EE5600 Assignment 3

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***Abstract*—This document contains the solution to a Linear-Programming question.**

Download all python codes from

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https://github.com/Jayanth9969/EE5600/tree/
    master/Assignment3/codes
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1 Problem

Maximise $Z = 3x + 2y$ subject to
$x + 2y \leq 10, 3x + y \leq 15,\ x, y \geq 0$

2 Solution

$$Maximize : 3x_1 + 2x_2 \tag{2.0.1}$$
$$Subject - to : x_1 + 2x_2 \leq 10 \tag{2.0.2}$$
$$3x_1 + x_2 \leq 15 \tag{2.0.3}$$

The Problem is converted into canonical form by adding slack variables.Then Problem becomes,

$$Maximize : 3x_1 + 2x_2 + 0s_1 + 0s_2 \tag{2.0.4}$$
$$Constraints : x_1 + 2x_2 + s_1 = 10 \tag{2.0.5}$$
$$3x_1 + x_2 + s_2 = 15 \tag{2.0.6}$$

we write the Simplex tableau ,

$$\begin{pmatrix} x_1 & x_2 & s_1 & s_2 & c \\ 1 & 2 & 1 & 0 & 10 \\ 3 & 1 & 0 & 1 & 15 \\ \hline -3 & -2 & 0 & 0 & 0 \end{pmatrix} \tag{2.0.7}$$

Keeping the Pivot element as 3 and by using gauss-jordan Elimination we get

$$\begin{pmatrix} x_1 & x_2 & s_1 & s_2 & c \\ 0 & \frac{5}{3} & 1 & \frac{-1}{3} & 5 \\ 1 & \frac{1}{3} & 0 & \frac{1}{3} & 5 \\ \hline 0 & -1 & 0 & 1 & 15 \end{pmatrix} \tag{2.0.8}$$

Keeping the Pivot element as $\frac{5}{3}$ and by using gauss-jordan Elimination we get

$$\begin{pmatrix} x_1 & x_2 & s_1 & s_2 & c \\ 0 & 1 & \frac{3}{5} & \frac{-1}{5} & 2 \\ 1 & 0 & \frac{-1}{5} & \frac{2}{5} & 3 \\ \hline 0 & 0 & \frac{3}{5} & \frac{4}{5} & 18 \end{pmatrix} \tag{2.0.9}$$

In this tableau Since all indicators in last row are non-negative ,we found optimal solution to given problem. Therefore Optimal Solution will be:

$$(x_1, x_2) = (4, 3) \tag{2.0.10}$$
$$Z = 3x_1 + 2x_2 \tag{2.0.11}$$
$$Z = 3 \times 4 + 2 \times 3 \tag{2.0.12}$$
$$Z = 18 \tag{2.0.13}$$

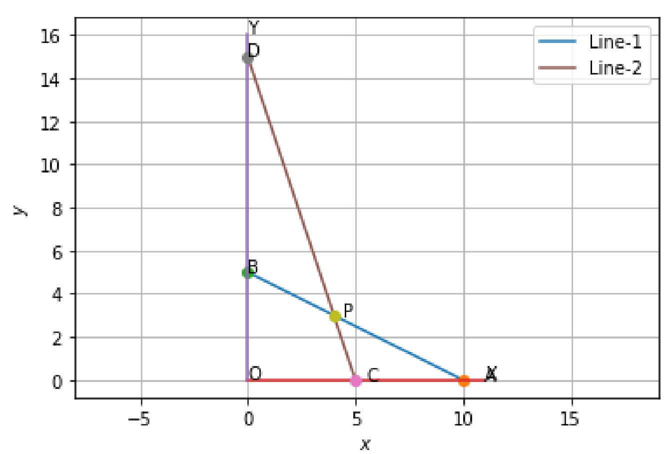

Fig. 2.0: Region OBPC is Valid region

This Problem can be represented in matrix form as follows,

$$\max_{\mathbf{x}} Z = \begin{pmatrix} 3 & 2 \end{pmatrix} \mathbf{x} \tag{2.0.14}$$

$$s.t. \quad \begin{pmatrix} 1 & 2 \\ 3 & 1 \end{pmatrix} \mathbf{x} \leq \begin{pmatrix} 10 \\ 15 \end{pmatrix} \tag{2.0.15}$$

$$\mathbf{x} \geq \mathbf{0} \tag{2.0.16}$$

$$\mathbf{y} \geq \mathbf{0} \tag{2.0.17}$$

this is solved using cvxpy in python,we get

$$\mathbf{x} = \begin{pmatrix} 3.99999999 \\ 2.99999999 \end{pmatrix}, Z = 17.99999996 \tag{2.0.18}$$