



Module 12: Advanced Topics

12.1 Applications of Decision Analysis to Environmental Problems




Decision Analysis

- ♦ Decision analysis is a methodology to help organize information and inform decision makers
- ♦ It can use either quantitative or qualitative methods
- ♦ It won't make the decision but it does help compare decision alternatives
- ♦ It also makes the process more transparent by explicitly laying out what has been considered and how it has been evaluated






Decision Analysis

- ◆ First, in conjunction with all of the stakeholders in the decision process, you decide on the important criteria or goals to achieve
 - ◆ The different decision criteria can be all considered equally important or can be given different weights
 - ◆ A number of decision alternatives are then created
- 




Decision Analysis

- ◆ Those knowledgeable about the alternatives and the criteria then rank how well each alternative would meet each criteria
 - This can be done scientifically and quantitatively, or
 - Qualitatively using judgment
- 





Decision Analysis

- ◆ An objective function is formed that merges together the information on the weights and the rankings to give an overall evaluation of each alternative
 - ◆ This gives an objective, transparent, and consistent way to evaluate and compare decision alternatives
- 





Example

- ◆ Let's say that you need to make a cleanup decision for a contaminated industrial site in a small town
 - ◆ You meet with the company's officers, local elected officials, and residents who raised initial concerns
 - ◆ You then hold some public meetings to get ideas from a broader range of stakeholders
 - Employees
 - Neighbors
 - Parents
 - Etc
- 




Example

- ◆ From these meetings, you
 - Identify concerns
 - Form a stakeholder group to continue to work with
- ◆ You find three overall concerns:
 - The economy of the town depends on the company's continued operation
 - The local residents are concerned about their and their children's health (children walk next to and across the site)
 - Local ecologists are worried that runoff from the site might impact important wetlands and local wildlife




Example

- ◆ So, there are three things that are important to balance
 - Human health concerns
 - Economic concerns
 - Ecological concerns
- ◆ The group you are working with debates the relative importance of these and decides that the first two are equally important and the ecological goal is half as important as them






Example

- ◆ A number of different types of cleanup could be done
 - No Action until the company closes the plant (about 10 years)
 - Partial remediation now to mitigate hazards with more cleanup at shutdown
 - Immediate shutdown of the operation and total cleanup
- 



Example

- ◆ You then work with the group to identify how well each alternative would meet each criteria
 - You call in experts to help with this if needed
 - ◆ You come up with a ranking scheme where each alternative is rated from 0 to 5 where
 - 0 = does not meet criteria
 - 1 = meets criteria poorly
 - 3 = meets criteria moderately
 - 5 = meets criteria perfectly
- 

Example


		Criteria		
		Health	Economy	Ecology
Alternatives	No Action	0	5	0
	Partial Cleanup	3	4	3
	Total Cleanup	5	0	5

Example

- ◆ The objective function:
 - Weights are 1, 1, and 0.5 (you can use any numbers here as long as they have the correct relationship)
 - The overall evaluation = $\text{weight}_1 * \text{rating}_1 + \text{weight}_2 * \text{rating}_2 + \text{weight}_3 * \text{rating}_3$



Example

- ◆ Alternative 1 (No Action)
 - Evaluation = $1 * 0 + 1 * 5 + 0.5 * 0 = 5$
 - ◆ Alternative 2 (Partial Cleanup)
 - Evaluation = $1 * 3 + 1 * 4 + 0.5 * 3 = 8.5$
 - ◆ Alternative 3 (Total Cleanup)
 - Evaluation = $1 * 5 + 1 * 0 + 0.5 * 5 = 7.5$
- 



Example

- ◆ So, the partial cleanup has the highest overall evaluation
 - ◆ Whether or not the decision makers chose this alternative, the process has resulted in a discussion of goals, relative weights, and possible decision alternatives
 - ◆ Sometimes the process is as important or more important than the outcome
- 