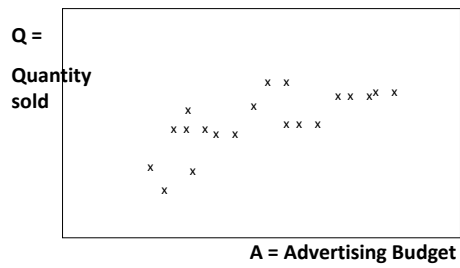


Finding Optimal Advertising or Promotion Expense

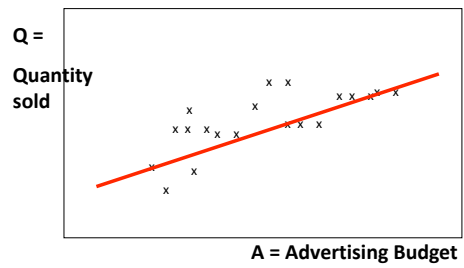
Ted Mitchell

Customer Response to Advertising Effort

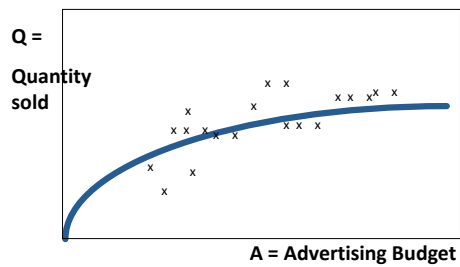
$$Q = ???A$$



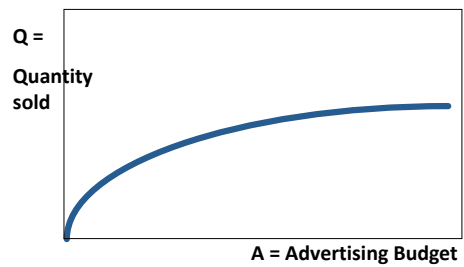
$$Q = y + xA$$

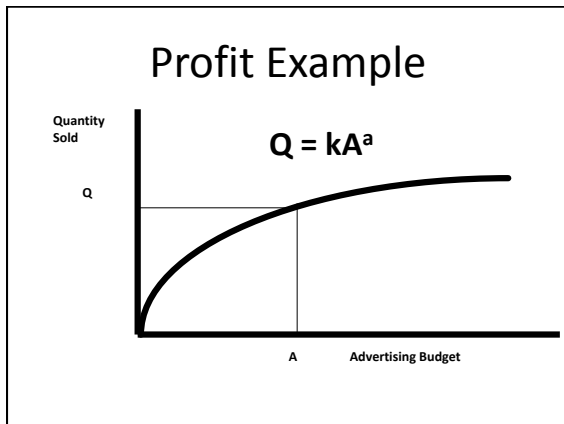


$$Q = kA^a$$

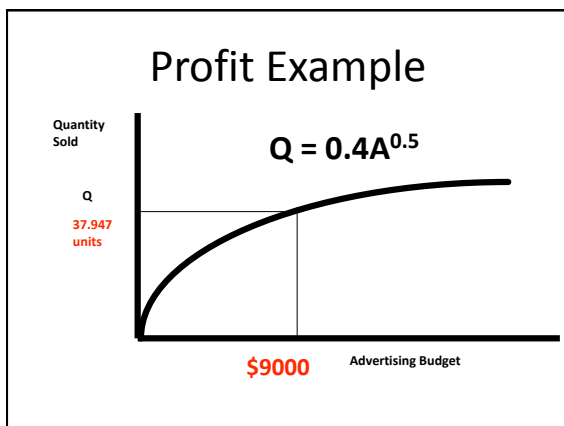


$$Q = kA^a$$





- ### Profit Example
- Customer Response to advertising is
 - $Q = 0.4A^{0.5}$
 - How many units will be sold if \$9000 is spent on advertising?
 - $Q = 0.4(9000^{0.5})$
 - $Q = 37.947$ units



- ### Example
- From Market Research
 - Customer Response to Advertising is $Q = 0.4A^{0.5}$
 - Revenue = PQ
 - Revenue = $P(0.4A^{0.5})$
 - If the Selling Price = \$500
What is the Revenue?
 - Revenue = $\$500(37.947) = \$18,973$

- Assume Total Cost of Operations
- Total Cost = $VQ + A + F$
- Total Cost = $50Q + A + \$6,000$
- Customer Response is $Q = 0.4A^{0.5}$
- Total Cost = $50(0.4A^{0.5}) + A + \$6,000$
- If the Advertising is **\$9,000**
What is the Total Cost?
- Total Cost =
 $\$50(0.4(9000^{0.5})) + \$9,000 + \$6,000$
- Total Cost = $\$16,897$

Profit Example

$$Z = R - C$$

$$Z = P(Q) - (VQ + A + F)$$

$$Z = PQ - VQ - A - F$$

Substitute, $P = \$500$, $V = \$50$, $F = \$6,000$

$$Z = \$500Q - (\$50Q + A + \$6000)$$

$$Z = 500Q - 50Q - A - 6000$$

$$Z = 500(0.4A^{0.5}) - 50(0.4A^{0.5}) - A - 6000$$

Profit Example

$$Z = 500(0.4A^{0.5}) - 50(0.4A^{0.5}) - A - 6000$$

$$Z = 450(0.4A^{0.5}) - A - 6000$$

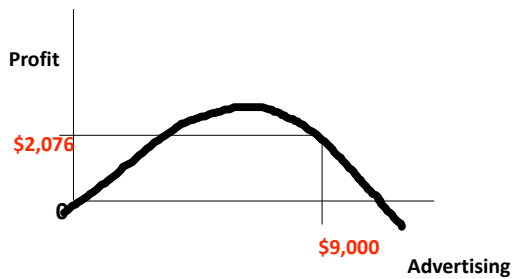
What is the profit if the advertising is **\$9,000**?

$$Z = 450(0.4(9000^{0.5})) - 9000 - 6000$$

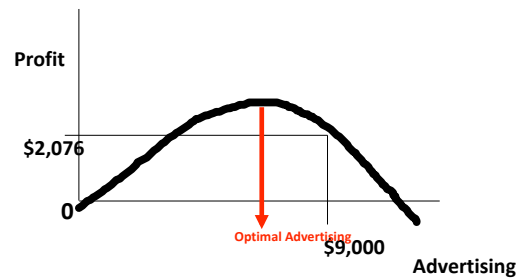
$$Z = \$2,076$$

Price per unit	\$500	
Quantity = $kA^a = 0.4A^{0.5}$	37.947	
Revenue $R = PQ$		\$18,973
Variable Cost per unit, V	\$50	
Cost of Goods Sold, VQ		\$1,897
Gross Profit, G		\$17,076
Advertising, A		\$9,000
General Overheads, OH		\$6,000
Profit, Z		\$2,076

What Does The Profit Curve Look Like?



What Does The Profit Curve Look Like?



Objective Task Method

When Maximum Profit is
The Objective

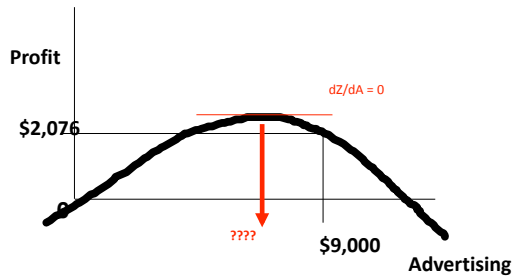
Optimal Advertising

Goal: Maximum Profit!

What is the Optimal Advertising Budget?

What Profit Does it generate?

What Does The Profit Curve Look Like?



Simplify

$Z = \text{Revenue} - \text{Total Variable Costs} - \text{Advertising} - \text{Other Fixed Costs}$

$$Z = PQ - VQ - A - F$$

$$Z = 500(0.4A^{0.5}) - 50(0.4A^{0.5}) - A - 6000$$

$$Z = 180A^{0.5} - A - 6000$$

$$Z = 180A^{0.5} - A - 6000$$

First derivative w.r.t. A

$$dZ/dA = 0.5(180)A^{-0.5} - 1A^0$$

$$dZ/dA = 0.5(180)A^{-0.5} - 1$$

Set $dZ/dA = 0$ and solve for A

$$0.5(180)A^{-0.5} - 1 = 0$$

$$90A^{-0.5} = 1$$

$$A^{-0.5} = 1/90$$

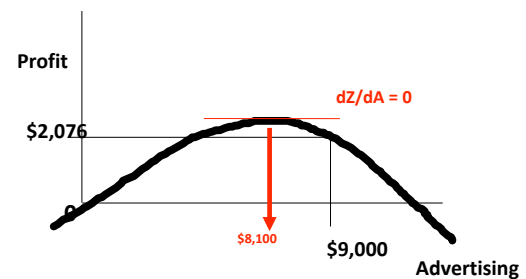
$$1/A^{0.5} = 1/90$$

$$A^{0.5} = 90^1$$

$$A^{0.5/0.5} = 90^{1/0.5}$$

$$A = 90^2 = \mathbf{\$8,100 \text{ is optimal}}$$

What Does The Profit Curve Look Like?



Optimal Advertising

The Optimal Advertising Budget = \$8100

What Profit Does it generate?

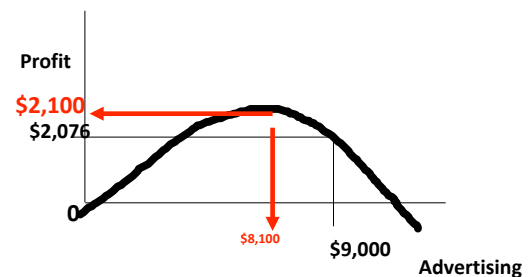
$$Z = 180A^{0.5} - A - 6000$$

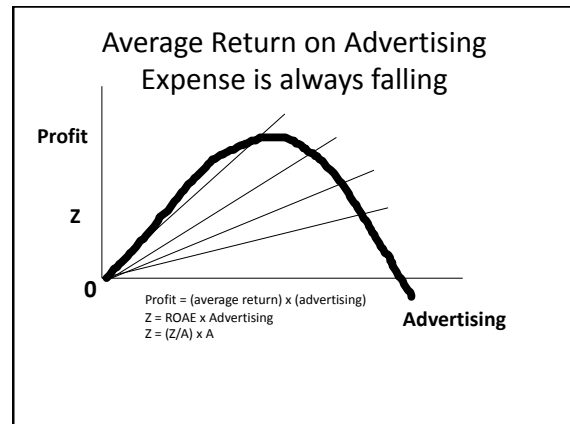
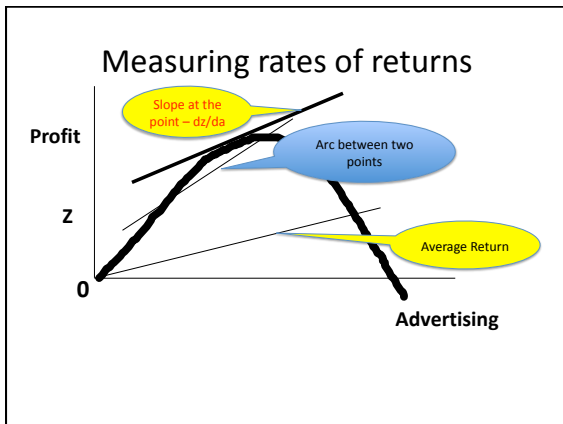
Substitute the optimal budget $A = \$8100$ back into the profit equation

$$Z = 180(8100)^{0.5} - 6000 - 50(0.4(8100)^{0.5}) - 8100$$

$$\mathbf{\text{Maximum Profit } Z = \$2,100}$$

What Does The Profit Curve Look Like?





There is

- An optimal level of advertising expense,
- An optimal number of sales calls,
- An optimal level of product quality,
- An optimal number of retail outlets,
- etc.
- **For maximum profit!**

