

17/11/15 DECISIONS MCOA
Multi criteria decision analysis

Swing weighting - with our best difference in best cases of each option

A tip - compare two items to each other and put down a value for your preference

	Sal	city	work	family	
Sal	1	7	6	5	0.6
city	0.14	1	0.2	0.25	0.05
Work	0.16	5	1	0.3	0.14
Family	0.2	2	3	1	0.2

add up sums and divide by the sum

For different job v different variables do a table for each variable, i.e. Salary of all jobs, then, city of all jobs etc.

(checking consistency)

EXERCISE 1

	R	T	S
R	1	3	7
T	$\frac{1}{3}$	1	5
S	$\frac{1}{7}$	$\frac{1}{5}$	1

$3\frac{1}{2}$ 4.2 13

Normalized: divided by \uparrow

	R	T	S	Outcome
R	0.29 0.677	0.42 0.71	0.53 0.77	0.64
T	0.22	0.23	0.38	0.28
S	0.09	0.06	0.07	0.07

R most important

	V	W	normalized	result
V	1	4	0.8 0.8	0.8
W	$\frac{1}{4}$	1	0.2 0.2	0.2
	1.25	5		

	V	W	normalized	result
V	1	$\frac{1}{3}$	0.25 0.25	0.25
W	3	1	0.75 0.75	0.75
	4	$\frac{4}{3}$		

	V	W	normalized	result
V	1	6	0.14 0.14	0.14
W	$\frac{1}{6}$	1	0.16 0.16	0.16

The government has decided to open the University of the Irish Midlands, and is considering whether or not to expand Athlone (T) or to build it on a greenfield site in Dromod, Co. Leitrim. It is interested in the transport links (T), the cost of building infrastructure (C), the population size in the surrounding area (P), and the possibility of gaining seats in the subsequent general elections from the decision (G).

The government has compared each objective and has decided upon the following matrix of pairwise comparisons:

T	1	3.33	2	2.5
C	3	1	5	1
P	0.5	0.33	1	1.5
G	0.4	1	0.6	1
	T	C	P	G

On transport, Athlone is very slightly better than Dromod (scoring 2). New facilities will have to be built from scratch in both cases, and the cost of building infrastructure will therefore again be only marginally better in Athlone (scoring 2). Athlone has a larger surrounding population (scoring 4). And the government thinks that politically it would be much more shrewd to build the university in Leitrim, and thereby Dromod scores 5.

Use the analytic hierarchy approach to determine which location should be chosen.

Are the government objectives consistent?

Before the final decision is announced, an independent commission is appointed to look at the findings after public dispute about the process used. The commission announce that they are happy to use the government's preferences as they stand except they do not think the political impact in future elections should be taken into account. They therefore only consider transport, the cost of infrastructure and size of local population. Even before they recalculate weights for the criteria, they look at the scores for the towns on each criterion and quickly choose to place the next university in Athlone. Why can they do so?

A company is evaluating 2 locations, Carlow and Dundalk, for a new office. The locations are evaluated by three objectives: transport links (T), qualified workforce (Q) and attractiveness of town (A). The company compares each objective and constructs the following matrix of pairwise comparisons

$$A = \begin{pmatrix} 1 & 4 & 5 \\ 0.25 & 1 & 1 \\ 0.2 & 1 & 1 \end{pmatrix} \begin{matrix} T \\ Q \\ A \end{matrix}$$

using the usual scale for quantifying the relative importance of two objectives e.g. from 1 = equally important, through 5 = strongly more important to the largest value 9 = absolutely more important.

On transport, the company thinks that Dundalk beats Carlow with a score of 2. On qualified workforce, Carlow beats Dundalk with a score of 3. On attractiveness, Carlow beats Dundalk with a score of 4.

Use the analytic hierarchy approach to determine which location should be chosen.
(6 marks)

23/11/15 DECISIONS GOAL PROGRAMMING
 EXAM QUESTION 2007 AHP
 AHP example QB 2007, Carl and David like jobs

E Q P			weighted average			weight		
E	1	0.25	0.2	0.1	0.072	0.15	1.375/3	0.042
Q	5	1	0.125	0.4	0.108	0.09	1.57/3	0.199
P	8	8	1	0.5	0.865	0.75	2.115/3	0.705
	10	9.75	1.325					

weight	
E	0.09
Q	0.2
P	0.71

C D		average		weight	
C	1	4	0.8	0.8	0.8
D	1/4	1	0.2	0.2	0.2
	1.25	5			

C D		average		weight	
C	1	4	0.8	0.8	0.8
D	1/4	1	0.2	0.2	0.2

C D		average		weight	
C	1	1/6	0.15	0.15	0.15
D	6	1	0.85	0.85	0.85
	7	1.16			

	Carl	David
E 0.09	0.8	0.2
Q 0.2	0.8	0.2
P 0.71	0.15	0.85

Answer 0.33 0.67

Goal Programming Example
 X_A number of A's X_B number of B's

Min $10X_A + 25X_B$

ST: $X_A \geq 4X_B$

$7X_A - 4X_B \geq 0$

$2X_A + 4X_B \leq 240$

$X_A, X_B \geq 0$

SECOND EXAMPLE

A - number of A's B - number of B's

Objective function: maximize $A+B$ $400A + 1000B$

ST: $2A + 4B \leq 5000$

$4A + 4B \leq 4200$

$2A + 3B \leq 2200$

$A, B \geq 0$

Extra constraint: $A + B \geq 1000$

if (profit ≥ 60000 , add in new objective function and constraint
stop when can't reach the constraint satisfy the constraint.

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GOAL PROGRAMMING - LONG QUESTION

Total 1240 = 14 x 40 = 560

W - whisky R - Rum U - vodka

non hours $1.5W + 1.25R + 2V - d_1^+ + d_1^- = 560$

budget $200W + 150R + 10V - d_2^+ + d_2^- = 50000 - W$

W $-d_3^+ + d_3^- = 100$

R $-d_4^+ + d_4^- = 120$

V $-d_5^+ + d_5^- = 150$

$W - d_3^+ = 50$ whisky has 50

Want to have no stock \rightarrow minimize the d_i^+

$30d_1^+ + 5d_1^- + d_2^+ + d_2^- + d_3^+ + d_3^- + d_4^+ + d_4^- + d_5^+ + d_5^-$

Minimize $30d_1^+ + 5d_1^- + d_2^+ + d_2^- + 10d_3^+ + 5d_3^- + 10d_4^+ + 10d_4^- + 10d_5^+ + 60d_5^-$

Formulate and give extra steps in solver which you would do