Market Mix Models:
Shining the Light Inside the Black Box

Council on Advertising Effectiveness
May 22nd, 2007

Modeling Emerges

- ***Marketers looking for***
  1. *More scientific approach to marketing*
  2. *Ways to address accountability demands*
  3. *A way to assess ROI and optimize increasingly complex marketing mix*
- ***Some promising techniques emerged***
  - *MMM applied successfully by IRI to scanner data, copied by Nielsen. Some exciting early start ups appeared.*
  - *In the UK, 'econometrics' approach was borrowed from finance by marketers to assess the impact of advertising*

A Variety of Challenges Were Overlooked

- The concept of a 'model' was not well understood
  - Cannot mistake the model for the process
- Database integration issues were substantial
  - Cost
  - Poor quality data
  - The wrong data plentiful – the right data hard to come by
- Observational data, alone, was not a strong candidate for causal analysis
  - Uncontrolled
  - Non random
  - Missing data

Marketing Mix Modeling Today

- Answers two questions:
  - What level or combination of product, price, promotion, and place maximizes sales, market share, or profit?
  - How do sales, market share, or profit respond to past levels of expenditures on the 4 Ps?

Basic Philosophy

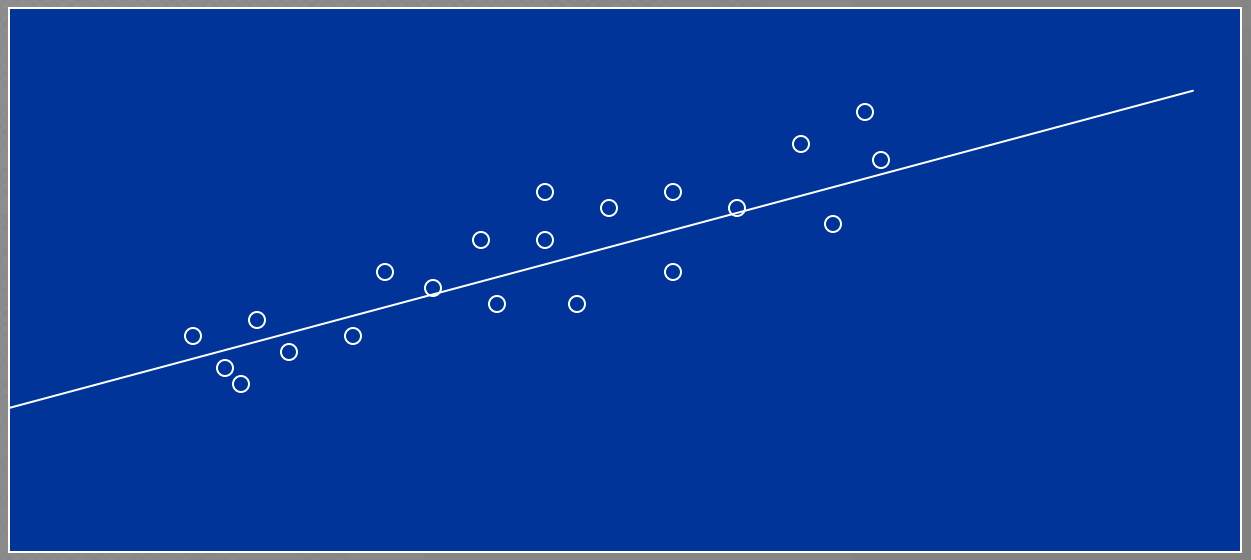
- Past data on consumer response to the marketing mix can enlighten our understanding today
  - Past data can help us predict (decision support modeling)
- Marketers' challenge:
  - New media & channels touching the customer
  - Content and creative impact is dynamic & 'now'
  - Sophistication of models needs to be translated
- The 'other' 4 Ps of strategic marketing:
  - Probing (marketing research)
  - Partitioning (segmentation)
  - Prioritizing (targeting)
  - Positioning

How Modeling Works

Marketing mix models use time series data in a structured modeling approach to determine all the relevant independent marketing and non-marketing variables that affect the outcome variable being examined (such as sales). Heavily dependent on the amount and granularity of the underlying data, marketing mix models try to account for advertising carryover and wear out, diminishing returns, and interaction effects.

Basic Form of Relationship

$$Y = a + b_1 X_1 + b_2 X_2 + ...+ e$$



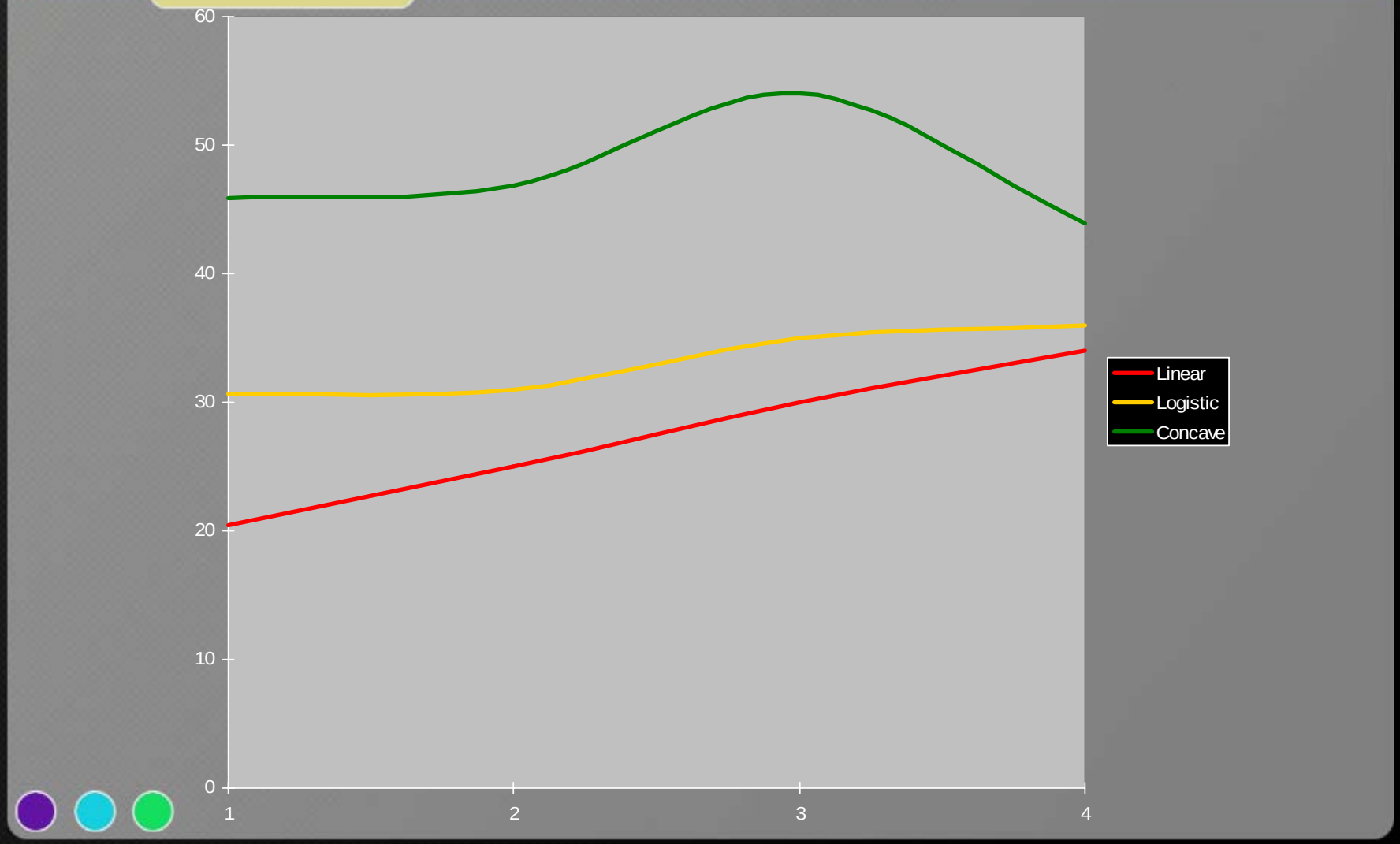
Seven Patterns of Marketing Response

1. Immediate effects (short term) – change in sales concurrent with exposure to marketing
2. Carryover effects (long term) change in sales in the future that we can ascribe to marketing/advertising
   - Delayed exposure
   - Delayed response
   - External roadblocks
   - Buzz

Seven Patterns of Marketing Response

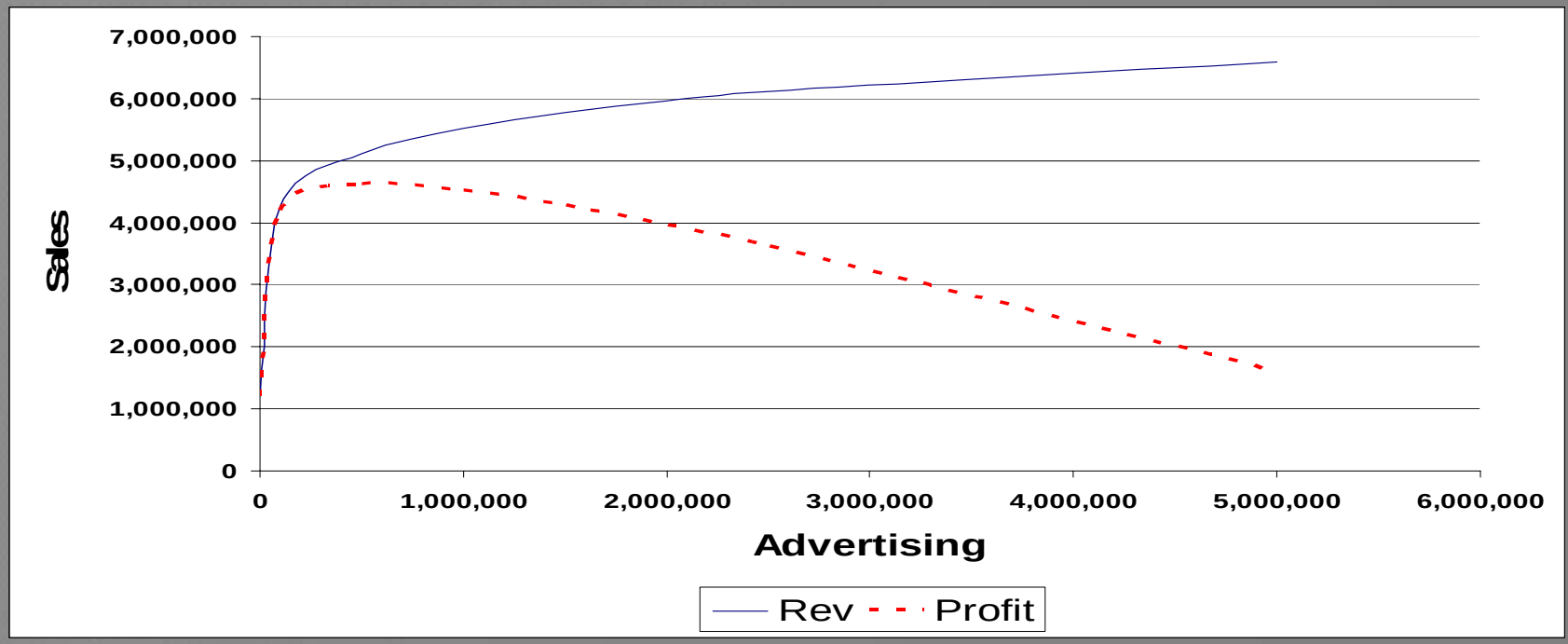
3. Shape effects – change in sales in response to increased marketing in the same period
   - Linear, logistic, concave
   - A change in rate

Common Responses to Advertising



Diminishing Ad Spend Effectiveness

- **Here is an illustration of advertising's effect on revenue and profits**
  - **Increasing advertising usually increases sales, but only raises profits to a point. As advertising expenditures increase, they begin eroding profits as higher cost per unit sales are incurred**



Seven Patterns of Marketing Response

4. Competitive effects – change in sales in response to competitor's marketing efforts in the same period
   - Positioning
   - Brand 'weight'
   - Brand familiarity

Seven Patterns of Marketing Response

5. Dynamic effects – change in sales in response to time
   - Carryover
   - Wear in, wear out
     - Related to response curves
   - Hysteresis
     - What's left after the advertising stops

Seven Patterns of Marketing Response

6. Content effects – variation in response to advertising due to variation in the content or creative cues of an ad
   - Creative impacts
   - Rational-emotional
     - Heath: Implicit/explicit memory traces

Seven Patterns of Marketing Response

7. Media effects – difference in response to marketing due to the channel of delivery
   - Where it touches the consumer in the sales funnel/purchase cycle
   - New media explosion
   - Integrated/synergistic impacts

The Modeling Challenge

- One model cannot address all 7 elements:
  - To address all seven advertising response patterns, a combination of models would be needed
- Cost, time, data considerations
- Current Challenges:
  - Integration: how do we bring all these measurement models together into a coherent, useful package?
  - Is our measurement of content (quality) and (new) media effects valid, usable, or useful?

Technical Issues

- Operations researchers, amongst others, were one of the earliest groups to identify the fact that econometric models generally fail to represent business processes, except possibly over a limited range.[1] The major limitations that were identified, and which hold true today, include:
  - Collinearity: factors (variables) that affect the impact of advertising are highly interconnected, thus clouding the assessment of 'what is causing what'
  - Autocorrelation: data from one period may depend on a previous period (note this is also a problem with brand and ad tracking studies). This is another variation of the halo or carryover effect well known to marketers
  - Simultaneity: changes in advertising may take place at the same time as changes in another factor that also impacts consumer response and behavior

[1] Little, J.D.C. (1979). "Aggregate Advertising Models: The State of the Art". *Operations Research*, Volume 27, Number 4, July/August, 1979.

Technical Issues

- Cleaning and integration is an important part of building the necessary 'single source' data set
  - However, aggregating, decomposing, and transforming raw data imposes arbitrary decisions, judgments, and assumptions by the modeler that may not jibe or make sense to the marketer
  - These all become a source of bias and error
- Poor data quality results in excessive collinearity, impacts and effects are virtually impossible to reconcile
- Specification error, a component of regression modeling, is frequently overlooked in the rush to build single source data sets using the data at hand
  - The result is a model and result that at the very least can be spurious and misleading, but at its worst, wrong

Technical Issues

- The accommodation of endogeneity: endogeneity is a factor internal to the marketing mix model that refers to the fact that an independent variable included in the model is potentially a 'choice' variable, and this choice is moderately or highly correlated with other variables not included in the model – sometimes this is called a 'lurking variable' (lurking out of sight but having profound influence on the model). An example: if less able workers are more likely to join a union and therefore receive lower wages (all things being equal), then failure to control for this correlation will yield an estimated union effect on wages that is biased down.
- Allowance for cross sectional heterogeneity regarding impact: simply, can we measure and analyze the effect or impact of marketing across segments? There is a differential effect depending on which loyalty, satisfaction, and/or demographic segment one belongs. The ability to do this is 'averaged' out by the econometric requirement of interval level independent variables.

Panel

- Wes Nichols
  MarketShare Partners
- Bill Pink
  Millward Brown
- Nancy Smith
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