SFWR ENG 4O03

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Contents

Linear

Linear Program: an optimization problem in which the objective function is linear and each constraint is a linear inequality or equality
Decision variables: describe our choices that are under our control
Objective function: describes a criterion that we wish to max/minimize; doesn't have an in/equality e.g. max 40x + 30y
Constraints: describe the limitations that restrict our choices for our decision variables, always *inequalities*.

Converting constraints to equalities

Slack variable: equation variable greater than constraint, added
Surplus variable: equation variable less than constraint, subtracted

Hyperplane: a hyperplane in R^x is a shape in R^{x-1}, e.g. line in R^2

Feasible Solution:
Optimal Solution:

Standard form: when you take inequalities and use slack variables to turn them into equalities.

- Note: all variables need to be ≥ 0.
- All remaining constraints are expressed as equality constraints.

e.g.)

$2x_1 + 4x_2 - x_3 - x_4 \quad \geq 1$
$2x_1 + 4x_2 - x_3 - x_4 + s \quad = 1$

Graphical Method

1. Sketch the region corresponding to the system of constraints. The points inside or on the boundary of the region are the feasible solutions.
2. Find the vertices of the region.

3. Test the objective function at each of the vertices and select the values of the variables that optimize the objective function. For a bounded region, both a minimum and maximum value will exist. For an unbounded region, if an optimal solution exists, then it will occur at a vertex.

Simplex Method

Simplex Method: useful for solving linear optimization problems cheaply

- Cannot be done with **strict inequalities**, i.e. when there is no possibility of being equal
- Can only work if your objective function is in *standard form*

Simplex Tableau: visual representation of stuff

Phase Simplex

When the origin is not part of your basic solution