

Study Notes of OR and Modeling

Jiuzhang

Update on January 17, 2024

Contents

I	Linear programming	3
1	Introduction for Linear Programming	4
1.1	What is Linear Programming?	4
1.2	How to build a LP model?	4

Preface

Notes mainly refer to following materials:

- * theory

- linear programming
 - * [lecture notes from washington](#)
 - * [lecture notes by ted](#)
- integer programming
 - * [lecture notes by karthik](#)

- * modeling

- Model Building in Mathematical Programming by willian
- [Application of LPs](#)
- [Application of IPs](#)
- [lecture notes from utc](#)
- [handbook of discrete optimization modeling](#)

Part I

Linear programming

Chapter 1

Introduction for Linear Programming

1.1 What is Linear Programming?

A mathematical optimization problem is one in which some function is either maximized or minimized relative to a given set of alternatives. The function to be minimized or maximized is called the *objective function* and the set of alternatives is called the *feasible region* (or constraint region). In this course, the feasible region is always taken to be a subset of \mathbb{R}^n (real n -dimensional space) and the objective function is a function from \mathbb{R}^n to \mathbb{R} .

We further restrict the class of optimization problems that we consider to linear programming problems (or LPs). An LP is an optimization problem over \mathbb{R}^n wherein the objective function is a linear function, that is, the objective has the form

$$c_1x_1 + c_2x_2 + \dots + c_nx_n$$

for some $c_i \in \mathbb{R}$ ($i = 1, \dots, n$), and the feasible region is the set of solutions to a finite number of linear inequality and equality constraints, of the form

$$a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n \leq b_i \quad i = 1, \dots, s$$

and

$$a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n = b_i \quad i = s + 1, \dots, m.$$

Linear programming is an extremely powerful tool for addressing a wide range of applied optimization problems. A short list of application areas is resource allocation, production scheduling, warehousing layout, transportation scheduling, facility location, flight crew scheduling, parameter estimation,...

1.2 How to build a LP model?