# CS 600 Advanced Algorithms

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Homework 12

## 1 R-26.6.7 Convert the following linear program into standard form:

$$minimize : z = 3y_1 + 2y_2 + y_3$$

$$subjectto : -3y_1 + y_2 + y_3 \geq 1$$

$$2y_1 + y_2 + y_3 \geq 2$$

$$y_1, y_2, y_3 \geq 0$$

Minimize: $z = 3y_1 + 2y_2 + y_3$
Changing inequality
Standard form
Maximize: $z = -3y_1 - 2y_2 - y_3$
Subject to:
$3y1 - y2 - y3 \leq -1$
$-2y_1 - y_2 + y_3 \leq -2$
$y_1, y_2$ and $y_3 \leq 0$
Since the minimization issue has been transformed to maximization, all of the inequality signs have been flipped. We must employ slack variables to convert the supplied inequalities to equality constraints when utilizing the simplex approach. As a result, we introduce two more slack variables, $y_4$ and $y_5$. The inequality equations will be rewritten as
$3y_1 - y_2 - y_3 + y_4 = -1$
$-2y_1 - y_2 + y_3 + y_5 = -2$
$y_1, y_2, y_3, y_4, y_5 \geq 0$
As a result, using the Simplex approach, the above linear program is converted to standard form by introducing additional slack variables to eliminate the inequality restrictions.

## 2 C-26.6.26 The minimum spanning tree of a weighted graph G is a spanning tree T of G such that the sum of the edge weights in T is minimized.

To obtain the minimal spanning tree of a graph, we must create a linear programming formulation. We may use an indicator variable for each edge. Each vertex in a spanning graph must be incident to at least one edge, and each sub-graph F of a tree T has no more than |F| - 1 edges. We must determine the cheapest way to go to all vertices from each vertex. Assume the overall cost of the spanning tree is 'z,' and $x_{ij} = 1$ if there is an edge from i to j, otherwise it equals 0. MST must have a maximum of |F| - 1. This is the limitation in finding a solution. Hence the linear programming formulation of Minimum spanning tree is
Minimize $z = \Sigma_{i,j\epsilon E} C_{ij} * x_i j$
Subject to: $\Sigma_{i,j\epsilon E} x_{ij} = |F| - 1 \ \forall \ F\epsilon G$

$$x_{ij} \geq 0$$

E is the collection of vertices of the graph G in this case. As a result, the spanning tree's needed linear programming formulation is developed.

## 3 A-26.6.31 Design and solve a linear program to determine the best combination of ads for the campaign.

In this case, we must optimize total effect by picking the optimal combination of print, radio, and television advertisements within the specified cost limits. So, the essential variables are print, radio, and television, which we will denote as x, y, and z to reflect the total number of commercials of each medium. The highest overall impact linear equation would therefore be
Maximize $z = ax + by + cz$
We have the entire money, available airtime, and print space limits specified in the inquiry. As a result, the inequality constraint equations are listed below. Assume that 'M' is the maximum budget.
Subject to: $10000x + 70000y + 110000z \leq M$
$x \leq 25$
$y \leq 7$
$z \leq 15$
Because the effect values of each category are supplied as variables in the question, finding a solution for the given restrictions is impossible. As a result, the preceding is the linear equation for the stated need.