HW Wk 05 - Make a decision!

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The decision we chose to evaluate using the Decision Matrix and AHP methodologies was which electric vehicle to purchase. We considered factors such as price, range, 0-60 time, and safety for three EVs: the Tesla Model 3, Hyundai Ioniq 5, and Nissan Leaf.

The **Decision Matrix** for this decision was relatively straightforward, with the greatest weight placed on price, while 0-60 time was the least important criterion to us.

		Tesla Model 3	Hyundai Ioniq 5	Nissan Leaf
Price	**5**	3	3	5
Range	**3**	5	4	2
0-60 time	**3**	4	3	1
Safety	**4**	5	5	5
Score		17	15	13

Using the **AHP method** is more complex for computing scores, but it is important because it reduces bias and focuses more on the objective attributes of each vehicle.

We started by computing the weights of each criterion via pair-wise comparisons:

	Price	Range	0-60 Time	Safety	Mean	Weight
Price	1	8	8	9	6.50	0.50
Range	0.13	1	7	8	4.03	0.31
0-60 Time	0.13	0.14	1	7	2.07	0.16
Safety	0.11	0.13	0.14	1	0.34	0.03

The higher the weight, the greater the importance. According to the table, price is the most important criterion, while safety is the least important.

First, we rated the price alternatives using this formula:

$$\alpha = \frac{min\{cost\}}{cost}$$

We then normalized them using this formula:

$$normalized\ \alpha_i = \frac{\alpha_i}{\Sigma^n_1 a_j}$$

The priority averages for the **price**:

Vehicle (price)	Tesla	Hyundai	Nissan	Row Sum	Priority Avg
Tesla	0.32	0.31	0.31	0.94	0.32
Hyundai	0.32	0.31	0.31	0.94	0.31
Nissan	0.37	0.37	0.37	1.11	0.37

The same approach was applied to the **range** criterion, using the longest range in the numerator because a greater range signifies better performance, unlike the price comparisons, where a lower value was preferred.

Vehicle (range)	Tesla	Hyundai	Nissan	Row Sum	Priority Avg
Tesla	0.41	0.41	0.41	1.23	0.41
Hyundai	0.36	0.36	0.36	1.08	0.36
Nissan	0.24	0.24	0.24	0.72	0.24

The **0-60 time** matrix followed the same principle as the price criterion, in which lower values represent better performance. Using the formula above, the resulting table is shown below:

Vehicle (0-60 time)	Tesla	Hyundai	Nissan	Row Sum	Priority Avg
Tesla	0.39	0.39	0.39	1.17	0.39
Hyundai	0.36	0.36	0.36	1.09	0.36
Nissan	0.25	0.24	0.24	0.74	0.25

The final category, **safety**, saw all cars earning 5-star ratings, which resulted in identical scores of 0.33 each.

Inputting all the results from the subtables, we get the final AHP Matrix:

		Tesla Model 3	Hyundai Ioniq 5	Nissan Leaf
Price	**0.50**	0.32	0.31	0.37
Range	**0.31**	0.41	0.36	0.24
0-60 time	**0.16**	0.39	0.36	0.24
Safety	**0.03**	0.33	0.33	0.33
Score		0.36	0.34	0.31

AHP Method ranking

1. Tesla Model 3
2. Hyundai Ioniq 5
3. Nissan Leaf

Decision Matrix Method ranking

1. Tesla Model 3
2. Hyundai Ioniq 5
3. Nissan Leaf

We can see that the rankings of the EVs are identical to the rankings obtained using the Decision Matrix method. Based on the results from both methods, we should buy the Tesla Model 3.