19/04/16 DECISIONS - GOAL PROGRAMMING

The Types
- Lexicographic / pre-emptive goal programming
- Weighted goal programming

Lexicographic GP
- Useful when there is a clear hierarchy between aims and
    - Decision maker is unwilling to compromise in more important aims to ~~compromise~~ achieve less important ones (implying they are infinitely more important)
    - Or the higher aims are not really comparable in terms of importance
- At the point where a priority cannot be met, the program stops

Car Example:
$A = \#$ Car A $\quad\quad B = \#$ of car B

Objective function: Maximise $400A + 1000B$

ST: $2A + 4B \leq 3000$

$4A + 4B \leq 4200$

$2A + 4B \leq 2700$

G1 constraint: $A + B \geq 1000$

If G1 constraint satisfied, add in new objective function and constraint. add in G2 constraint ($400A + 1000B \geq 6000$), add third constraint if still possible G_3: ($2A + 3B \leq 1600$).

Weighted Goal Programming
- For complex decisions (real life) it is not always possible to achieve all aims simultaneously.
- Multiple Goals
- The costs associated with missing targets may not be the same above and below goal.
- Hence, a linear program can be formulated, with an objective function of minimising the weighted deviation from the goal

Goal Programming - Long question - Lecture

Total hours = 14 x 40 = 560

W = Whiskey R = Rum V = Vodka

d^- = under production

d^+ = over production

Min Hours	15W	+ 1.25R	+ 2V	$-d_1^+ + d_1^-$	= 560	
Budget	200W	+ 150R	+ 110V	$-d_2^+ + d_2^-$	= 5000	
Whiskey	W			$-d_3^+ + d_3^-$	= 100	
Rum		R		$-d_4^+ + d_4^-$	= 120	
Vodka			V	$-d_5^+ + d_5^-$	= 150	Add wt
Whiskey no	W			$-d_3^+$	= 50	

Min hours	15W	+ 12R	+ 2V	$-30d_1^+ + 5d_1^-$	= 560
Budget	200W	+ 150R	+ 110V	$-d_2^+ + d_2^-$	= 5000
Whiskey	W			$-10d_3^+ + 50d_3^-$	= 100
Rum		R		$-10d_4^+ + 50d_4^-$	= 120
			V	$-10d_5^+ + 60d_5^-$	= 150
	W			$-10d_3^+$	= 50

Minimise: $-30d_1^+ - 5d_1^- + d_2 + 0d_2^- + 10d_3^+ + 50d_3^- + 10d_4^+ + 50d_4^- + 10d_5^+ + 60d_6^-$

Formulate and give extra steps which you would use in Excel

- Formulate problem. Have a LHS and RHS
- LHS is end result value from current set up. RHS is the goal value.
- Have a row for weights - the ± for going over or under
- Final row with the decision of each variable
  - → Run Solver
    - Objective: minimise the Objective function cell (record) cost of going over or under
    - By changing: values in the decision row
    - Subject to:
      - decision row is an integer
      - decision row is all greater than zero
      - LHS column is equal to RHS column

01/05/06

DECISIONS · REDDY · GOAL PROGRAMMING

Two types

- Lexicographic – pre emptive GP
- Weighted goal programming

Lexicographic

- Useful when there is a clear hierarchy between aims and
  - Decision maker is unwilling to compromise in more important aims to achieve less important ones (implying they are infinitely more important)
  - Or the higher aims are not really comparable in terms of importance
- At the point where a priority cannot be met, the program stops

Car Example

$A = \#$ Car A $B = \#$ Car B

Objective function: Maximise $400A + 1000B$

ST: $2A + 4B \leq 300$

$4A + 4B \leq 420$

$2A + 4B \leq 270$

G1 constraint $A + B \geq 100$

If solution exists and G1 is satisfied, add it into formula as a constraint, add in G2 constraint ($400A + 1000B \geq 60000$), add third constraint if it is still possible

Weighted Goal Programming

- For complex decisions, (real life) it is not always possible to achieve all aims simultaneously
- Multiple goals
- The costs associated with missing targets may not be the same above and below goal
- Here a linear program can be formulated with an objective function of minimising the weighted deviations

-There are times a decision maker wishes to achieve several objectives. With limited resources it may not be possible to achieve them simultaneously

On Spreadsheet:

1 - Input variables: these are our costs and returns for each course of action and any constraints that may be relevant such as total budget or max allowable resources
2 - Decision variables (Changing cells): number of each resource we will utilise or the degree to which we follow each option
3 - Objective Variable (target cell): What we aim to max/minimise
4 - Other outputs: secondary outputs such as total amount spent or values for goals
5 - Constraints: The parameters within which we must work

The inputs should be expressed as a table that encompasses the return on goal objectives for each potential option. Begin by having trial values. Total cost can be found by finding the SumProduct of cost per unit, number of units

Solver should be used to find any solution that falls within all of the constraints. It will become clear through an error message that the goals cannot be achieved with the given budget. As such we must reclassify our parameters as "hard" and "soft" constraints. Hard constraints cannot be broken in any circumstance, soft constraints are prioritised. We first attempt to satisfy the soft goals with the highest priority, then, if there is room left in our hard constraints we aim to accomplish the next goal

Accomplished by sequentially running Solver multiple times, setting the amount already allocated to satisfy the highest priority as a new lower bound constraint. This process is repeated all the way down to the lowest priority goal

Pairwise Comparison Mutually Inconsistent?

- PC could be inconsistent because this test is not purely mathematical, it is also psychological. It relies on the decision maker defining their preferences for the decision criteria, which may not be done in a rational or reproducible way