Accepted Manuscript

On the structure of the inverse-feasible region of a linear program

Onur Tavaslıoğlu, Taewoo Lee, Silviya Valeva, Andrew J. Schaefer

PII: S0167-6377(17)30518-7
DOI: https://doi.org/10.1016/j.orl.2017.12.004
Reference: OPERES 6318

To appear in: *Operations Research Letters*

Received date : 13 September 2017
Revised date : 11 December 2017
Accepted date : 11 December 2017

On the Structure of the Inverse-Feasible Region of a Linear Program

Onur Tavaslıoğlu[a], Taewoo Lee[b], Silviya Valeva*[c], and Andrew J. Schaefer[c]

[a]Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, PA 15260, USA
[b]Department of Industrial Engineering, University of Houston, Houston, TX 77204, USA
[c]Department of Computational and Applied Mathematics, Rice University, Houston, TX 77005, USA

Abstract.

Given a set of feasible solutions $\mathcal{X}$ to a linear program, we study the set of objectives that make $\mathcal{X}$ optimal, known as the inverse-feasible region. We show the relationship between the dimension of a face of a polyhedron and the dimension of the corresponding inverse-feasible region, which leads to necessary and sufficient conditions of the extreme, boundary, and inner points of a linear program. We also characterize the set of objectives that render a given solution uniquely optimal.

Keywords: Inverse Optimization - Linear Programming - Polyhedral Theory - Unique Solutions

1 Introduction

Given a feasible solution to a linear program, inverse linear programming seeks to find an objective vector d that makes the solution optimal while minimizing an L_p norm from a target vector $\hat{d}$ [1, 22]. Several special cases of inverse linear programming have been studied, such as minimum cost flow [21], shortest path [7], and facility location [23].

Inverse optimization has been studied for various types of optimization problems such as combinatorial optimization problems [11], conic programs [12], integer programs [18], convex programs [14], mixed-integer programs [15], countably infinite linear programs [10], and variational inequalities [5]. Inverse optimization has also found a wide variety of applications including production planning [20], finance [4], cancer treatment planning [8], medical decision making [3, 9], and electricity markets [6].

In this paper, we characterize the feasible region of an inverse linear programming problem where the input is a set of forward-feasible solutions, i.e., the set of objectives that make all the given

*Corresponding Author. silviya.valeva@rice.edu