

Chapter 6

Simplex Method

This chapter is the very hard core of this course!

Here we learn how to solve LPs manually. You may think that it is useless to know such arcane things: We should use computers, you might say — especially since the practical LPs are so large that no-one really solves them manually. This criticism is valid. But, we do not study how to solve LPs manually in order to solve them manually in practical problems (although it is not a completely useless skill). We study how to solve them manually in order to understand them!

This lecture is adapted from [2, Ch. 2] and [4, Ch. 4].

6.1 Towards Simplex Algorithm

Checking Corners

Theorem 5.2.9 told us that the optimal solution of an LP is in one of the corners of the feasible region. So, it seems that we have a very simple algorithm for finding the optimum: Just check all the corners! And, indeed, this naïve approach works well with such petty examples that we have in this course. The problem with this naïve approach in practice is the so-called combinatorial curse, a.k.a. the curse of dimensionality: An LP with n decision variables and m constraints has

$$\binom{n}{m} = \frac{n!}{(n-m)!m!}$$

corners.

Let us consider the curse of dimensionality more closely: Consider an LP with 30 decision variables and 15 constraints. This LP has

$$\binom{30}{15} = 155,117,520$$

corners. Suppose you have a computer that checks 100 corners per second (this is pretty fast for today's computers, and right-out impossible if you program

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