

# Week 1: Modeling Business Decisions in Low-Uncertainty Settings

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- ◆ The First Example: Advertising Campaign at Hudson Readers Inc.
  - ◆ How to Build an Optimization Model: Decisions Variables, Objective Function, Constraints
- Session 1**
- ◆ Optimizing with Solver
  - ◆ Alternative Data Inputs
  - ◆ Bringing in Risk Considerations: Managing Investments at Epsilon Delta Capital

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**Session 2**

# Searching for the Best Spending Plan: A Model

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- ◆ Combining the **decision variables**, **objective function** and **constraints** together, we can express our model as

Maximize  $0.05 \cdot A_{SI} + 0.04 \cdot A_{SC} + 0.02 \cdot A_{EI} + 0.03 \cdot A_{EC}$

subject to

$A_{SI} + A_{SC} + A_{EI} + A_{EC} \leq 195$  (advertising budget)

$0.05 \cdot A_{SI} + 0.02 \cdot A_{EI} \geq 3$  (net sales increase in India)

$0.04 \cdot A_{SC} + 0.03 \cdot A_{EC} \geq 4$  (net sales increase in China)

$0.02 \cdot A_{EI} + 0.03 \cdot A_{EC} \geq 0.8 \cdot (0.05 \cdot A_{SI} + 0.04 \cdot A_{SC})$

(Standard vs. Enhanced net sales increase)

$A_{SI}, A_{SC}, A_{EI}, A_{EC} \geq 0$  (non-negative advertising spending)

# Optimal Spending Plan

	A	B	C	D	E	F	G	H
1	Hudson Readers.xlsx							
2	Modeling Risk and Realities MOOC					=SUMPRODUCT(B11:C12,B6:C7)		
3								
4	Net Sales Increase (in \$ per \$ spent on advertising)					Total Net Sales Increase		
5	Product/Market	India	China			(in \$ millions)		
6	Standard	0.05	0.04			7.38		
7	Enhanced	0.02	0.03					
8								
9	Spending Amounts (in \$ millions)							
10	Product/Market	India	China					
11	Standard	67.66	17.97					
12	Enhanced	0.00	109.37					
13								
14	Constraints							
15	Total Spending Budget	195.00	<=	195.00		=SUMPRODUCT(B11:B12,B6:B7)		
16	Sales Increase in India	3.38	=>	3.00		=SUMPRODUCT(C11:C12,C6:C7)		
17	Sales Increase in China	4.00	=>	4.00		=SUMPRODUCT(B12:C12,B7:C7)		
18	Sales Increase for Enhanced Version	3.28	=>	3.28				
19								
20								

◆ See Hudson Readers.xlsx

# Optimal Spending Plan: A Closer Look

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- ◆ See Hudson Readers.xlsx
- ◆ The entire advertising budget of \$195 million is used up
- ◆ The maximum possible total net sales increase HRI can realize using this budget is \$7.38 million
- ◆ The advertising budget is allocated as follows (values are rounded to 0.1%):

Spending %	India	China
Standard	34.7	9.2
Enhanced	0.0	56.1

# What About Different Values of Advertising Budget?

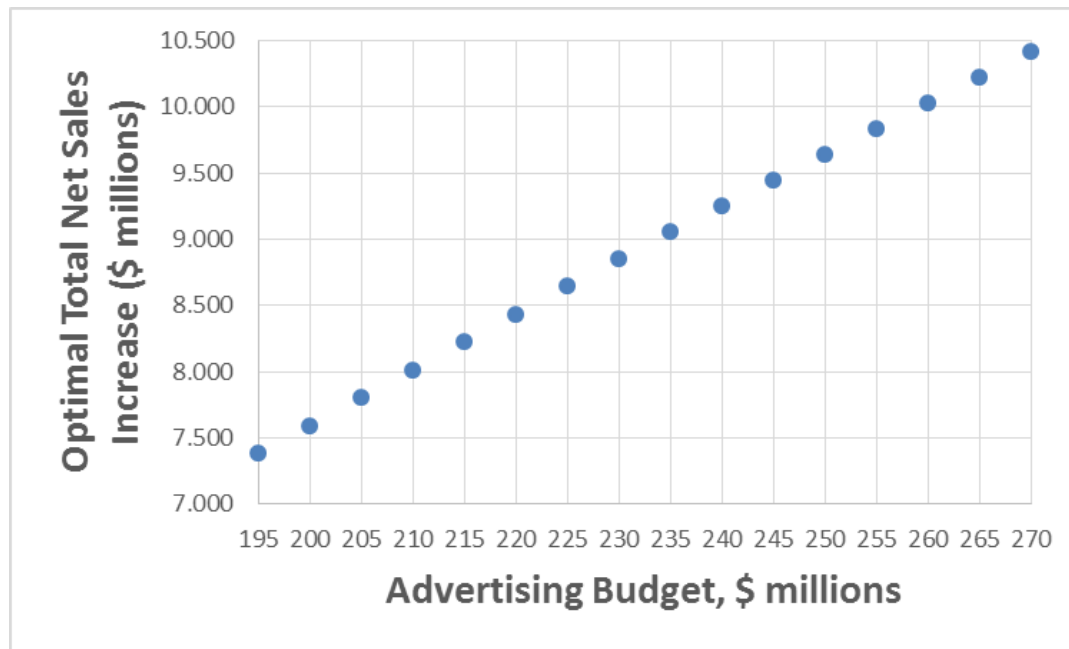
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- ◆ See Hudson Readers.xlsx, Sheet “Analysis”
- ◆ For advertising budget of \$200 million, the maximum possible total net sales increase HRI can realize using this budget is \$7.59 million
- ◆ The advertising budget of \$200 million is allocated as follows (values are rounded to 0.1%):

<b>Spending %</b>	<b>India</b>	<b>China</b>
<b>Standard</b>	35.9	7.8
<b>Enhanced</b>	0.0	56.2

# How Far Do Your Advertising \$ Go: Total Net Sales Increase as a Function of Advertising Budget

- ◆ See Hudson Readers.xlsx, Sheet “Analysis”



- ◆ You can obtain this data by manually changing the value of the advertising budget and re-optimizing the problem, or you can automate the process using Excel Add-in SolverTable (check here [http://kelley.iu.edu/albright/free\\_downloads.htm](http://kelley.iu.edu/albright/free_downloads.htm))

# How Far Do Your Advertising \$ Go: Total Net Sales Increase as a Function of Advertising Budget

- ◆ See Hudson Readers.xlsx, Sheet “Analysis”

$$0.0422 = (7.594 - 7.383)/(200-195)$$

Budget (\$ millions)	Optimal Total Net Sales Increase (\$ millions)	Extra Optimal Net Sales Increase/Extra Budget
195.000	7.383	
200.000	7.594	0.0422
205.000	7.805	0.0422
210.000	8.016	0.0422
215.000	8.227	0.0422
220.000	8.438	0.0422
225.000	8.648	0.0422
230.000	8.859	0.0422
235.000	9.064	0.0410
240.000	9.257	0.0386
245.000	9.450	0.0386
250.000	9.643	0.0386
255.000	9.836	0.0386
260.000	10.029	0.0386
265.000	10.221	0.0386
270.000	10.414	0.0386

$$0.0386 = (10.414 - 10.221)/(270-265)$$



# How Far Do Your Advertising \$ Go: Total Net Sales Increase as a Function of Advertising Budget

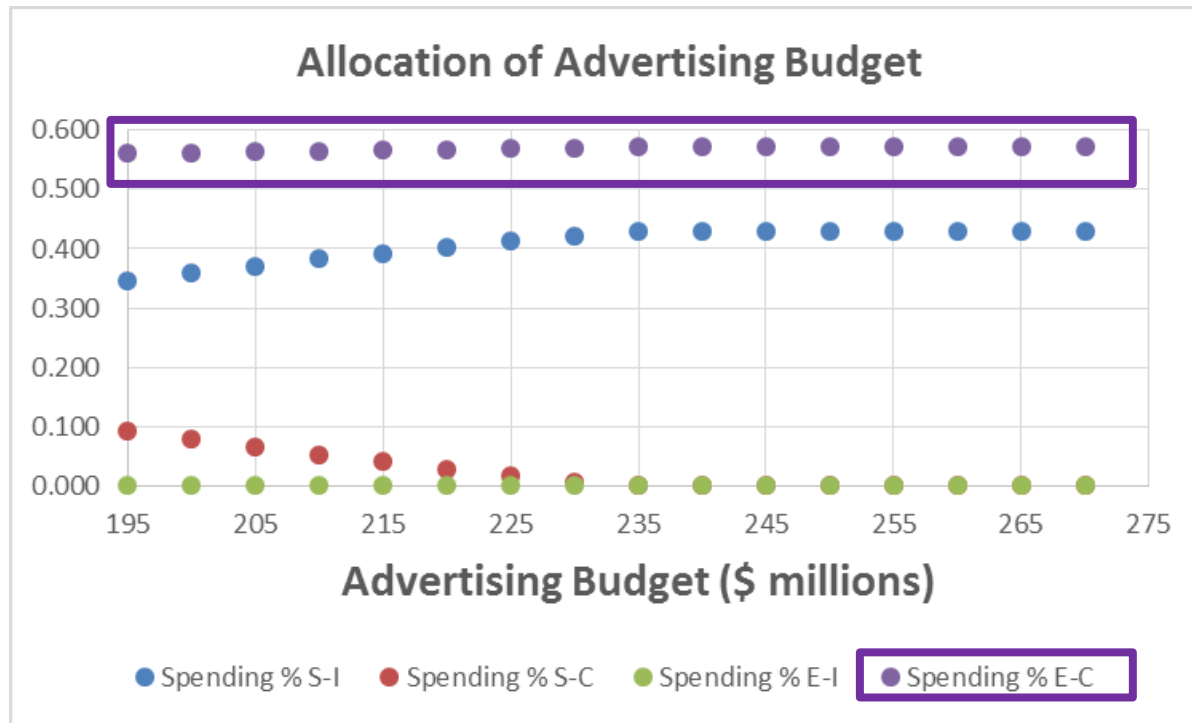
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- ◆ The impact of increased budget drops from 4.22c to 3.86c on a \$

# How is the Advertising Budget Allocated?

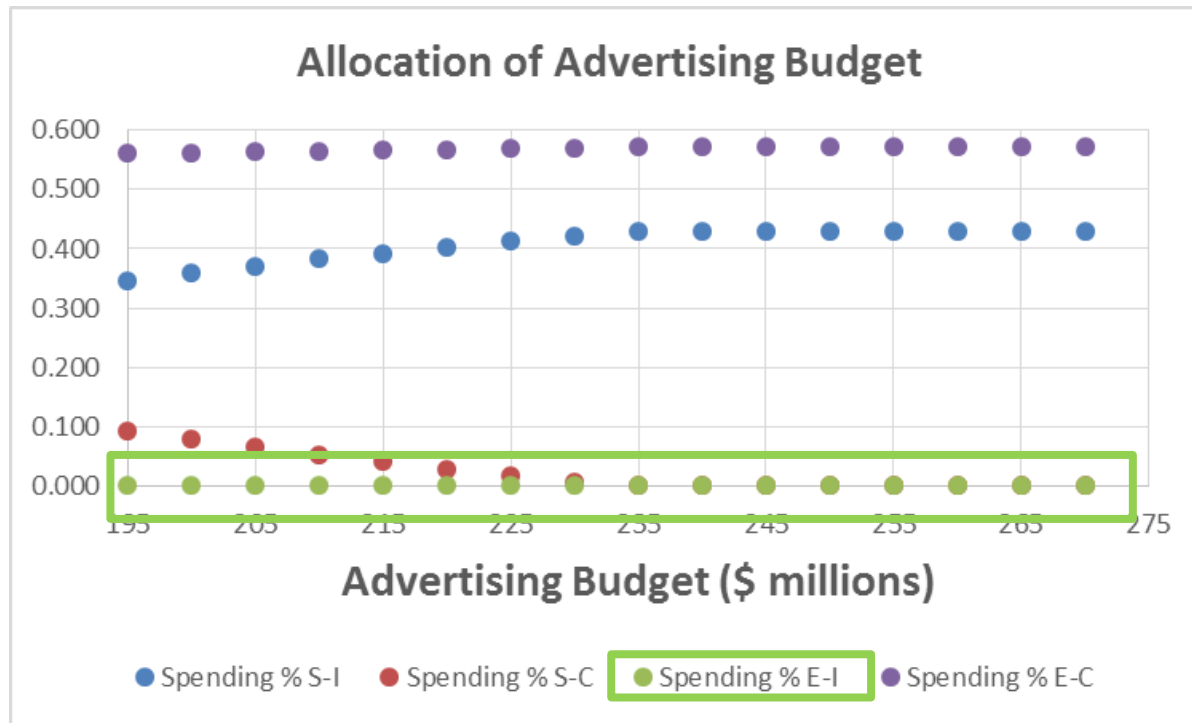
- ◆ See Hudson Readers.xlsx, Sheet “Analysis”



- ◆ Advertising of the Enhanced version in China remains stable around 56%-57% across the range of budget values between \$195 and \$270 million

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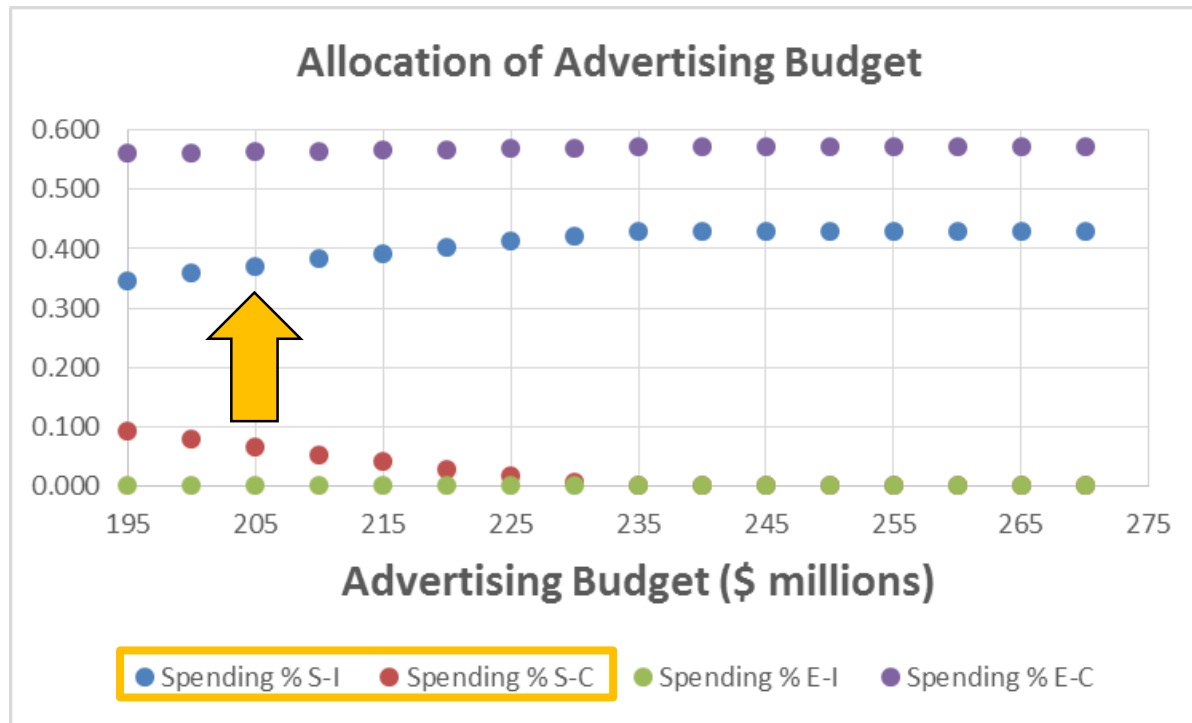
- ◆ See Hudson Readers.xlsx, Sheet “Analysis”



- ◆ Advertising of the Enhanced version in India remains unattractive across the same range of budget values

# How is the Advertising Budget Allocated?

- ◆ See Hudson Readers.xlsx, Sheet “Analysis”



- ◆ The share of advertising of the Standard version shifts from China to India for the same range of budget values