Linear Programming

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Lecture 1 Introduction

- Linear programming example

$$\begin{aligned} \min \quad & x_1 - 2x_2 \\ \text{s.t.} \quad & x_1 + x_2 \le 40 \\ & 2x_1 + x_2 \le 60 \\ & x_1, x_2 \ge 0 \end{aligned}$$

- Graphic representation

$P = \{(x_1, x_2) \,|\, x_1 + x_2 \le 40,\ 2x_1 + x_2 \le 60,\ x_1, x_2 \ge 0\}$ (Feasible domain)

- LP Passage to advanced subjects

-NLP
-Network Flows
-IP
-Conic Programming
-Semidefinite Programming
-Robust Optimization

- How to study LP?

-Geometric intuition
-Algebraic manipulation
-Computer programming

- How to solve LP?

Q: What's special about LP?
A: Linear constraints shape the feasible domain as a convex polyhedral set with a finite number of vertices. Linear objective function provides a linear contour of each fixed value.

- Fundamental Theorem of LP

For a linear programming problem, if its feasible domain is not empty, then its optimum is either unbounded or is attained at least at one vertex of the feasible domain.