User Manual: City Pollution Reduction Plan Optimizer

Welcome to the City Pollution Reduction Plan Optimizer! This application is designed to solve a complex resource allocation problem using the Simplex Algorithm. Its purpose is to help a city planner determine the most cost-effective mix of environmental projects to meet specific pollution reduction targets. This guide will walk you through setting up the application on your computer and using its features to find an optimal solution.

Accessing the Application

You can access this application in two ways: through a direct web link (easiest) or by running the code locally on your computer (for developers).

Option A: Use the Web Application (Recommended)

This is the simplest way to use the optimizer. No installation is needed. All you need is a modern web browser (like Chrome, Firefox, or Safari).

1. **Open the Link:** Simply click the link below to open the application directly in your browser.
   Link: https://rannssuuu.shinyapps.io/finalproject/
2. **Start Using:** Once the page loads, you can proceed directly to the "Using the Application" section of this manual.

Option B: Run the Application Locally

Prerequisites:

- **R:** The programming language. Download R here.
- **RStudio:** An integrated development environment (IDE) that makes using R much easier. Download RStudio Desktop.

Get the Project Files

1. Visit project github repository.

   Link : (https://github.com/Ransu29/CMSC150_PollutionMitigation)

2. Download the project folder.
3. Unzip the folder to a location you can easily access on your computer, such as your Desktop or Documents folder. You should see a folder containing files like ui.R, server.R, setup.R, etc.

Open the Project in RStudio

1. Open the RStudio application.
2. Go to **File > Open Project...**
3. Navigate to the folder you unzipped and open the file ending with the .Rproj extension (e.g., FinalProject.Rproj).
    - *Why this is important:* Opening the .Rproj file automatically sets the correct working directory, ensuring the app can find all its source files (setup.R, simplex.R, etc.).

Install Required Packages

The app depends on several R packages. You only need to install them once.

1. In RStudio, go to the **Console** pane (usually at the bottom left).
2. Copy and paste the following command into the console and press **Enter**:
   install.packages(c("shiny", "bslib", "shinyWidgets", "ggplot2", "thematic", "scales"))
3. R will now download and install the packages. This may take a few minutes. Wait for the process to complete.

Step 4: Launch the Application

1. With the project open in RStudio, open either the ui.R or server.R file by clicking on it in the **Files** pane (bottom right).
2. In the top-right corner of the editor pane, you will see a **"Run App"** button with a green play icon. Click it.
3. The application should now launch in a new window or in your web browser.

Using the Application

The application is divided into three main tabs: **Optimizer**, **Problem Statement**, and **About**. The main workflow happens in the **Optimizer** tab.

Step 1: Select Mitigation Projects

- On the left side of the **Optimizer** tab, you will see a **sidebar** titled "Mitigation Projects".
- Use the checkboxes to select which environmental projects you want to include in the optimization problem.
- You can use the **"Select All"** and **"Clear All"** buttons for convenience.
- By default, a few projects are already selected.

Step 2: Observe the Initial Tableau

- In the main content area, the first card, "Initial Problem Setup (Tableau)," shows a table.
- This table is the mathematical representation of the problem you have defined. It will **update live** as you check or uncheck projects in the sidebar.

Step 3: Run the Optimization

- When you are satisfied with your project selection, click the blue **"Optimize Cost"** button at the top of the main content area.
- A "Running simplex algorithm..." progress bar will appear while the calculation is performed.

Step 4: Analyze the Results

Once the calculation is complete, a series of result cards will appear below the initial setup card.

- **Optimal Solution Summary:** This is the most important card.
    - **Total Optimal Cost:** Shows the final, minimum cost (the Z-value) required to meet the targets.
    - **Summary of Recommended Projects:** A table listing which projects should be funded, the number of "units" for each, and their individual costs.
    - **Total Pollutant Reduction:** A table showing the total amount of each pollutant that will be reduced by the optimal plan, compared against the required target.
- **Final Basic Solution:** This table is for more advanced analysis, showing the final values of all variables (including slack variables) in the mathematical model.
- **Allocation Visualization:** A horizontal bar chart that visually represents the "Summary of Recommended Projects," making it easy to see which projects are most significant in the optimal solution.

Step 5: Explore the Iterations

- In the header of the "Optimal Solution Summary" card, click the **"View Steps"** button.
- A large pop-up window (a modal) will appear, showing the step-by-step process of the Simplex algorithm.
- On the left side of the modal, use the **"Select state"** radio buttons to choose which iteration you want to inspect (from the "Initial Setup" to the "Final Optimal Tableau").
- The main area of the modal will display two tables for the selected step:
    1. **Tableau:** The full mathematical matrix at that step.
    2. **Basic Solution:** The values of the variables as calculated at that step.