Market Response Modeling

- Response Modeling Basics

Response–1

The Concept of a Response Model

Idea: Marketing Inputs:

- Selling effort
- Advertising spending
- Promotional spending

↓

Market

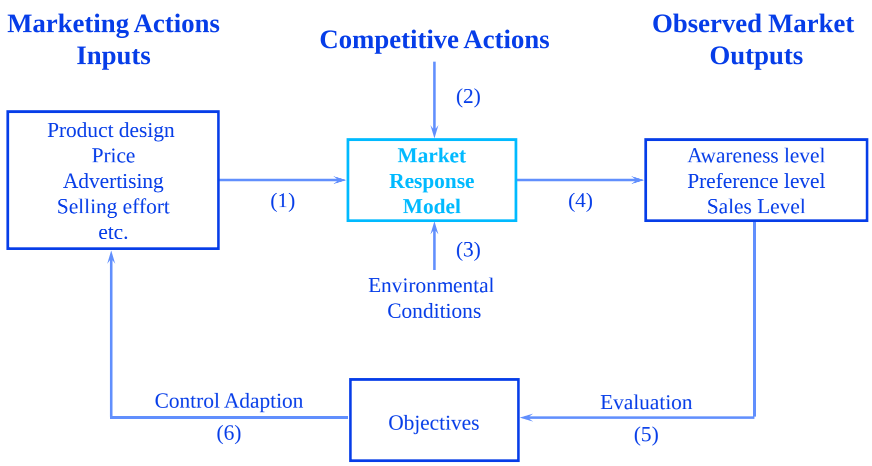
↓

Marketing Outputs:

- Sales
- Share
- Profit
- Awareness, etc.

Response–2

Input-Output Model



Response–3

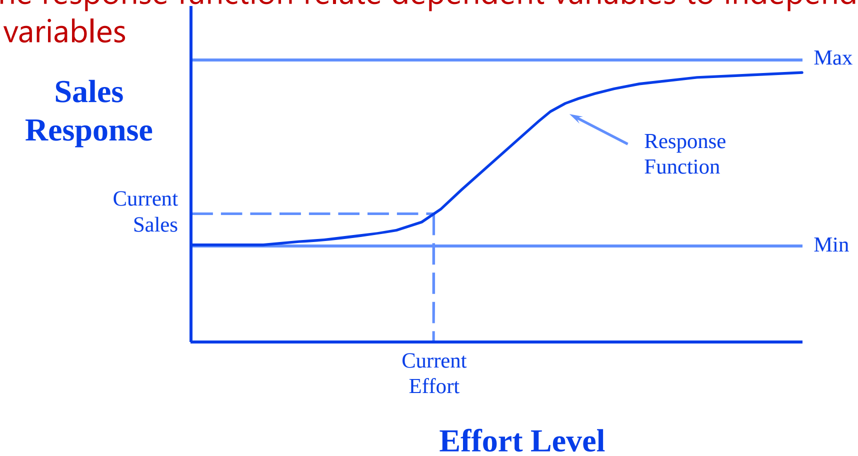
Response Models can be characterized by:

1. By the number of marketing variables
2. By whether they include competition or not
3. By the nature of the relationship between the input variables
    1. Linear vs.S–Shape
4. By whether the situation is static vs. dynamic
5. By whether the models reflect individual or aggregate response
6. By the level of demand analyzed
    - ❑Sales vs. market share

Response–5

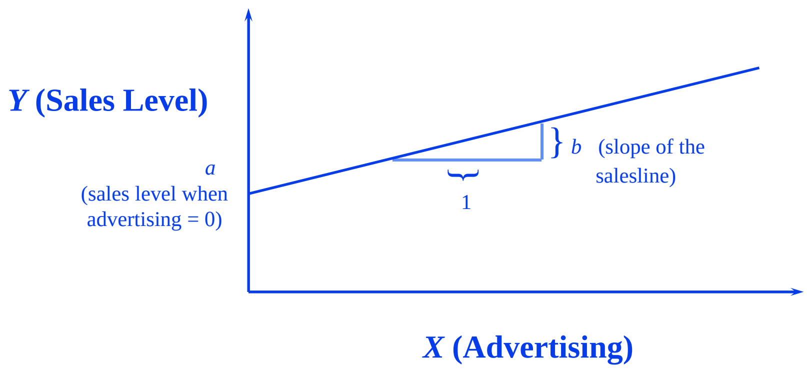
Response Function

The response function relate dependent variables to independent variables



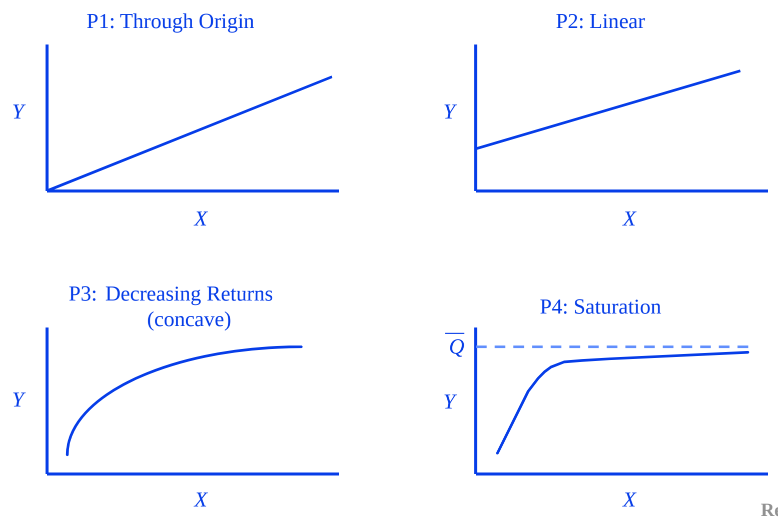
- Parameters are the constants in the mathematical representation of models
- Calibration: is the process of determining appropriate values to the parameters

A Simple Model



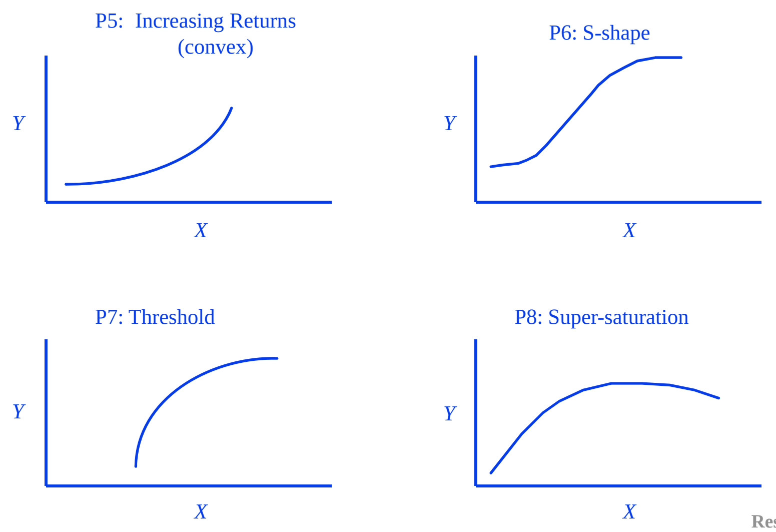
Response–8

Phenomena



Response–9

Phenomena



Aggregate Response Models: Linear Model

$$Y = a + bX$$

- ❑ Linear/through origin
- ❑ Saturation and threshold (in ranges)

Advantages:

•One can use standard regression methods to estimate the parameters

•Easy to visualize and understand

Disadvantages:

•Assumes constant returns to scale everywhere (can not accommodate concave (P3) , convex (P5), or S-Shape(P6))

Aggregate Response Models:
The Power Series Model

$$Y = a + bX + cX^2 + dX^3 + \ldots.$$

- Fit well within the range of data,
- Behaves badly (becoming unbounded) outside the data range
- All but P4, P7 (Saturation, and Threshold)

Response–12

Aggregate Response Models:
Fractional Root Model

$$Y = a + bX^c$$

where: c is pre-specified

- c can be interpreted as elasticity when a = 0.
- Linear, increasing or decreasing returns (depends on c).
  - When c = ½ the model is called square root model
  - When c = -1 the model is called the reciprocal model, Y approaches the value of a when X gets larger

Response–13

Aggregate Response Models: The Semilog Model

$$Y = a + b \ln X$$

- Handles situations in which constant percentage increase in marketing effort result in constant absolute increases in sales

Aggregate Response Models: Exponential Model

$$Y = ae^{bx};\ x > 0$$

Increasing or decreasing returns (depends on *b*).

Used as a price-response function for b<0 (increasing returns to decreases in price) when Y approaches 0 as X becomes large

Handles:
(b >0) ➔P5. Convex
(b <0)➔ P4. Saturation (Y approaches 0, a lower bound here)

Aggregate Response Models: Modified Exponential Model

$Y = a(1 - e^{-bx}) + c$

Decreasing returns and saturation.

Widely used in marketing.

Has an upper bound or saturation level at a + c and a lower bound of c, and it shows decreasing return to scale

Handles:
P3. Concave
P4. Saturation , used as a response function to selling effort
Can accommodate P1. (Through origin) when c = 0

Response–16

Aggregate Response Models: The Logistic model

$$Y = \frac{a}{1 + e^{-(b + cX)}} + d$$

- The most common
- Easy to estimate
- Widely used

Handles:
P4. Saturation
P6. S-Shape

Response–17

Aggregate Response Models: Adbudg Function

$$Y = b + (a-b)\frac{X^c}{d + X^c}$$

S-shaped and concave; saturation effect.

Widely used.

Handles:
P1. Through Origin
P3. Concave
P4. Saturation
P6. S-Shape

Used to model response to advertising and selling effort

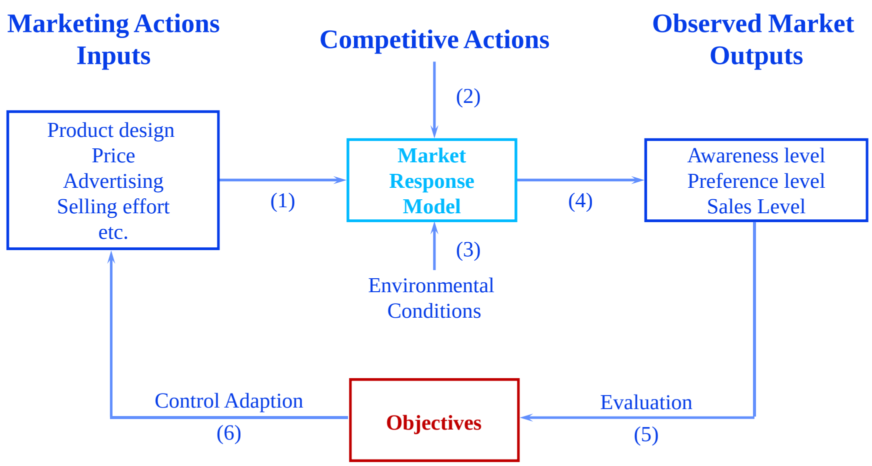
Calibration

- Calibration is assigning *good* values to the parameters of the model

$$Y = a + bX$$

- Estimate the values of *a* and *b* such that the relation becomes a good approximation of how Y varies with values of X
- Objective Calibration vs. Subjective Calibration
  - actual experimental or market data
  - the data used for estimation is subjective judgment

Input-Output Model



Response–20

Objectives

- To evaluate marketing actions and to improve the performance of the firm in the marketplace, the manager must specify objectives.
- Short-run profit
- Long-run profit
- Uncertainty → Decision-tree analysis
- Multiple Goals
  - Multi-criteria decision making
  - Goal programming
  - Trade-off analysis
  - Analytic hierarchy process

Response–21

Multiple Marketing-Mix: Interactions

X_1 and X_2 are marketing mix variables with $f(X_1)$, and $g(X_2)$ individual response function

Interactions:

1. No interactions

   → $Y = af(X_1) + bg(X_2)$

2. Multiplicative

   → $Y = af(X_1) * bg(X_2)$

3. Multiplicative and additive

   → $Y = af(X_1) + bg(X_2) + cf(X_1)g(X_2)$

Response–22

Dynamic Effects

- Many customers purchase more than they can consume of a product during a short-term price promotion
- This action leads to inventory buildup in customers' homes and lower sales in subsequent periods.
- Furthermore, the effect of that sales promotion will depend on how much inventory buildup occurred in past periods (i.e., how much potential buildup is left).

Response–26

Dynamic Effects

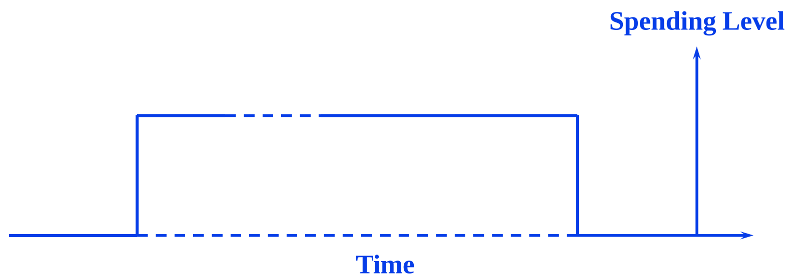
- If customers stocked up on brand A cola last week, a new promotion this week is likely to be less effective than one a long period after the last such promotion

Carryover effects

- The general term used to describe the influence of a current marketing expenditure on sales in future periods

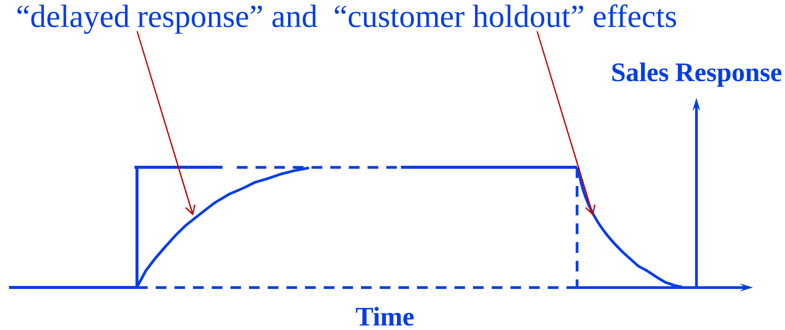
Dynamic Effects

1. Marketing Effort
   eg, sales promotion



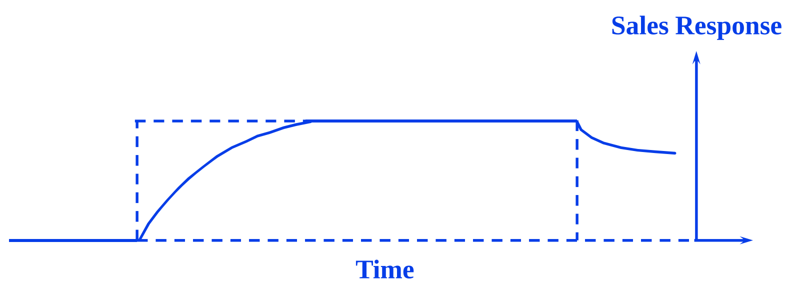
Dynamic Effects

2. Conventional
“delayed response” and “customer holdout” effects



Dynamic Effects

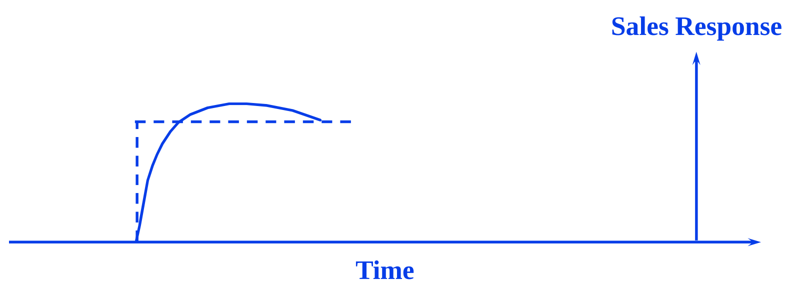
3. "Hysteresis" effect



Response–31

Dynamic Effects

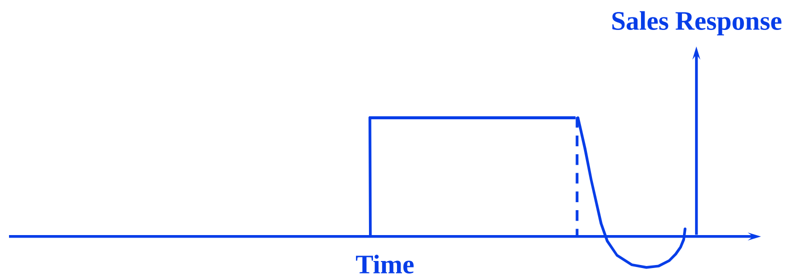
4. "New trier"
"wear out" effect



Response–32

Dynamic Effects

5. "Stocking" effect



Aggregate Response Models: Dynamics

❑ Dynamic response model

$$Y_t = a_0 + a_1 X_t + \lambda Y_{t-1}$$

carry-over effect

Current effect

This equation says that sales at time t (Y_t) are made up of
•a constant minimum base (a_0),
•an effect of the current activity a_1X_1 ,
•a proportion of last period's sales (lamda) that carries over to this period.

Managers can either guess (Lamda) directly as the proportion of sales that carries over from one period to the next or estimate it by using linear regression.

Market Share Model and Competitive Effects

- Brand sales Models (Y)
- Product class sales models (V)
- Market-share models (M)

$$Y = M \times V$$

Response–35

Aggregate Response Models: Market Share

- Market share (attraction) models

$$M_i = \frac{A_i}{A_1 + A_2 + \ldots + A_n}$$

A_i = attractiveness of brand *i*.

- Each firm's market share must be between 0 and 100 percent (range restriction)
- Market shares, summed over brands, must equal 100 percent (sum restriction).
- Has "proportional draw" property.

Response–36

Example

- Suppose *A1=10, A2=5, and A3=5.*
- In a market with *A1 and A2 only:*
- *m1=* *m2=*
- Suppose A3 enters. Then after entry,
- m1= m2= m3=

Response–37

Individual-Level Response Models: Requirements

- So far we have looked at market response at the level of the entire marketplace.
- However, markets are composed of individuals, and we can analyze the response behavior of those individuals and either use them directly (at the segment or segment-of-one level) or aggregate them to form total market response.

Response–39

Individual-Level Response Models: Requirements

- Aggregate response model focus on either brand sales, or market share.
- Models at the individual level focus on purchase probability
- Purchase probability is equivalent to market share.

Response–40

Individual-Level Response Models: Requirements

- Multinomial logit model to represent "probability of choice."
- The individual's probability of choosing brand 1 is:

$$P_{il} = \frac{e^{A_{il}}}{\sum_j e^{A_{ij}}}$$

Where:

A_{ij} = *attractiveness of product j for individual i*

$$A_{ij} = \sum_k w_k b_{ijk}$$

b_{ijk} = *individual i's evaluation of product j on product attribute k, where the summation is over all the products that individual i is considering purchasing*

w_k = *importance weight associated with attribute k in forming product preferences*

Response–41

Individual-Level Response Models: Requirements

- Satisfies sum and range constraints.
- Has the “proportional draw” property.
- Widely used in marketing.

Response–42

Example

Suppose that someone performed a survey of shoppers in an area to understand their shopping habits and to determine the share of shoppers that a new store might attract. The respondents rated three existing stores and one proposed store (described by a written concept statement) on a number of dimensions:

(1) variety, (2) quality, (3) parking, & (4) value for the money

Response–44

Attribute Ratings per Store

Store	Variety	Quality	Parking	Value for Money
1	0.7	0.5	0.7	0.7
2	0.3	0.4	0.2	0.
3	0.6	0.8	0.7	0.4
4 (new)	0.6	0.4	0.8	0.5
Importance Weight	2.0	1.7	1.3	2.2

Response–45

Shares per Store

Store	(a) $A_j = w_k\, b_{jk}$	(b) e_j^A	(c) Share estimate without new store	(d) Share estimate with new store	(e) Draw (c)–(d)
1	4.70	109.9	0.512	0.407	0.105
2	3.30	27.1	0.126	0.100	0.026
3	4.35	77.5	0.362	0.287	0.075
4	4.02	55.7		0.206	

Response–46

20