

Linear Programming for Optimization

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1. Introduction

1.1 Definition

Linear programming is the name of a branch of applied mathematics that deals with solving optimization problems of a particular form. Linear programming problems consist of a linear cost function (consisting of a certain number of variables) which is to be minimized or maximized subject to a certain number of constraints. The constraints are linear inequalities of the variables used in the cost function. The cost function is also sometimes called the objective function. Linear programming is closely related to linear algebra; the most noticeable difference is that linear programming often uses inequalities in the problem statement rather than equalities.

1.2 History

Linear programming is a relatively young mathematical discipline, dating from the invention of the simplex method by G. B. Dantzig in 1947. Historically, development in linear programming is driven by its applications in economics and management. Dantzig initially developed the simplex method to solve U.S. Air Force planning problems, and planning and scheduling problems still dominate the applications of linear programming. One reason that linear programming is a relatively new field is that only the smallest linear programming problems can be solved without a computer.

1.3 Example

(Adapted from [1].) Linear programming problems arise naturally in production planning. Suppose a particular Ford plant can build Escorts at the rate of one per minute, Explorers at the rate of one every 2 minutes, and Lincoln Navigators at the rate of one every 3 minutes. The vehicles get 25, 15, and 10 miles per gallon, respectively, and Congress mandates that the average fuel economy of vehicles produced be at least 18 miles per gallon. Ford loses \$4000 on each Escort, but makes a profit of \$5000 on each Explorer and \$15,000 on each Navigator. What is the maximum profit this Ford plant can make in one 8-hour day?

The cost function is the profit Ford can make by building x Escorts, y Explorers, and z Navigators, and we want to maximize it:

$$-4000x + 5000y + 15000z \quad (1.3.1)$$

The constraints arise from the production times and Congressional mandate on fuel economy. There are 480 minutes in an 8-hour day, and so the production times for the vehicles lead to the following limit:

$$x + 2y + 3z \leq 480 \quad (1.3.2)$$

The average fuel economy restriction can be written:

$$25x + 15y + 10z \geq 18(x + y + z) \quad (1.3.3)$$

which simplifies to:

$$7x - 3y - 8z \geq 0 \quad (1.3.4)$$

There is an additional implicit constraint that the variables are all non-negative: $x, y, z \geq 0$.

Linear Programming Chvatal Solutions Manual

Lingjun Ying



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Solutions Manual for Linear Programming Vasek Chvatal, 1984-06-01 **Linear Programming** Vašek Chvátal, 1983-09-15 This comprehensive treatment of the fundamental ideas and principles of linear programming covers basic theory selected applications network flow problems and advanced techniques Using specific examples to illuminate practical and theoretical aspects of the subject the author clearly reveals the structures of fully detailed proofs The presentation is geared toward modern efficient implementations of the simplex method and appropriate data structures for network flow problems Completely self contained it develops even elementary facts on linear equations and matrices from the beginning Back cover **The Algorithm Design Manual: Text** Steven S. Skiena, 1998 This volume helps take some of the mystery out of identifying and dealing with key algorithms Drawing heavily on the author's own real world experiences the book stresses design and analysis Coverage is divided into two parts the first being a general guide to techniques for the design and analysis of computer algorithms The second is a reference section which includes a catalog of the 75 most important algorithmic problems By browsing this catalog readers can quickly identify what the problem they have encountered is called what is known about it and how they should proceed if they need to solve it This book is ideal for the working professional who uses algorithms on a daily basis and has need for a handy reference This work can also readily be used in an upper division course or as a student reference guide THE ALGORITHM DESIGN MANUAL comes with a CD ROM that contains a complete hypertext version of the full printed book the source code and URLs for all cited implementations over 30 hours of audio lectures on the design and analysis of algorithms are provided all keyed to on line lecture notes

Algorithmische Mathematik Winfried Hochstättler, 2010-04-06 Mit diesem Buch wollen wir verschiedene Teilgebiete der Mathematik aus algorithmischer Perspektive vorstellen und dabei auch Implementierungs und Laufzeitaspekte diskutieren Gleichzeitig möchten wir bei einer verkürzten Grundausbildung in Mathematik in naturwissenschaftlichen und informatischen Studiengängen möglichst viele Teilaspekte der Mathematik vorstellen und vielleicht zu einer vertiefenden Beschäftigung mit dem einen oder anderen Aspekt anregen Unser Ziel ist es dabei nicht den Leser zu einem versierten Anwender der besprochenen Algorithmen auszubilden sondern wir wollen immer ausgehend von konkreten Problemen Analyse und Lösungsstrategien in den Mittelpunkt stellen Hierbei spielen insbesondere Beweise und Beweistechniken eine zentrale Rolle Subject Guide to Books in Print, 1996 *Books in Print*, 1991 *How to Solve Real-world Optimization Problems* Eugene J. Zak, 2024-03-01 Written by an experienced operations research practitioner with a strong applied mathematics background this book offers practical insights into how to approach optimization problems how to develop intelligent and efficient mathematical models and algorithms and how to implement and deliver software products to customers With a focus on revealing the similarities and differences between academia and industry in mathematical modeling the book provides useful tips and advice based on the author's extensive experience as a principal developer

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