20	0	25	50	30	10	0	30	0	0	40	0	20	0	0	0	5	0	25	0	0	10	10	30	0	0	45	25	0	15	35	40	5	45	30	10	0	0		
123-812467	0	0	0	35	0	0	0	15	30	0	0	45	0	25	5	25	0	15	45	0	15	50	5	45	25	35	0	40	5	0	0	0	30	0	45	5	5	0	0	0	30	35	0	35	50	0	0	20	0	50				
123-808227	15	0	0	0	0	30	35	0	15	0	0	5	35	40	0	35	0	10	35	0	0	10	5	0	0	0	10	5	0	0	25	50	45	45	0	20	20	0	15	35	0	0	0	30	0	40	0	0	50	25	0	0		
123-705284	0	50	50	20	0	45	0	0	0	5	0	50	0	0	15	0	0	0	30	0	25	30	25	0	0	0	0	0	0	0	0	0	5	0	0	25	0	0	35	0	0	40	0	5	0	10	0	40	15	0	5			
123-179258	30	0	0	0	0	0	0	0	0	40	0	45	0	15	0	40	0	0	0	10	0	0	0	0	0	0	0	0	0	0	30	0	0	0	10	0	0	35	0	0	15	0	45	0	0	15	0	35	40	30	0	35		
123-455042	0	0	0	15	0	0	0	10	30	10	20	15	0	0	10	0	30	0	45	15	0	0	0	5	0	0	30	5	0	0	0	0	40	0	20	0	0	0	0	0	0	0	0	0	35	0	40	0	0	30	5	0		
123-493966	0	0	50	0	0	0	0																																															

Sample Output – Ad Spending

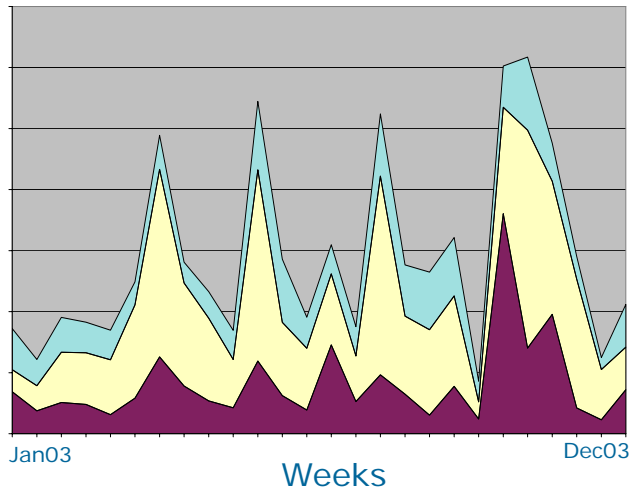


Sample Output – Plan Comparison

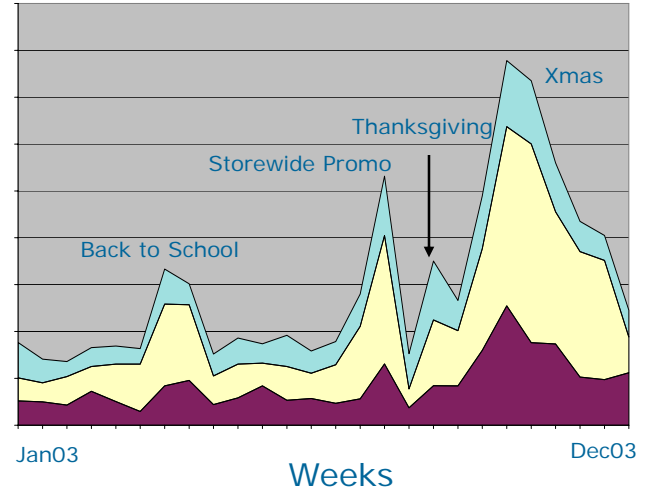
- Product 123-811407
- Product 123-811419
- Product 123-811417

Print Pages

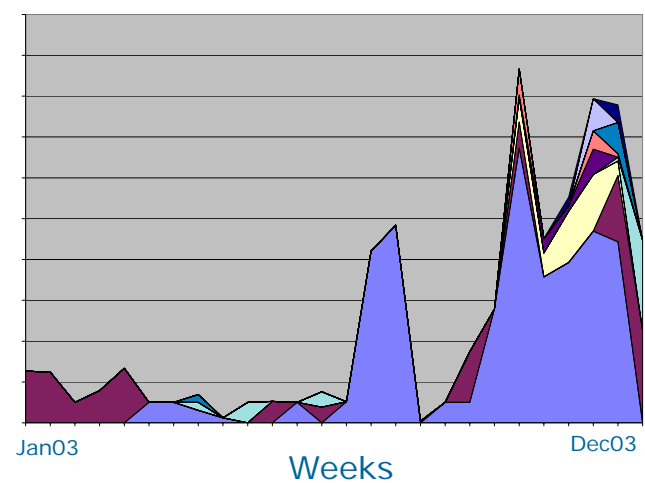
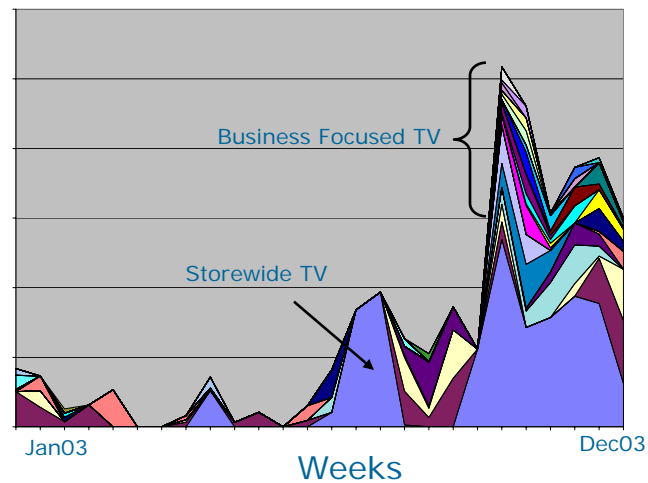
Current Plan



Optimized Plan



TV GRPs



Summary

- ❏ We proposed a Marketing Mix Optimization model for recommending prices and advertisement schedules to retailers
- ❏ The MMO model is, in general, a large-scale MINLP which is not easy to solve, but an approximate large-scale MIQP is more manageable
- ❏ MMO could improve revenues and profits in the order of 5-10%; a significant amount of savings in advertising cost is also possible

