ECE 215 Spring 2025

Objective 1.8: Decision Matrices

UNITED STATES AIR FORCE ACADEMY

Objective 1.8

I can use a decision matrix to quantitatively compare various measures of merit.

Decision Matrices

- Quantitative approach to decision making
- What we care about: Measures of Merit
- Suppose we have 2 systems (A and B) to compare

	Cost	Efficiency
Sys A	$600	75.50%
Sys B	$1,500	99.19%

- How we do it:
  - Normalize each value
  - Weight each measure of merit
  - Add scores for each system

Normalization

- Normalization, removes units, levels playing field
- Best option gets a score of 1.0, other scores are calculated by:

$$\text{Score}_{\text{normalized}} = \frac{\text{Lowest Raw Value}}{\text{Raw Value}} \longrightarrow \text{Minimize Parameter}$$

-OR-

$$\text{Score}_{\text{normalized}} = \frac{\text{Raw Value}}{\text{Highest Raw Value}} \longrightarrow \text{Maximize Parameter}$$

- Which formula do we use?
- What if we pick the wrong one?!?!

Normalization in Action

Back to our example:

	Cost		Efficiency	
	Value	Normalized	Value	Normalized
Sys A	$600		75.50%	
Sys B	$1,500		99.19%	

Weighting and Combining

- Weights assign relative importance to Measures of Merit
- Weights must add up to 1
- Total score is:

Total Score

$$(\text{Weight}_1 \times \text{Score}_{1,\text{normalized}}) + (\text{Weight}_2 \times \text{Score}_{2,\text{normalized}}) + \ldots$$

	Cost			Efficiency			
	Value	Normalized	Weighted	Value	Normalized	Weighted	Total
Sys A	\$600	1		75.50%	0.761		
Sys B	\$1,500	0.4		99.19%	1		

Real World Example

	Cost	Camera	Display	Battery	RAM
Galaxy S22 Ultra	$ 1199	108 MP (triple)	500 ppi	5000 mAh	8 GB
Pixel 6pro	$1049	50 MP (triple)	512 ppi	5003 mAh	12 GB
OnePlus 10	$700	48 MP (triple)	525 ppi	5000 mAH	12 GB

- What if all the attributes are equally important?
- What if you're flush with cash and don't care about money, but battery life is really important?

Class Competition!

Goal: Build the best-performing voltage divider

Rules of the competition:

- Your team must build a series circuit using two resistors, the DC power supply, and a breadboard.
- You may use any two resistors in the bins.
- Your source voltage must be 5V.
- Performance will be based on 50% weightings for both measures of merit:
  - *Target voltage accuracy.* One resistor will be the load (R_{load}). Your team must try to get as close to 3.1V across R_{load} as possible.
  - *Power loss.* The non-load resistor represents losses (R_{loss}). Your team must try to minimize the power consumed by R_{loss}.