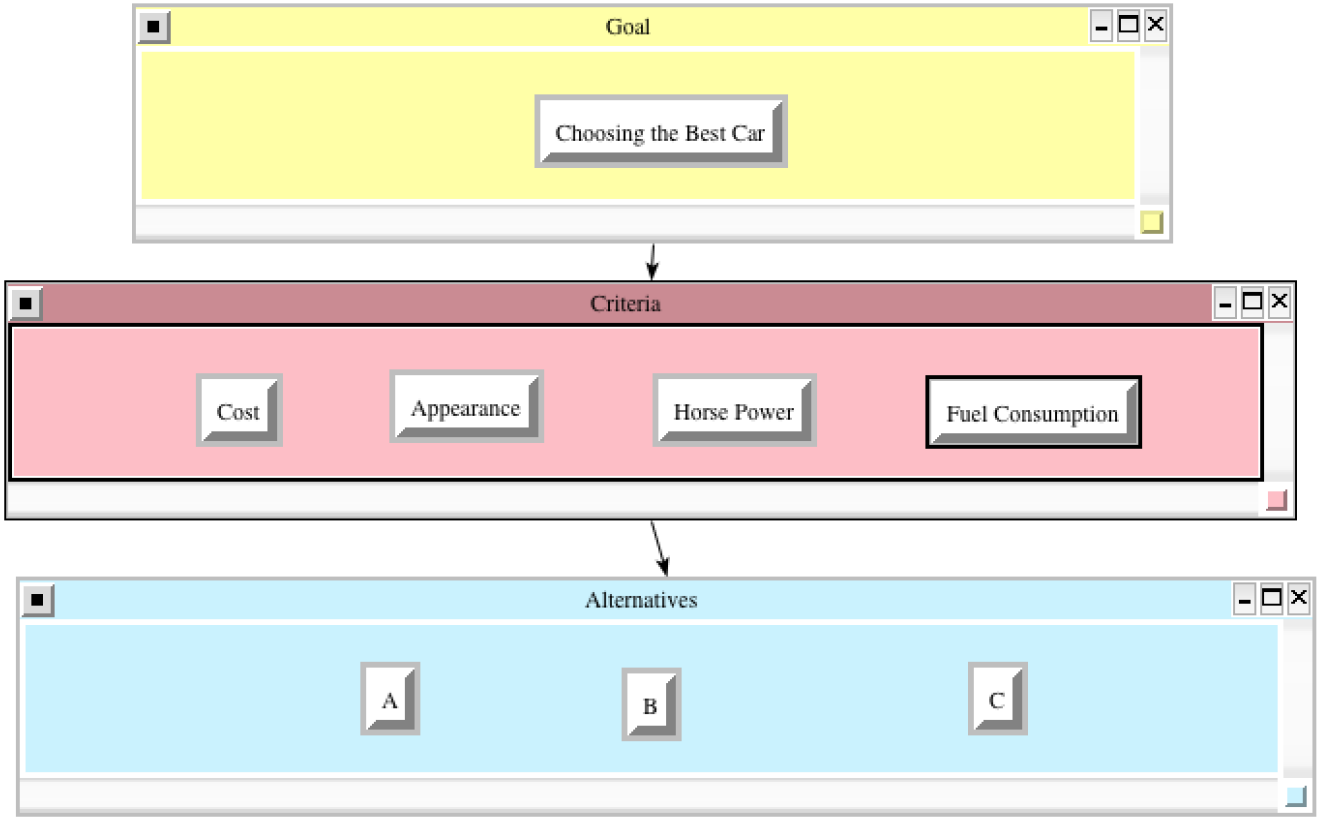
1. THE ANALYTIC HIERARCHY PROCESS (AHP)

Problem: You've just started new job and you want to get your first car. You have four criteria to influence the decision: Price of the vehicle, fuel consumption, vehicle appearance and horsepower. There are 3 vehicle alternatives to decide: A, B and C.

Hierarchy for the Purchasing Decision Problem



Cost			
	A	**B**	**C**
A	1	3	1
B	1/3	1	1/5
C	1	5	1

Appearance			
	A	**B**	**C**
A	1	3	1
B	1/3	1	1/5
C	1	5	1

Horse Power			
	A	**B**	**C**
A	1	3	1
B	1/3	1	1/5
C	1	5	1

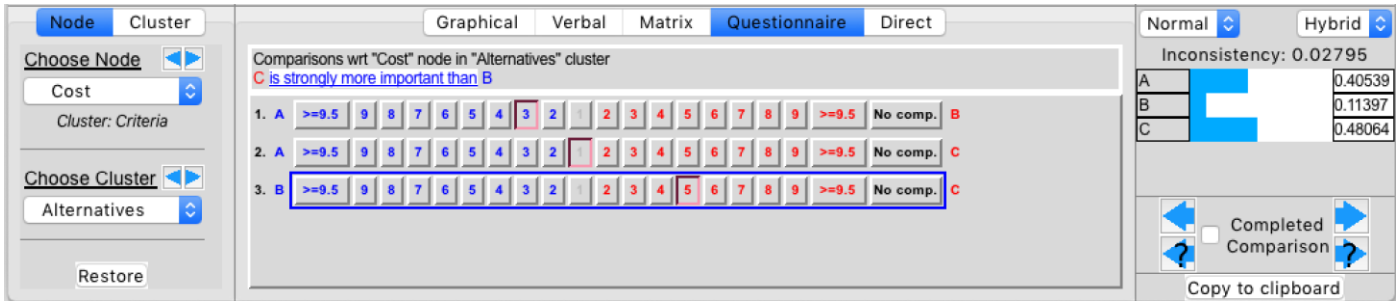
Fuel Consumption			
	A	**B**	**C**
A	1	6	1/3
B	1/6	1	1/9
C	3	9	1

Criteria				
	Cost	**Fuel Consumption**	**Appearance**	**Horse Power**
Cost	1	1/5	3	4
Fuel Consumption	5	1	9	7
Appearance	1/3	1/9	1	1
Horse Power	1/4	1/7	1	1

Priority Vector for Criteria

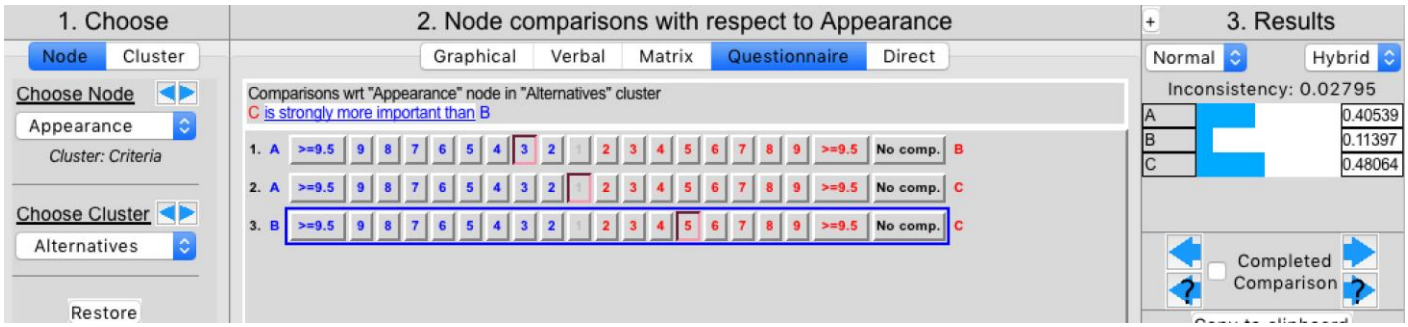
Inconsistency:0.035995. Since the consistency ratio, CR, is less than 0.10, this is well within the acceptable range for consistency.

Priority Vector for Cost



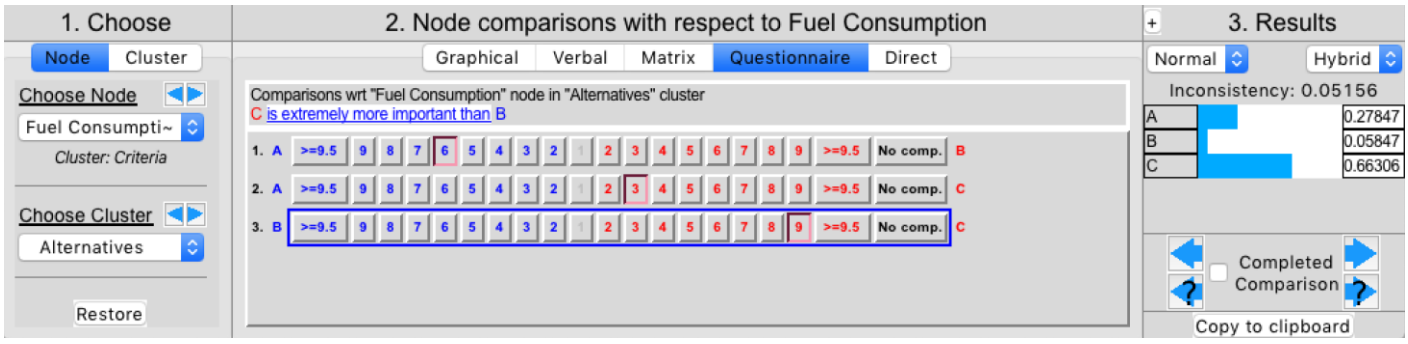
Inconsistency:0.02795. Since the consistency ratio, CR, is less than 0.10, this is well within the acceptable range for consistency.

Normalized Matrix for Appearance and Priority Vector for Appearance



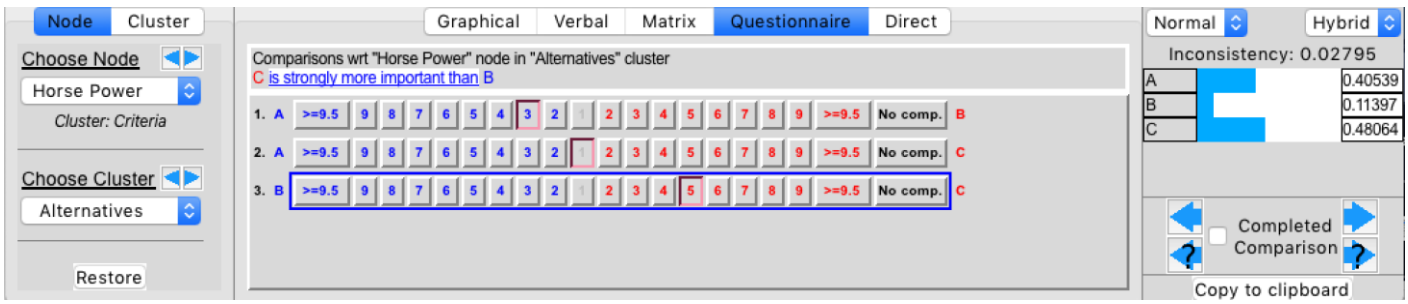
Inconsistency:0.02795. Since the consistency ratio, CR, is less than 0.10, this is well within the acceptable range for consistency.

Normalized Matrix for Fuel Consumption and Priority Vector for Fuel Consumption



Inconsistency:0.05156. Since the consistency ratio, CR, is less than 0.10, this is well within the acceptable range for consistency.

Normalized Matrix for Horse Power and Priority Vector for Horse Power



Inconsistency:0.02795. Since the consistency ratio, CR, is less than 0.10, this is well within the acceptable range for consistency.

Overall Priority Vector: C appears to be the overall recommendation**.**

Name	Graphic	Ideals	Normals	Raw
A		0.532238	0.320642	0.160321
B		0.127674	0.076916	0.038458
C		1.000000	0.602442	0.301221

2. PROMETHEE

Problem

We have an agricultural farm. And we need to buy a new tractor to our farm. We have 3 actions and 4 criteria for this need. Because of the criteria that are not very important, we have to choose between the following 3 choices.

1) Fendt 312 Vario
2) New Holland T5
3) Kubota M9540

Definition of Criteria and Type of Criteria

There are 5 criteria which are very important for us. These are described below in the order. In addition, what functions are used for the solution method with Promethee are explained.

Tractor Selection Scenario								
		Weights	Min or Max	Actions			Type Of Criteria	Parameters
				Fendt 312 Vario	New Holland T5	Kubota M9540		
Criterions	Price	0,27	Min	150000	90000	75000	V	q=5000, p=10000
	Lift Capacity	0,13	Max	6	4,5	2,3	III	p=1,5
	Horse Power	0,20	Max	200	150	100	IV	q=40, p=100
	Fuel Consumption	0,27	Min	6	5	3,5	II	q=1
	Speed	0,13	Max	60	50	40	II	q=10

1) Price

Because our purchasing power is limited, the price of the tractor is very important for us. Therefore, the weight of the price property is %27. The min 5.000 euro changes in tractor price are important. Difference is good for us the tractor price is between 5.000 – 10.000. We preferred the linear function of the Promethee criteria definitions functions for the price value. (**Linear**, **%27**, **min**, **q=5.000, p=10.000**)

2) Lift Capacity

The equipment we use for planting is very heavy. Therefore, we expect the tractor to have good lifting capacity. But according to other criteria, the lift capacity is not very important for us. So we gave %13 by weight. We want to minimun lifting capacity threshold value 1.5 tons. That's why we prefer V-Shape.

(V-Shape, %13, min, p=1.5)

3) Horse Power

Especially during the harvest period rain is raining, so our fields can be mud. That's why we think we should prefer a powerful tractor. We gave %20 by weight as this value is of medium importance for us. The min 40 changes in tractor horse power are important to us. Difference is good for us that the tractor horse power is between 40-100. Therefore, we chose the level function.

(Level, %20, max, q=40, p=100)

4) Fuel Consumption

We want the tractor to be a bit stingy about fuel consumption. And this feature is one of the most important criteria for us. So, we preferred 27% by weight. We also don't want the tractor to have more fuel consumption difference than 1 L / Decare. That's why we chose the U-Shape function.

(U-Shape, %27, min, q=1)

5) Speed

Since the distance between our agricultural farm and our fields is a bit distant, we also care that the tractor is fast. But it is not very important according to other criteria. That's why we chose our weight to be 13%. Our critical difference value for speed is 10 Km / H. That's why we prefer V-Shape.

(V-Shape, %13, max, q=10)

We aim to solve this decision-making problem with Promethee Technique. We defined criteria and actions using the Promethee-Gaia Program. We entered the weight values of the criteria and the results of our internet research of the tractor options. It will be seen below.

	Tractor Selection S...	Price	Lift Capacity	Horse Power	Fuel Consum...	Speed
	Unit	Currency	Tons	HP	L/Decare	Km/H
	Cluster/Group	◆	◆	◆	◆	◆
	Preferences					
	Min/Max	min	max	max	min	max
	Weight	0,27	0,13	0,20	0,27	0,13
	Preference Fn.	Linear	V-shape	Level	U-shape	U-shape
	Thresholds	absolute	absolute	absolute	absolute	absolute
	- Q: Indifference	€ 5.000,00	n/a	40,00	1,00	10,00
	- P: Preference	€ 10.000,00	1,50	100,00	n/a	n/a
	- S: Gaussian	n/a	n/a	n/a	n/a	n/a
	Statistics					
	Minimum	€ 75.000,00	2,30	100,00	3,50	40,00
	Maximum	€ 200.000,00	6,00	200,00	6,00	60,00
	Average	€ 121.666,67	4,27	150,00	4,83	50,00
	Standard Dev.	€ 55.727,51	1,52	40,82	1,03	8,16
	Evaluations					
☑	Fendt 312 Vario	€ 200.000,00	6,00	200,00	6,00	60,00
☑	New Holland T5	€ 90.000,00	4,50	150,00	5,00	50,00
☑	Kubota M9540	€ 75.000,00	2,30	100,00	3,50	40,00

Result

As a result, the Ø value of our Kubota M9540 option was as high as 0.1950. Because of this result, we decided to buy this tractor.

	Phi+	Phi-	Phi
Fendt 312 Vario	0,3450	0,4050	-0,0600
New Holland T5	0,2500	0,3850	-0,1350
Kubota M9540	0,5400	0,3450	0,1950