27/11/13 Mang Sci. Revision

- Identify and list all the decision variables in the problem
- Identify if max or min then derive a linear function in terms of these variables which meet the objective of the exercise

- Identify all the items that constrain the problem.
- Express these constraints in the form of linear equalities/inequalities of the decision variables

Graphical Solution
- Draw graph
- Indentify feasible solution space noting binding and non binding constraints
- To calculate optimal solution calculate all the corner points OR use the iso function lines

Shadow Price
Also known as Dual Price, is the amount of change in the optimum solution if one more unit of a binding constraint was available

Add 1 unit to RHS Binding 1 and leave binding 2 fixed and resolve
Do same for binding 2 holding binding 1 fixed at original price

Sensitivity analysis for Graphical Solution
This determines how sensitive the optimum solution is to changes in:
- The objective function will be optimal as long as the slope of the objective function is between the slopes of the binding constraints

- the RHS ranges for the binding constraints

Feasible Region

- Feasible region for a two variable LP can be non existent, a single point, a line, a polygon, or unbounded area

- Any LP falls in one of 3 categories:
  - is infeasible
  - has a unique optimal solution or alternative optimal solutions.
  - has an objective function which can be increased without bound.

- A feasible region may be unbounded and yet there may be optimal solutions. This is common in min problems and possible in max problems

Special cases

- Alternative optimal solutions
  In graphical method, if O.F. line is parallel to a boundary constraint in the direction of optimization, there are alternative optimal solutions with all points on this line segment being optimal

- Infeasibility
  A LP which is overconstrained so that no point satisfies all the constraints is said to be infeasible

- Unboundedness

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Gauss Jordan Algorithm

Step 1: New pivot equation (row) = old pivot equation (row) ÷ pivot element

Step 2: Other equations = old equations (rows) − ((pivot column (coef) x new pivot equation (row)))

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3/12/13 Simplex method for two or more dimensional problems

To develop a general solution method, the LP problem must be put into standard form

- ≤ constraints - simply add a slack variable to the constraint

- = constraint - ~~Simply add a slack variable to~~
An artificial variable is added to equality constraints. the variable must also be included in the O.F.

- ≥ constraints: subtract a surplus variable to ensure equality and include an artificial variable to allow generate on initial solution. Modify the O.F. as for = constraint.

Initial Table for Simplex
- Row for the O.F and a row for each of the constraints

- Column for each of the variables including the S, A and Z variables

- In addition we add 3 further columns one for the solution, one for the ratio and one for the basic variable (variables) that are in the present solution

Filling the Initial Table
- For Z row, usually top row we enter coeff's from Z equation i.e. the O.F. remembering to keep all variables on LHS

- For each of rows for constraints we enter the coeffs from each of the constraints

- To complete our initial tableau, may choose some initial solution

- We set the resource variables to zero and make the slack variables basic, with a value (solution) equal to the RHS.

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Steps in the Simplex Method

- Using Standard form, determine a Starting feasible Solution by Setting the non basic variable to zero.

- Select an entering variable among the current non basic variable which when increased above zero can improve the value of the objective function. If none exists stop, the current basic solution is optimal

- Select a leaving variable from among the current basic variables that must be set to zero (becoming non basic) when the entering variable become basic

- Determine the new basic solution by making the entering variable basic and the leaving variable non basic. Repeat from the Second step above

Entering and Leaving Variables

- The non basic variable with the most negative coef is selected as the entering variable

- To indentify the leaving variable, we calculate the ratio column by dividing the Solution column by the corresponding value in the selected column of the entering variable to get the variable with the minimum (non-negative) ratio.

Pivot Column, Row and Element

Pivot column is that of the entering variable

Pivot row is that of leaving variable

The pivot element is that at the intersection of entering column and leaving row

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Simplex v. Dual Simplex

- Simplex procedure starts with a feasible but non optimum solution and moves to an optimum solution maintaining feasibility

- Dual Simplex starts with an optimum but infeasible solution works to clear infeasibility

Use of Dual Simplex

- Adding an extra constraint to problem we add to final table

- Use dual simplex procedure to eliminate the need for artificial variables

Initially require all $\geq$ converted to $\leq$ by $(\times -1)$
Eliminates need for artificial variables

- Original form of LP is called the primal
- The dual is LP derived completely from primal
- Optimal value of the dual is equal to that of the primal