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 = 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:

Maximize $150*R + 160*N$

subject to

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

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

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

R, N = integer

$R, N \ge 0$

=SUMPRODUCT(C9:D9,C10:D10)

=SUMPRODUCT($C$10:$D$10,C14:D14)

	A	B	C	D	E	F	G
1	**Zooter.xlsx**						
2	**Operations Analytics MOOC**						
8			**Razor**	**Navajo**			
9	**Profit Contribution ($/unit)**		150	160		**Total Profit ($)**	
10	**Units to Make**		**840**	**450**		**198000**	
12		**Resource requirements**					
13			**Razor**	**Navajo**	**Required (hours)**		**Available (hours)**
14	**Frame Manufacturing**		4	5	5610	<=	5610
15	**Wheels and Deck Assembly**		1.5	2	2160	<=	2200
16	**QA and Packaging**		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