Damian, Beam Railey M.
2021-09482

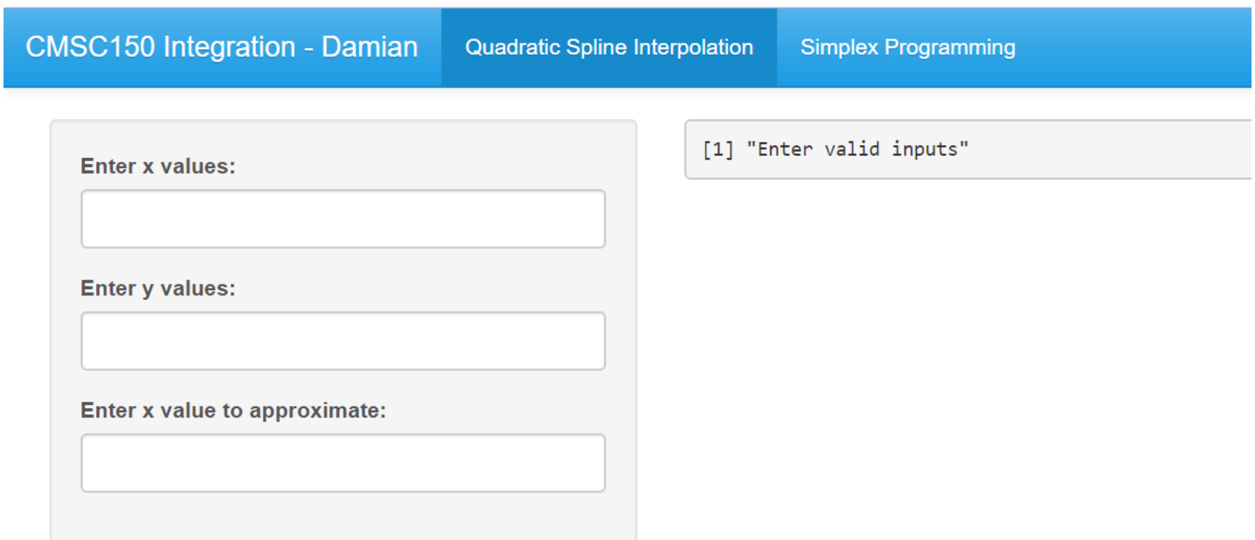
CMSC150 – Exercise 10
User Manual

Installation and Start-Up

Foremost, install the “shiny” and “shinythemes” packages. To do this, enter the following commands in the R console:

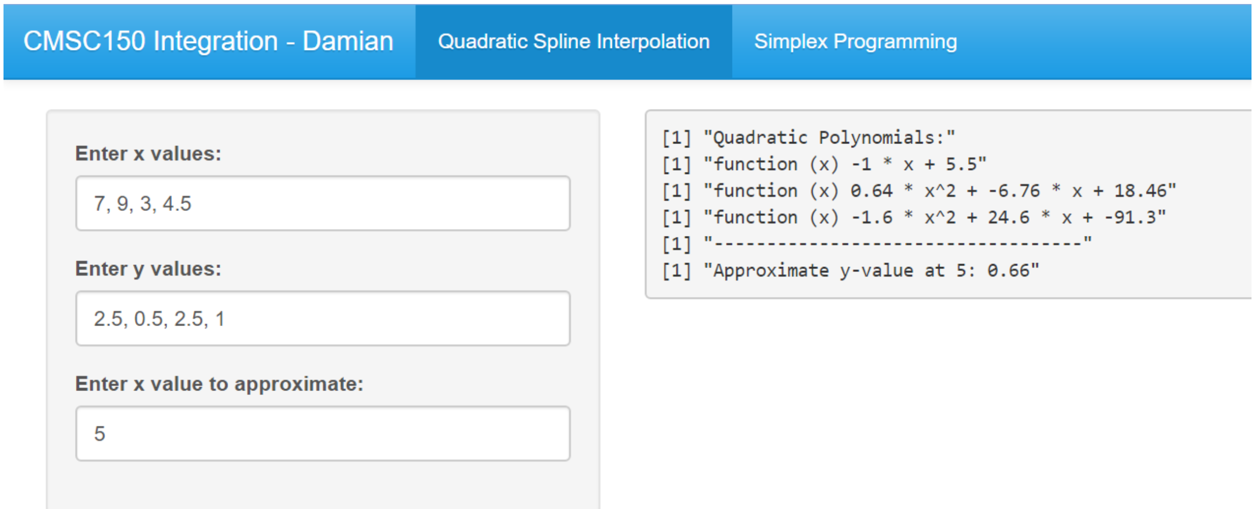
```
install.packages("shiny")
install.packages("shinythemes")
```

Make sure to put all of the files from the zip file in the same directory. To start the application, hit the “Run App” button with “DamianExer10.R” opened. Doing this would open this window:



Usage of the Quadratic Spline Interpolation Feature

This is the default tab opened and can be accessed by clicking the tab of the same name in the navigation bar. To use the program, enter the x and y values separated by commas. Note that order matters, meaning that the second y value, for instance, must be in correspondence to the second x value. For the x value to approximate, simply enter a single number. Upon entering valid inputs, the result would be automatically printed. If the inputs are still invalid or are made invalid by modifying a previously valid input, “Enter valid inputs” would be printed.



Usage of the Simplex Programming Feature

Click the tab of the same name in the navigation bar to access this functionality. The user needs to provide three inputs: maximization or minimization, given or new problem, and the values of the constraints and objective function. For the values of the constraints and objective function, enter one constraint per line and separate them by commas.

Per line, enter the values and separate them by commas. Enter only the coefficients. For instance, if the constraint is $2x_1 + 3x_2 + x_3 <= 24$, enter “2,3,1,24,”. Note that every constraint must have the same number of values. Hence, if it is missing one variable, simply put it as 0. $2x_1 + x_3 <= 24$ would be “2,0,1,24,”.

Furthermore, if the problem is maximization, the constraints’ inequalities should be <=. Hence, if there are constraints whose inequality is >=, it should be flipped. To do this validly, multiply the values by -1. For instance, $2x_1 + 3x_2 + x_3 >= 24$ in a maximization problem should be “-2,-3,-1,-24,”. Leave constraints with <= as is.

The opposite is true for minimization, which necessitates that all constraints’ inequalities be >=. Multiply the values of constraints with <= by -1. $2x_1 + x_3 <= 24$ would be “-2,0,-1,-24,”.

For the objective function, which would be the last input line, multiply the coefficients by -1 and use 0 as the last input value. For instance, $Z = 2x_1 + 3x_2 + x_3$ would be “-2,-3,-1,0”.

A full example is seen below:

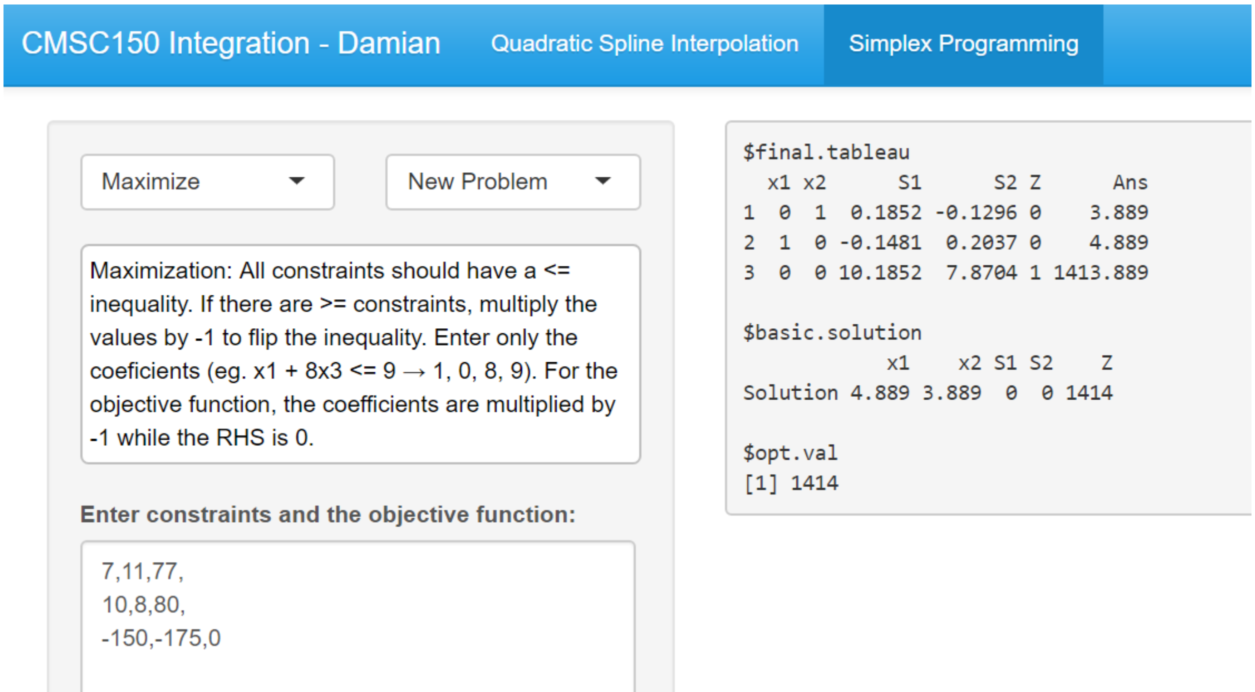
Maximize $Z = 150x_1 + 175x_2$ → -150,-175,0

With constraints:

$7x_1 + 11x_2 \leq 77$ → 7,11,77

$10x_1 + 8x_2 \leq 80$ →10,8,80

Entering valid inputs would automatically induce the printing of the result:



The "New/Given Problem" parameter must only be "Given" if the problem is related to the PPE shipping problem presented in the CMSC150 handout. Selecting "Given Problem" would make the program return another value called shipping.num:

CMSC150 Integration - Damian | Quadratic Spline Interpolation | Simplex Programming

Minimize | Given Problem

Minimization: All constraints should have a >= inequality. If there are <= constraints, multiply the values by -1 to flip the inequality. Enter only the coeficients (eg. x1 + 8x3 <= 9 → 1, 0, 8, 9). For the objective function, the coefficients are multiplied by -1 while the RHS is 0.

Enter constraints and the objective function:

```
-1,-1,-1,-1,-1,0,0,0,0,0,0,0,0,0,0,-310,
0,0,0,0,0,-1,-1,-1,-1,-1,0,0,0,0,0,-260,
0,0,0,0,0,0,0,0,0,0,-1,-1,-1,-1,-1,-280,
1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,180,
0,1,0,0,0,0,1,0,0,0,0,1,0,0,0,80,
0,0,1,0,0,0,0,1,0,0,0,0,1,0,0,200,
0,0,0,1,0,0,0,0,1,0,0,0,0,1,0,160,
0,0,0,0,1,0,0,0,0,1,0,0,0,0,1,220,
-10,-8,-6,-5,-4,-6,-5,-4,-3,-6,-3,-4,-5,-5,-9,0
```

```
$final.tableau
   S1 S2 S3 S4 S5 S6 S7 S8 x1 x2 x3 x4  x5 x6 x7  x8  x9 x10 x11 x12 x13 x14 x15 Z  Ans
1   0  0  0  0  0  0  0  0  1  0 -1  0   0  0  0   0   0   0  -1   0   1   0   0 0    6
2   0  0  0  0  0  0  0  0  0  1 -1  0   0  0  0   0   0   0   0  -1   1   0   0 0    3
3  -1  0  1  0  0  0  0  0  0  0  1  0   0  0  0   0   0   0   0   0  -1   0   0 0    1
4   0  0  0  0  0  0  0  0  0  0 -1  1   0  0  0   1  -1   0   0   0   0   0   0 0    0
5  -1  0  0  0  0  0  0  1  0  0  0  0   1  0  0   0   0   0   0   0   0   0   0 0    4
6   0  0  0  0  0  0  0  0  0  0  0  0   0  1  0  -1   0   0  -1   0   1   0   0 0    4
7   0  0  0  0  0  0  0  0  0  0  0  0   0  0  1  -1   0   0   0  -1   1   0   0 0    2
8  -1  0  0  0  0  1  0  0  0  0  1  0   0  0  0   0   0   0   0   0   0   0   0 0    6
9  -1  0  0  0  0  0  1  0  0  0  1  0   0  0  0  -1   1   0   0   0   0   0   0 0    5
10  0  0  0  0  0  0  0  0  0  0  1  0  -1  0  0  -1   0   1   0   0   0   0   0 0    4
11 -1  0  0  1  0  0  0  0  0  0  1  0   0  0  0   0   0   0   1   0  -1   0   0 0    4
12 -1  0  0  0  1  0  0  0  0  0  1  0   0  0  0   0   0   0   0   1  -1   0   0 0    5
13 -1  1  0  0  0  0  0  0  0  0  1  0   0  0  0  -1   0   0   0   0   0   0   0 0    2
14  0  0  0  0  0  0  0  0  0  0  0  0   0  0  0   1  -1   0   0   0  -1   1   0 0    1
15  0  0  0  0  0  0  0  0  0  0  1  0  -1  0  0   0   0   0   0   0  -1   0   1 0    6
16 10  0  0  0  0  0  0  0  0  0 80  0 220  0  0 100 160   0 180  80  20   0   0 1 3200

$basic.solution
         S1 S2 S3 S4 S5 S6 S7 S8 x1 x2 x3 x4  x5 x6 x7  x8  x9 x10 x11 x12 x13 x14 x15    Z
Solution 10  0  0  0  0  0  0  0  0  0 80  0 220  0  0 100 160   0 180  80  20   0   0 3200

$opt.val
[1] 3200

$shipping.num
        Sacramento Salt Lake City Albuquerque Chicago New York City
Denver           0              0          80       0           220
Phoenix          0              0         100     160             0
Dallas         180             80          20       0             0
```