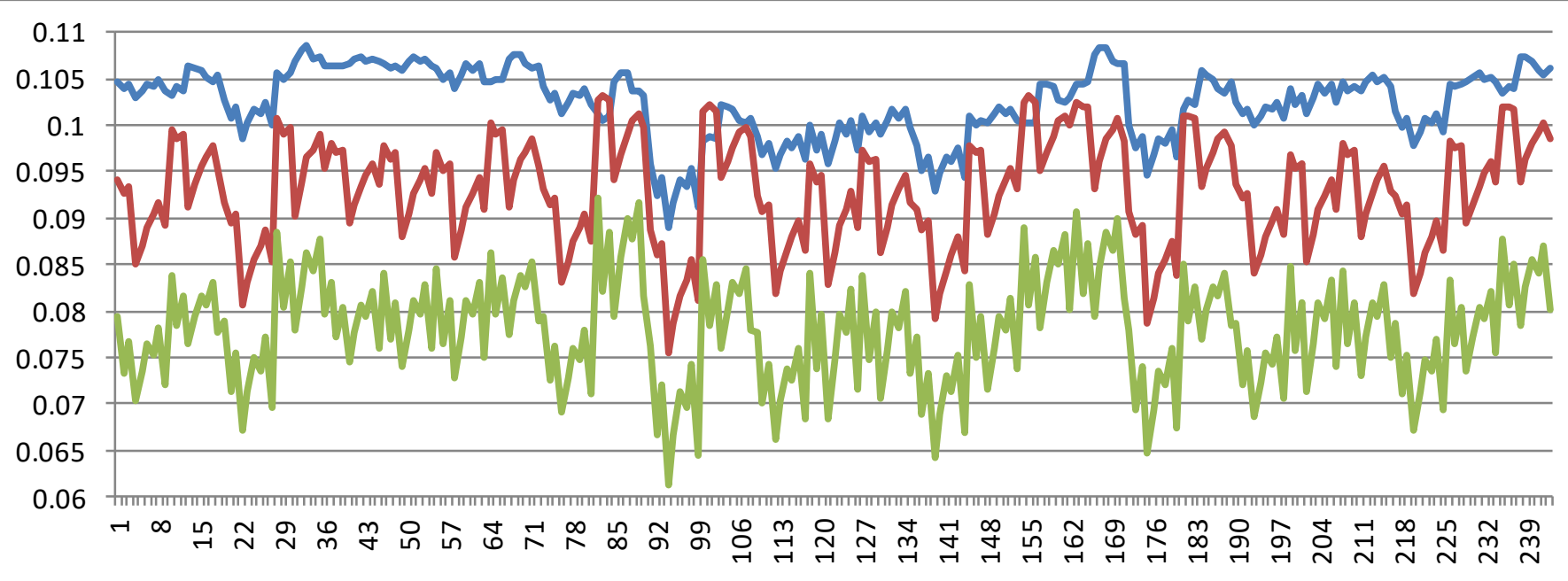


ANP Sensitivity Analysis

Orrin Cooper

3rd Party Logistics Provider Selection



- Third Party A
- Third Party B
- Third Party C

Value of Sensitivity Analysis

- ▶ Have you ever “known” which alternative would be the most preferred, only to synthesize the model and get a different result?
- ▶ How robust is my decision?
- ▶ Which criteria are most important or influential?
- ▶ What would happen if “this” or “this” criteria had been weighted differently?
 - ▶ How much can this priority change before the decision changes? (Limits: gas price example)
- ▶ Would it even make a difference in the final outcome? (Stakeholders)

Literature

- ▶ Mu, E., Cooper, O., & Peasley, M. (2020). Best Practices In Analytic Network Process Studies. *Expert Systems with Applications*
- ▶ Sava, M. G., Vargas, L. G., May, J. H., & Dolan, J. G. (2020). Multi-dimensional stability analysis for Analytic Network Process models. *Annals of Operations Research*, 1-24.
- ▶ Chen, Y., Yu, J., & Khan, S. (2013). The spatial framework for weight sensitivity analysis in AHP-based multi-criteria decision making. *Environmental modelling & software*, 48, 129-140.
- ▶ Adams, B. (2011, May). ANP Row Sensitivity. In *International Symposium on The Analytical Hierarchy Process*.
- ▶ Search: ANP Sensitivity Analysis - many methods
- ▶ Linear Programming, Optimization, Machine Learning Sensitivity Analysis
- ▶ Other MCDA tools also have/use Sensitivity Analysis

Value of AHP/ANP?

Competing Arguments:

- ▶ The method itself and the FINAL ANSWER (Hypothesis Testing/Post Hoc Analysis)
 - ▶ “If you torture the data enough, it’s going to ultimately tell you what you want it to tell you.” (Dr. Fauci, 2020)
- ▶ The PROCESS and how it helps us understand, design, and frame the problem. And then thoughtfully evaluate and make *trade-offs*.
 - ▶ What we learn in the PROCESS is as important as the FINAL ANSWER
- ▶ PROCESS and FINAL ANSWER and SENSITIVITY ANALYSIS
 - ▶ FINAL ANSWER of course, what we learn in the PROCESS, AND what we LEARN from the SENSITIVITY ANALYSIS (LP Baking Model: Sugar)

Understand the problem and the Supermatrix

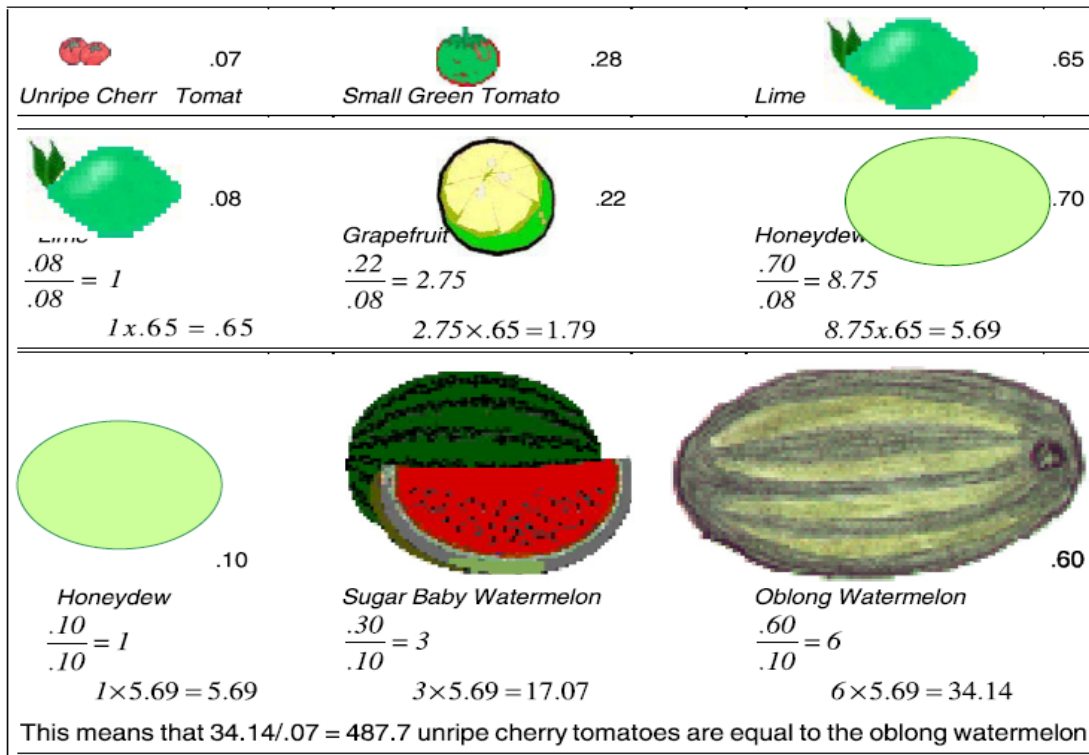
- ▶ Beauty of ANP - don't need to know scales or too expensive
 - ▶ Must pay attention to units of measurement
- ▶ Must know what is going on in your model or else:
 - ▶ Tamales Sales (regression)- increase price and sell more ...
 - ▶ Labrador dogs life expectancy - bleach my dog's hair ...
 - ▶ Pivot Tables - hard to get errors but students won't read the data key, no double checking - again the *process* as much as final decision
- ▶ Must know your model and how it works to do good / meaningful sensitivity analysis

Outline

- ▶ Understanding the Supermatrix via an ANP Fruit Baskets model
- ▶ Explore sensitivity analysis
 - ▶ Excel
 - ▶ Super Decisions

Understanding the Supermatrix ANP - Fruit Baskets Model

T.L. Saaty, J.S. Shang / European Journal of Operational Research 214 (2011) 703–715



Homogenous Clusters

Small Fruit		
Cherry Tomato		0.07
Small Green Tomato		0.28
Lime		0.65

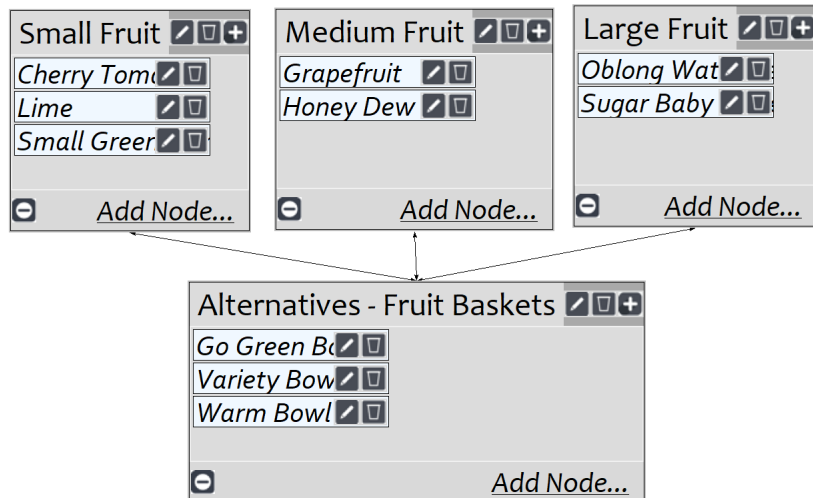
Medium Fruit		
Lime		0.08
Grapefruit		0.22
Honey Dew		0.70

Large Fruit		
Honey Dew		0.10
Sugar Baby Watermelon		0.30
Oblong Watermelon		0.60

Understanding the Supermatrix

ANP - Fruit Baskets Model

	Alternative 1 Variety Bowl	Alternative 2 Go Green Bowl	Alternative 3 Warm Bowl
Cherry Tomato	20	0	20
Small Green Tomato	0	5	0
Lime	5	10	5
Grapefruit	2	0	5
Honey Dew	1	4	1
Sugar Baby melon	0	0	1
Oblong Watermelon	1	0	0



Understanding the Supermatrix ANP - Fruit Baskets Model

- ▶ Unweighted Supermatrix
- ▶ Weighted Supermatrix
- ▶ Limit Matrix
- ▶ Final Priorities
 - ▶ Alternatives
 - ▶ Criteria
- ▶ What Sensitivity to do?
 - ▶ Controversial elements (whether or not “important”)
 - ▶ Size of Influence
 - ▶ “Weakest” Comparisons

Understanding the Supermatrix

ANP - Fruit Baskets Model

- ▶ Excel
- ▶ Super Decisions

Super Decisions Relocation of Corporate Headquarters2 - ANP BOCR Model

- ▶ Located under: Super Decisions Help/Sample Models/BOCR Models
- ▶ Excel
- ▶ Super Decisions

- ▶ 12 Subnetworks
 - ▶ Changes in Subnetworks WILL LIKELY Impact the Ratings Model
 - ▶ “If a node changes in 1 subnetwork should it change in another?”
 - ▶ Potentially Complicated but still some meaningful analysis

Reporting

- ▶ Good Quality Graphs
- ▶ Concerns not resolved in the literature: about how to reappportion weights, Many opinions but each need more research, is the analysis meaningful (or just complicated).
- ▶ Potentially different valid arguments depending on reasons
 - ▶ Important to be transparent and defend

Questions

