

Week 2: Making Best Decisions in Settings with Low Uncertainty

- ◆ A resource allocation example: Zooter Industries
- ◆ Converting a verbal problem description into an algebraic model: decisions, objective, constraints
- ◆ From an algebraic model to a spreadsheet implementation: optimizing with Excel Solver
- ◆ Matching demand and supply across space: Keystone Dry Goods

Logistics

Zooter Resource Allocation Problem: A Complete Model

Maximize $150 * R + 160 * N$

subject to

$4 * R + 5 * N \leq 5610$ (frame manufacturing hours)

$1.5 * R + 2.0 * N \leq 2200$ (wheel and deck manufacturing hours)

$1.0 * R + 0.8 * N \leq 1200$ (QA and packaging hours)

$R, N = \text{integer}$

$R, N \geq 0$

- ◆ We will use Solver to “optimize” this model, i.e., to find the best combination of values for decision variables R and N

Solver Optimizer on Various Platforms

- ◆ Likely to be a part of standard Excel installation on Windows
- ◆ On Mac (see <https://support.microsoft.com/en-us/kb/2431349>)
 - Included on Excel 2016 for Mac
 - Included starting with Excel for Mac 2011 Service Pack 1 (version 14.1.0).
 - Not included with Excel for Mac 2008, but can be downloaded from <http://www.solver.com/solver-2008-mac>
- ◆ Google Sheets: available as “add-on”

Spreadsheet Solution:

	A	B	C	D	E	F	G	H
1	Zooter.xlsx							
2	Operations Analytics MOOC							
3			Maximize $150 \cdot R + 160 \cdot N$ subject to $4 \cdot R + 5 \cdot N \leq 5610$ (frame manufacturing hours) $1.5 \cdot R + 2.0 \cdot N \leq 2200$ (wheel and deck manufacturing hours) $1.0 \cdot R + 0.8 \cdot N \leq 1200$ (QA and packaging hours) $R, N = \text{integer}$ $R, N \geq 0$					
4								
5								
6								
7								
8								
9	Profit Contribution (\$/unit)		Razor	Navajo		=SUMPRODUCT(C9:D9,C10:D10)		
10	Units to Make		150	160		Total Profit (\$)		
11			840	450				
12			=SUMPRODUCT(\$C\$10:\$D\$10,C14:D14)					
13			Resource requirements					
14	Frame Manufacturing		Razor	Navajo	Required (hours)		Available (hours)	
15	Wheels and Deck Assembly		4	5	5610		5610	
16	QA and Packaging		1.5	2	2160		2200	
17			1	0.8	1200		1200	

- ◆ Zooter.xlsx: a file containing the spreadsheet solution with added comments that express formulas we used
- ◆ According to Solver, the best decision is to produce 840 Razors and 450 Navajos in the coming week
- ◆ This decision will result in the weekly profit of \$198000

Optimization Concepts

- ◆ **Solution:** a particular choice of values for the decision variables
- ◆ **Feasible Solution:**
 - satisfies all constraints
 - $R=500$, $N=500$ is feasible
 - $R=500$, $N=750$ is infeasible
- ◆ **Objective Function Value (OFV):**
 - value of objective function for a solution
 - $OFV = \$155000$ for $R=500$, $N=500$
- ◆ **Optimal Solution:**
 - feasible solution whose OFV cannot be improved upon
 - $R=840$, $N=450$ is optimal for the Zooter model
 - in general, there may be more than one optimal solution