EE5600 Assignment 3

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Abstract—**This document contains the solution of geometry through linear algebra through the concept of optimization.**

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1 PROBLEM

Maximize $\mathbf{Z} = 5\mathbf{x} + 3\mathbf{y}$ subject to $3\mathbf{x} + 5\mathbf{y} \leq 15$, $5\mathbf{x} + 2\mathbf{y} \leq 10$, $\mathbf{x} \geq 0$, $\mathbf{y} \geq 0$.

2 EXPLANATION

This problem can be formulated as:

$$\max_{\mathbf{x}} Z = \begin{pmatrix} 5 & 3 \end{pmatrix} \mathbf{x} \qquad (2.0.1)$$

$$s.t. \quad \begin{pmatrix} 3 & 5 \\ 5 & 2 \end{pmatrix} \mathbf{x} \leq \begin{pmatrix} 15 \\ 10 \end{pmatrix} \qquad (2.0.2)$$

$$\mathbf{x} \geq \mathbf{0} \qquad (2.0.3)$$

$$\mathbf{y} \geq \mathbf{0} \qquad (2.0.4)$$

The given problem can be expressed in general as

$$\max_{\mathbf{x}} \mathbf{c}^T \mathbf{x} \qquad (2.0.5)$$

$$s.t. \quad \mathbf{Ax} \leq \mathbf{b}, \qquad (2.0.6)$$

$$\mathbf{x} \geq \mathbf{0} \qquad (2.0.7)$$

$$\mathbf{y} \geq \mathbf{0} \qquad (2.0.8)$$

where

$$\mathbf{c} = \begin{pmatrix} 5 \\ 3 \end{pmatrix} \qquad (2.0.9)$$

$$\mathbf{A} = \begin{pmatrix} 3 & 5 \\ 5 & 2 \end{pmatrix} \qquad (2.0.10)$$

$$\mathbf{b} = \begin{pmatrix} 15 \\ 10 \end{pmatrix} \qquad (2.0.11)$$

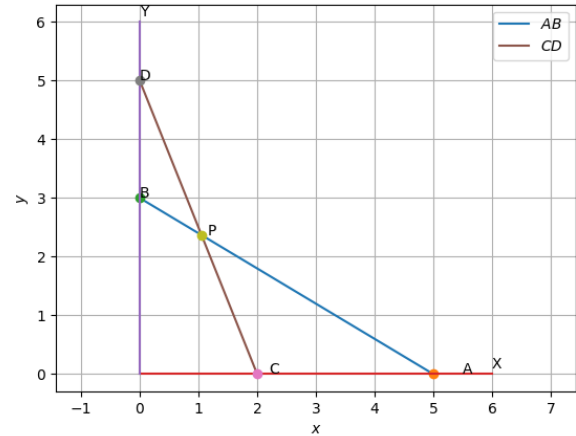Fig 0 shows the optimal point through the intersection of various lines.

Fig. 0: optimal point through the intersection of various lines

From 0, the following graph provides the optimal solution at $\begin{pmatrix} 5 \\ 0 \end{pmatrix}$ using (2.0.5).

The Maximum value of $\mathbf{Z}$ at $\begin{pmatrix} 5 \\ 0 \end{pmatrix}$ is 25.