SFWR ENG 4O03

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Fall 2015

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# 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 Rx is a shape in Rx–1, e.g. line in R2

**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.)

2x1 + 4x2 – x3 – x4 ≥ 1

2x1 + 4x2 – x3 – x4 + s = 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

## Bland’s Rule

**Bland’s Rule**: a way of guaranteeing that you don’t repeat going over the same variables (a cycle) by picking the negative number with the largest index