

Project Context

The goal of this project is to create an application that will implement the **Simplex Method** to optimize (minimize or maximize) an objective function provided with necessary constraints. A specific feature will be the **Restaurant Sales Predictor**, which when done, shall aim to maximize the amount of sales that can be generated, given a set of viands and an amount of ingredients which can be bought by a restaurant.

Cafe Antonio, abbreviated as CAnton, a coffee shop cum restaurant in Los Baños, wanted to optimize and improve its sales based on the availability of their stocked ingredients in their kitchen. In this way, they can craft new menu options for their upcoming revamp in the holidays. But in doing so, they need to have to try different menu combinations for the cafe to maintain its homey ambiance and quality food choices.

Thus, they turned to you, a CMSC 150 student, in which they have been informed that you know about the simplex method. They wanted you to create a program which will optimize their food stock consumption, without sacrificing their current sales.

Mathematical Formulation

Given

A set $V = \{v_1, v_2, \dots, v_m\}$ containing m viands in a menu combination

A set $I = \{I_1, I_2, \dots, I_n\}$ containing n ingredients, out of the viands in set V

Take note that not all of the viands indicated in their overall menu can be selected. They wanted to retain some items of the viands, but they also like to remove things as well. Therefore, some ingredients may also not be selected, depending on which viands were selected.

A set of parameters:

c_i	cost of viand i
a_i	amount of ingredient i available in the kitchen
x_i	number of servings of viand i that can be served
$i_{i,j}$	amount of ingredient i needed in viand j

Required

Maximize total sales S , where

$$S = \sum_{j=1}^m (c_j \times x_j), \quad \forall j \in V.$$

Subject to for each ingredient i in set I :

$$\sum_{j=1}^m (i_{i,j} \times x_j) \leq a_i, \quad \forall i \in I$$

Specifications

Ultimate Optimizer

Provide a file input and a textarea web or stand-alone interface (not via command line) where the user can specify the **objective function**, the **goal** (to minimize or to maximize) and the allowable **constraints**. The necessary syntax for the different inputs of the system will be provided in the next chapter. After specifying all the necessary information, the user will instruct the system to start solving (by pressing a button, etc.). This is by calling an R executable file, which reads the file and solves the input via the simplex method.

Note on the R Executable: I am not teaching this. You are free to consult the web for help.

Implement a program that solves the optimization problem using the simplex method. The tableau and the basic solution for each iteration must be placed in **comma separated files** in a folder named `iterations`, with each file named `iteration_<number>.csv` (e.g. `iteration_1.csv`). The **final solution** and **resulting value** of the objective function must be identified. **You should only use R as the programming language in doing the simplex method.** Incentives shall be given if the solution is displayed

In the event that the simplex method will generate an error due to incorrect inputs, the program should generate a file named `error.txt`, identifying the error.

In the event that the simplex method did not converge based on the given inputs, the program should generate a file named `diverge.txt`, telling that the simplex method has diverged.

Restaurant Sales Predictor

Let the user select a menu combination out of the set of viands, located in the data set below. Then, let the user add the amount of ingredients available for each of the ingredients for all selected viands. This is via a web or command-line interface.

Once these inputs are already in place, a file shall be generated which shall be the input to the Ultimate Optimizer, which takes the given optimization problem of the Restaurant Sales Predictor into account.

Data Set and Sample Test Cases

The data set and sample test cases shall be available in the comments section in the coming days. I am still on research mode for the appropriate costs and viands.

Take note that the Ultimate Optimizer is done separately with the Restaurant Sales Predictor. Your priority in this project should be the Ultimate Optimizer first.

Milestones

These milestones are subject to change, with prior notice at Google Classroom. You may present your work personally at PS C-112. Non-presentation of milestones on the specified dates shall merit a deduction of 10% from the final project grade.

1	File I/O done for Ultimate Optimizer Initial tableau being done	25 April 2016
2	Simplex Method done for Ultimate Optimizer Initial interface for the Restaurant Sales Predictor	9 May 2016
3	Final Project Presentation	23 May 2016