**MODULE OBJECTIVES**

* Review the role of objective weights in multi-criteria decision analysis
* Compare and contrast approaches for weighting objectives

**DISCUSSION**

* What role do objective weights play in multi-criteria decision analysis?
* What approaches have you learned so far for determining weights?

**MULTI-CRITERIA DECISION ANALYSIS**

* The thing that makes solving multiple objective problems difficult is the challenge of trading off apples for oranges
* MCDA requires use to determine the relative importance of the apples and oranges – once we do that, we are a long way toward solving the problem
* We call these relative importances *objective weights*

**SMART**

* If we have our weights, we can do some relatively simple calculations to solve the decision problem
* We can use the Simple Multi-Attribute Rating Technique:
  + First, simplify – consider dominated alternatives, irrelevant objectives, and even swaps
  + Then, solve by:
  + Standardizing all attributes
  + Assigning weights to each attribute
  + Calculating weighted sum of scores for each alternative
  + Identifying alternative with highest weighted score
  + Evaluating the results for insights and sensitivity

**WEIGHTS**

* Weights are a statement of the decision-maker’s values – how relatively important is this objective versus that objective?
* What do we want our weights to do?
  + Faithfully represent the values of the decision maker
  + Be understandable to the decision maker
  + Be feasible to elicit given the technical understanding of the decision maker

**SWING WEIGHTS**

* Swing weights use the “swing” of an objective (the range of the objective across alternatives) to determine weights
* Method:
  + Develop a *hypothetical* “worst case” alternative that sets each objective at its lowest level
  + Develop additional *hypothetical* alternatives (one for each objective) that move one objective at a time from its worst to its best value
  + Rank these hypothetical alternatives (the worst case will be ranked last)
  + Assign a score to these hypothetical alternatives (the worst will be 0 and the best will be 100) as a measure of the relative attractiveness of the alternative to the decision maker
  + Divide each score by the sum of all scores
  + Use these scores as the weights for the objectives (where the weight for objective *i* is from the alternative in which that objective was swung from worst to best)

**RABBIT MANAGEMENT**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Objective** | |  |  | **Range** | | **Hypothetical Alternatives (apartments)** | | | |
|  | Description | Attribute | Goal | Worst | Best | Benchmark | 1 | 2 | 3 |
|  |  |  |  |  |  |  |  |  |  |
| **A** | Rent | $K/mo | min | 1.8 | 1.2 | 1.8 | 1.2 | 1.8 | 1.8 |
| **B** | Location | Distance to work | miles | 5 | 0.8 | 5 | 5 | 0.8 | 5 |
| **C** | Neighborhood attractiveness | Walk score | max | 40 | 90 | 40 | 40 | 40 | 90 |
|  |  |  |  |  |  |  |  |  |  |
|  | Rank | (1 is best; 4 is worst) | | | | 4 |  |  |  |
|  | Score | (100 is best; 0 is worst) | | | | 0 |  |  |  |
|  | Weight | score/(sum of scores) | | | | 0 |  |  |  |

**DISCUSSION**

* Swing weighting is hard…
* What is hard about it?

**ALTERNATIVES TO SWING WEIGHTING**

* Rank-based calculations
* Use swing ranks (use ranks from swing weighting)
* Then use one of the rank-based methods, e.g.,
* Rank-reciprocal method:
* Rank-sum method:

where is the rank of objective and is the number of objectives

**ALTERNATIVES TO SWING WEIGHTING**

* Rank-then-score
* e.g., Fixed-point scoring
* Rank objectives
* Distribute a fixed number of points (e.g., 100) among objectives
* Requires DM to make tradeoffs because the total points are fixed
* Standardize values to sum to 1
* Doesn’t consider swing

**EXERCISE**

* Open the Florida Whooping Crane problem spreadsheet (Jan18\_Cranes.xlsx)
* Complete the swing-weighting exercise
* Complete the SMART analysis with equal weights (), swing weights, and rank-reciprocal weights
* Discuss the strengths and weaknesses of each method in your group
* Discuss the two important steps to take after analysis for evaluating your weights

**MODULE DEVELOPED BY:**

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