CSC373 Worksheet 6 Solution

August 12, 2020

1. **Rough Works:**

   1. Multiply objective function by - 1

   Maximize

   $$-2x_1 - 7x_2 - x_3$$

   Subject to

   $$\begin{aligned} x_1 - x_3 &= 7 \\ 3x_1 + x_2 &\geq 7 \\ x_2 &\geq 0 \\ x_3 &\leq 0 \end{aligned}$$

   2. Replace non-nonnegative constraints x_1

   Maximize

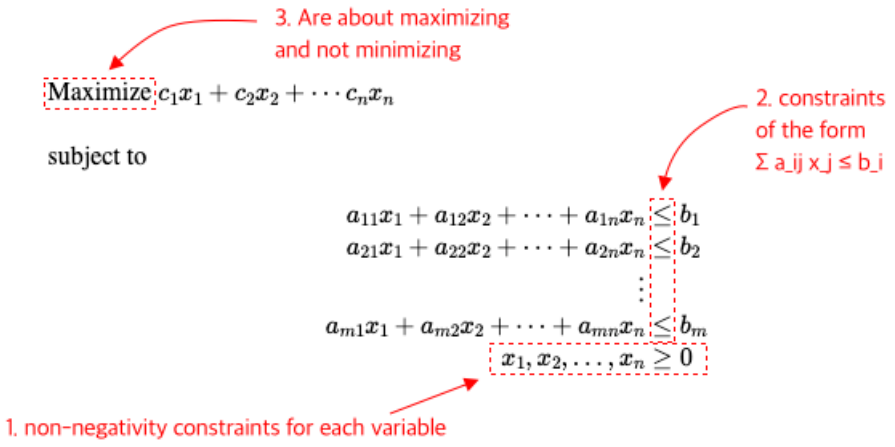
   $$-2x_1' + 2x_1'' - 7x_2 - x_3$$

   Subject to

$$\begin{aligned} x_1' - x_1'' - x_3 &= 7 \\ 3x_1' - 3x_1'' + x_2 &\geq 7 \\ x_1', x_1'', x_2 &\geq 0 \\ x_3 &\leq 0 \end{aligned}$$

Notes:

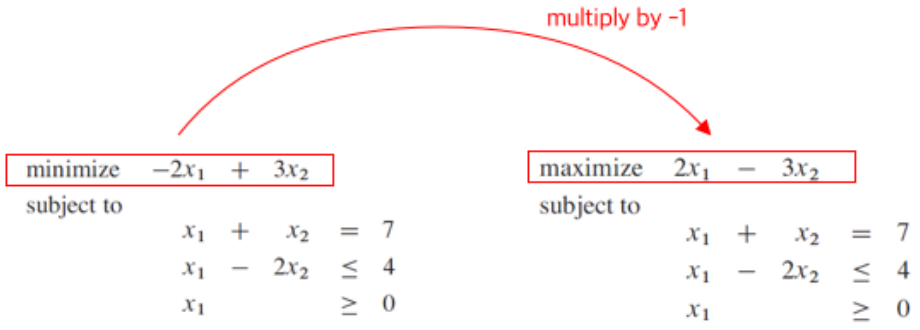
- **Linear Programming**
  - Is a method to achieve the best outcome (such as maximum profit or lowest cost) in a mathematical model whose requirements are represented by linear relationships. [1]
  - Is named to make it sound cool for government funding
    - Like dynamic programming
  - Applications
    - Microeconomics (maximize profits, minimize costs)
    - Company management
- **Standard Form**
  - Is a form of linear programming
  - Are about maximizing, not minimizing [2]
  - All have a positivity constraint for each variable [2]
  - All other constraints are all of the form "linear combination of variables $\leq$ constant". [2]



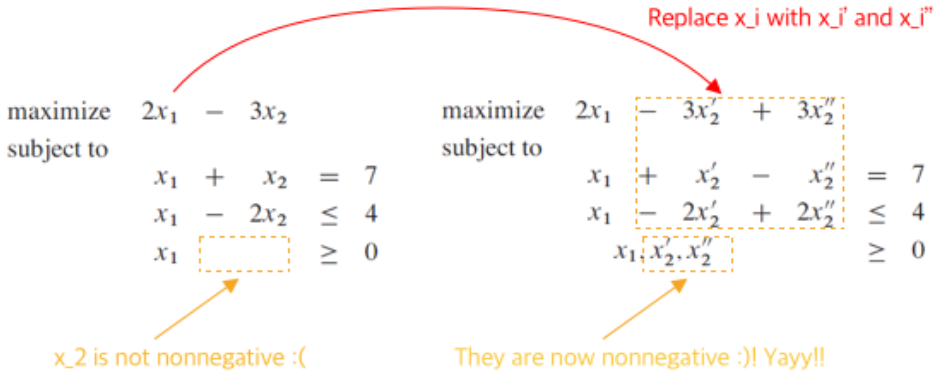
- **Converting Linear Programming to Standard Form**

  1) The objective function might be a minimization rather than a maximization

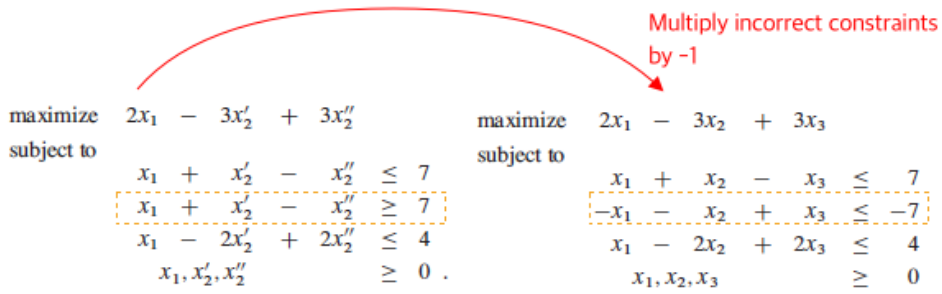
– Negate coefficients of the objective function



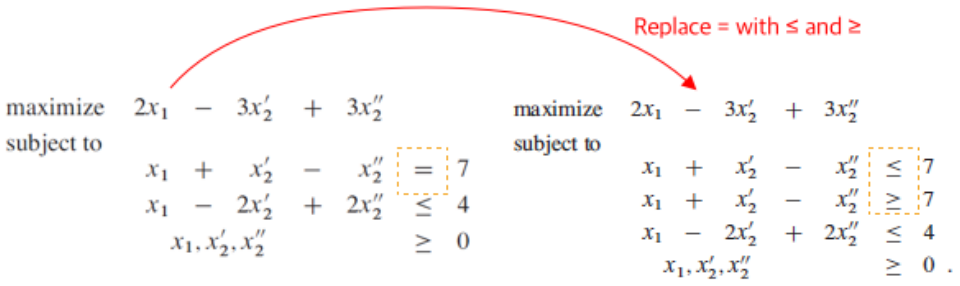
2) There might be variables without nonnegativity constraints
   – Replace each non-nonnegative variable x_i with x_i' and x_i''
   – Modify linear program



3) There might be **equality constraints**, which have an equal sign rather than a less-than-or-equal-to sign
   – Replace equality constraint $f(x_1, x_2, ..., x_n) = b$ with $f(x_1, x_2, ..., x_n) \leq b$ and $f(x_1, x_2, ..., x_n) \geq b$



4) There might be **inequality constraints**, but instead of having a less-than-or-equal-to-sign
   – Multiply incorrect inequality constraints by -1



References:

1) Wikipedia, Linear Programming, link
2) Instituto de Mathematicas, Standard form for Linear Programs, link