

# Guide/Manual to the Quadratic Spline Interpolation and Simplex Method Application

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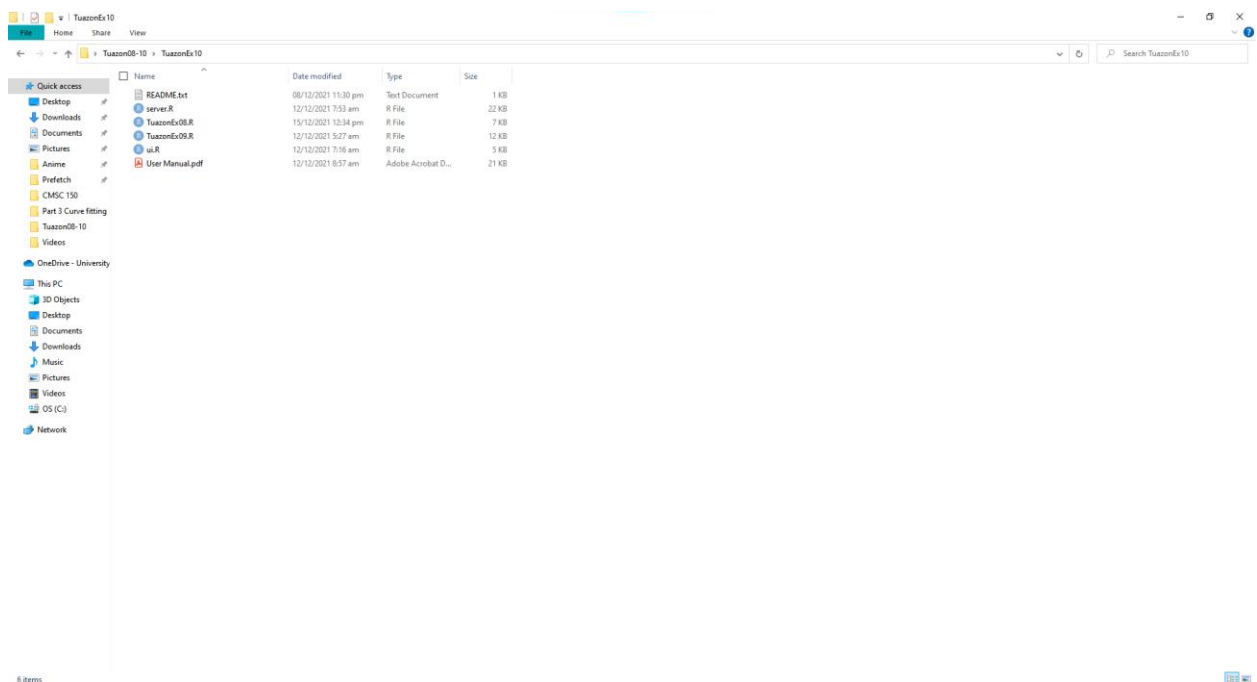
**Lab-Section:** AB1L

## Section I: Requirements

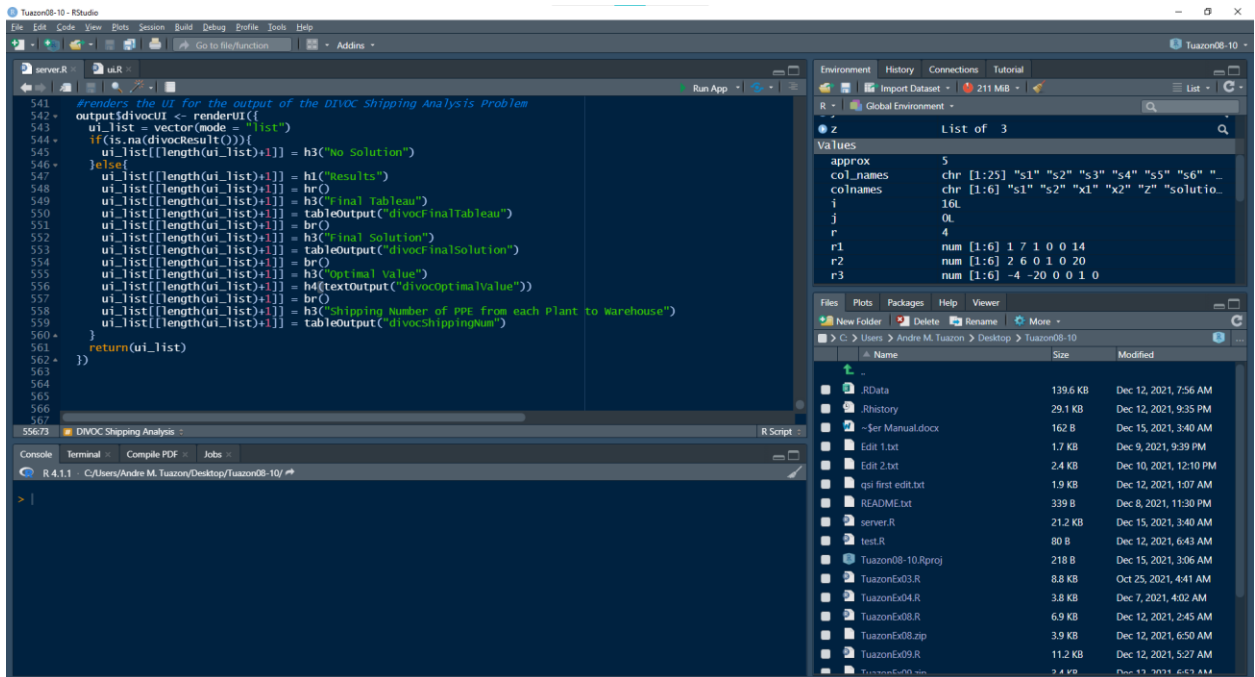
1. Need to install R-studio and the R shiny package

## Section II: How to open the Application

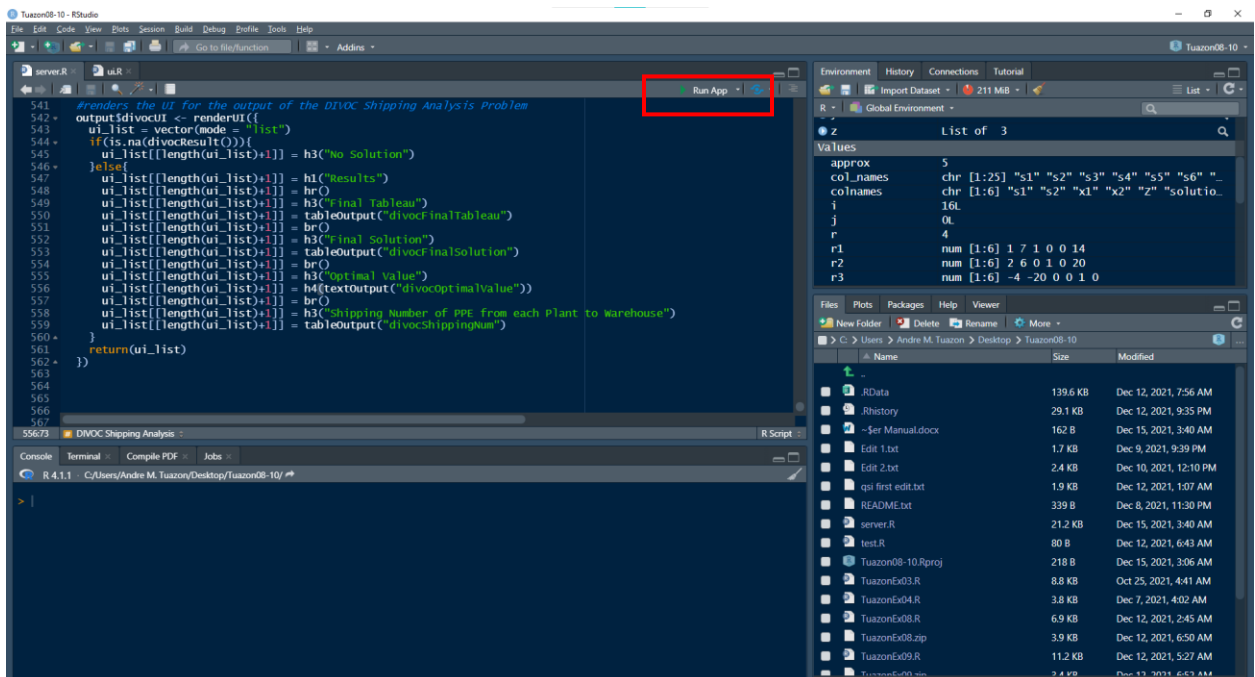
1. Unzip the TuazonEx10.zip



## 2. Open the ui.R and server.R files



## 3. Click the “Run App” button at the top of the screen, (it can work whether the server.R or the ui.R is open on the screen)



## Section III: General Interface

Quadratic Spline Interpolation and Simplex Method Application

Quadratic Spline Interpolation Simplex Method DIVOC Shipping Analysis

Simplex Method

Maximize or Minimize

Minimize

Number of Variables

2

Number of Constraints

2

Objective Function (Z):

$Z = \_\_x1 + \_\_x2$

Coefficient of x1:

14

Coefficient of x2:

20

Constraint 1

Coefficient of x1:

1

Coefficient of x2:

1

Results

Final Tableau

	s1	s2	x1	x2	Z	Solution
r1	0.00	1.00	0.25	-0.12	0.00	1.00
r2	1.00	0.00	-0.75	0.88	0.00	7.00
obj func	0.00	0.00	2.00	1.00	1.00	48.00

Final Solution

s1	s2	x1	x2	Z
0.00	0.00	2.00	1.00	48.00

Optimal Value

The Minimum Value is: 48

1. **Title Panel** – shows the title of the application
2. **Tabs** – show a variety of tabs for the user to choose which method will be used for the application whether he/she will use the application for Quadratic Spline Interpolation, Simplex Method, or DIVOC Shipping Analysis
3. **Sidebar Panel** – the area where the user will input the data for the selected method
4. **Main Panel** – the area where the result of the selected method will be shown

# Section IV: Quadratic Spline Interpolation

Number of data points input

Number of data points:

4

Data point inputs

Data Point 1

x0:

3.0

y0:

2.5

Data Point 2

x1:

4.5

y1:

1.0

Data Point 3

x2:

7.0

y2:

2.5

Data Point 4

x3:

Results

The Approximated y-value

The approximated y-value is 0.6600000000000029

Functions

[[1]]

function (x) 0 \* x^2 + -1 \* x^1 + 5.5

<environment: 0x000002a081b78e28>

[[2]]

function (x) 0.6399999999999999 \* x^2 + -6.759999999999999 \* x^1 + 18.46

<environment: 0x000002a081b78e28>

[[3]]

function (x) -1.5999999999999999 \* x^2 + 24.599999999999999 \* x^1 + -91.29999999999997

<environment: 0x000002a081b78e28>

Results

3.0

y0:

2.5

Data Point 2

x1:

4.5

y1:

1.0

Data Point 3

x2:

7

y2:

2.5

Data Point 4

x3:

9.0

y3:

0.5

To be Approximated

x-value to be approximated

5

Solve

Functions

[[1]]

function (x) 0 \* x^2 + -1 \* x^1 + 5.5

<environment: 0x000002a083332e90>

[[2]]

function (x) 0.6399999999999999 \* x^2 + -6.759999999999999 \* x^1 + 18.46

<environment: 0x000002a083332e90>

[[3]]

function (x) -1.5999999999999999 \* x^2 + 24.599999999999999 \* x^1 + -91.29999999999997

<environment: 0x000002a083332e90>

x-value to be approximated input

Solve button

1. **Number of Data points input** – This is the numeric input to input the number of data points to be used for the Quadratic Spline Interpolation. Take note that the minimum value it can take is 4.
2. **Data point inputs** – These are the numeric inputs to input the x and y values of each data point. The number of these numeric inputs will change depending on the input in the Number of Data points input.
3. **Results** – This is the area where the result will be shown based from the data inputted in the sidebar panel. It will show the approximated y-value and the list of functions from the result of the Quadratic Spline Interpolation. It will show “No Solution” when there is no solution.
4. **x-value to be approximated input** – This is the numeric input to input the x-value to be approximated by the Quadratic Spline Interpolation.
5. **Solve button** – This is the button to be clicked to calculate the approximated y-value from the inputted data using Quadratic Spline Interpolation and show the results of the calculations.

NOTE:

x -> refers to the x-values (where  $x_0 = x_0, x_1 = x_1, \dots, x_n = x_n$ )

y -> refers to the y-values (where  $y_0 = y_0, y_1 = y_1, \dots, y_n = y_n$ )

### Steps on Using Quadratic Spline Interpolation Section

1. Select the Quadratic Spline Interpolation Tab
2. Provide the number of data points to be used in the Number of Data points input
3. Input the x and y values of each Data point in the Data point inputs
4. Input the x-value to be approximated in the x-value to be approximated input
5. Click the solve button to calculate the approximated y-value from the inputted data using Quadratic Spline Interpolation and show the results

# Section V: Normal Simplex Method

Quadratic Spline Interpolation and Simplex Method Application

Quadratic Spline Interpolation | Simplex Method

Normal Simplex Method | DIVOC Shipping Analysis

### Simplex Method

Maximize or Minimize  
Minimize

Number of Variables  
2

Number of Constraints  
2

Objective Function (Z):  
 $Z = \_x1 + \_x2$

Coefficient of x1:  
14

Coefficient of x2:  
20

Constraint 1

Coefficient of x1:  
1

Coefficient of x2:  
2

### Results

#### Final Tableau

	s1	s2	x1	x2	Z	Solution
r1	0.00	1.00	0.25	-0.12	0.00	1.00
r2	1.00	0.00	-0.75	0.88	0.00	7.00
obj func	0.00	0.00	2.00	1.00	1.00	48.00

#### Final Solution

s1	s2	x1	x2	Z
0.00	0.00	2.00	1.00	48.00

Optimal Value  
The Minimum Value is: 48

Quadratic Spline Interpolation and Simplex Method Application

Quadratic Spline Interpolation | Simplex Method

Normal Simplex Method | DIVOC Shipping Analysis

Coefficient of x1:  
20

Coefficient of x2:  
14

### Constraint 1

Coefficient of x1:  
1

Coefficient of x2:  
2

Symbol:  
>=

Constant:  
4

### Constraint 2

Coefficient of x1:  
7

Coefficient of x2:  
6

Symbol:  
>=

Constant:  
20

Solve

The Minimum Value is: 48

1. **General Specification** – This is where the user selects if the simplex method to be used is for maximization or minimization. This is also the area to provide the number of variables and constraints to be used. Take note that the minimum value of the variables and the constraints that can be inputted is 1
2. **Objective Function input** – This is where the user will input the coefficients of the objective function of the simplex method.
3. **Results** – This is the area where the results of the simplex method will be shown. It will show the Final Tableau, Final Solution, and the Optimal Value of the Simplex method. It will show “No Solution” when there is no solution.
4. **Constraint Equation inputs** – This is the area where the user will input the coefficients of each variable in each constraint, the symbol to be used, and the constant. The number of inputs will adjust depending on the number of constraints and variables inputted earlier in the General Specification.
5. **Solve button** – This is the button to be clicked to calculate the optimal value from the inputted data using Simplex Method and to show the results of the calculations.

**NOTE:**

x -> refers to the variables (where  $x_1$  = variable 1,  $x_2$  = variable 2,...,  $x_n$  -> variable n)

s -> refers to the slack variables (where  $s_1$  = slack variable 1,  $s_2$  = slack variable 2,...,  $s_n$  -> slack variables n)

Z -> refers to the output of the objective function

r -> refers to the rows of the tableau (where  $r_1$  = row 1,  $r_2$  = row 2,...,  $r_n$  = row n)

obj func -> refers to the objective function

Solution -> refers to the Solution column in the tableau

### **Steps on Using Normal Simplex Method Section**

1. Select the Simplex Method tab then the Normal Simplex Method Tab
2. Select whether the simplex method to be used is for Maximization or Minimization in the General Specification
3. Provide the number of variables and constraints to be used in the General Specification
4. Provide the coefficients of the Objective function in the Objective Function input
5. Provide the coefficients, the symbol, and the constant of the constraints in the Constraint Equation inputs
6. Click the Solve button to calculate the optimal value from the inputted data using Simplex Method and show the results

# Section VI: DIVOC Shipping Analysis

Quadratic Spline Interpolation and Simplex Method Application

Quadratic Spline Interpolation Simplex Method

Normal Simplex Method DIVOC Shipping Analysis

## DIVOC Shipping Analysis

### Demand of each Warehouse

Sacramento, California

180

Salt Lake City

80

Albuquerque, New Mexico

200

Chicago, Illinois

160

New York City, New York

220

### Supply of each Plant

Denver, Colorado

310

Phoenix, Arizona

260

Dallas, Texas

## Results

### Final Tableau

	s1	s2	s3	s4	s5	s6	s7	s8	SAC1	SAC2	SAC3	SL1	SL2	SL3	ALB1	ALB2	ALB3	CHI1	CHI2
r1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	-1.00	0.00	0.00	0.00	-1.00	0.00	1.00	0.00	0.00
r2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	0.00	0.00	0.00	-1.00	1.00	0.00	0.00
r3	1.00	0.00	0.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	-1.00	0.00
r4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	-1.00	-1.00	0.00	1.00	0.00	0.00
r5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	-1.00	1.00	0.00	0.00
r6	0.00	1.00	0.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	-1.00	0.00
r7	0.00	0.00	0.00	0.00	0.00	-1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	-1.00	0.00	0.00
r8	0.00	0.00	1.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
r9	0.00	0.00	0.00	0.00	0.00	-1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	0.00	0.00
r10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	1.00	0.00	1.00	-1.00
r11	0.00	0.00	0.00	1.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	0.00	1.00
r12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	-1.00
r13	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	0.00	0.00
r15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	-1.00	0.00	0.00
obj	0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	180.00	0.00	0.00	80.00	80.00	100.00	20.00	0.00	160.00
func																			

### Final Solution

## Supply of each Plant

Denver, Colorado

310

Phoenix, Arizona

260

Dallas, Texas

280

## Shipping Cost from each Plant to each Warehouse

Denver to Sacramento

10

Phoenix to Sacramento

6

Dallas to Sacramento

3

Denver to Salt Lake City

8

Phoenix to Salt Lake City

5

Dallas to Salt Lake City

4

## Results

### Final Solution

	s1	s2	s3	s4	s5	s6	s7	s8	SAC1	SAC2	SAC3	SL1	SL2	SL3	ALB1	ALB2	ALB3	CHI1	CHI2	CHI3
s1	0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	180.00	0.00	0.00	80.00	80.00	100.00	20.00	0.00	160.00	0.00

### Optimal Value

The minimum cost is: \$3200

### Shipping Number of PPE from each Plant to each Warehouse

	SAC	SL	ALB	CHI	NYC
DEN	0.00	0.00	80.00	0.00	220.00
PHO	0.00	0.00	100.00	160.00	0.00
DAL	180.00	80.00	20.00	0.00	0.00



Shipping cost inputs

Solve button

Plant	Warehouse	Shipping Cost
Denver	Albuquerque	6
	Chicago	5
	New York City	4
Phoenix	Albuquerque	4
	Chicago	3
	New York City	6
Dallas	Albuquerque	5
	Chicago	5
	New York City	9

Solve

1. **Demand inputs** – These are the numeric inputs to input the demand of each warehouse on the number of PPEs
2. **Supply inputs** – These are the numeric inputs to input the supply of each plant on the number of PPEs
3. **Shipping cost inputs** – These are the numeric inputs to input the shipping cost from each plant to each warehouse
4. **Results** – This is the area where the results of the simplex method of the DIVOC Shipping analysis will be shown. It will show the Final Tableau, Final Solution, Minimum Cost, and the Shipping Number of PPE from each Plant to each Warehouse based on the problem in the exercise. It will show “No Solution” when there is no solution.
5. **Solve button** – This is the button to be clicked to calculate the minimum cost using the Simplex Method and to show the results of the calculations.

**NOTE:**

s -> refers to the slack variables (where s1 = slack variable 1, s2 = slack variable 2,..., sn -> slack variables n)

Z -> refers to the output of the objective function

r -> refers to the rows of the tableau (where r1 = row 1, r2 = row 2,..., rn = row n)

obj func -> refers to the objective function

Solution -> refers to the Solution column in the tableau

SAC1 -> refers to the shipping number of PPE from Denver to Sacramento  
SAC2 -> refers to the shipping number of PPE from Phoenix to Sacramento  
SAC3 -> refers to the shipping number of PPE from Dallas to Sacramento  
SL1 -> refers to the shipping number of PPE from Denver to Salt Lake City  
SL2 -> refers to the shipping number of PPE from Phoenix to Salt Lake City  
SL3 -> refers to the shipping number of PPE from Dallas to Salt Lake City  
ALB1 -> refers to the shipping number of PPE from Denver to Albuquerque  
ALB2 -> refers to the shipping number of PPE from Phoenix to Albuquerque  
ALB3 -> refers to the shipping number of PPE from Dallas to Albuquerque  
CHI1 -> refers to the shipping number of PPE from Denver to Chicago  
CHI2 -> refers to the shipping number of PPE from Phoenix to Chicago  
CHI3 -> refers to the shipping number of PPE from Dallas to Chicago  
NYC1 -> refers to the shipping number of PPE from Denver to New York City  
NYC2 -> refers to the shipping number of PPE from Phoenix to New York City  
NYC3 -> refers to the shipping number of PPE from Dallas to New York City

DEN -> refers to the plant in Denver, Colorado  
PHO -> refers to the plant in Phoenix, Arizona  
DAL -> refers to the plant in Dallas, Texas  
SAC -> refers to the warehouse in Sacramento, California  
SL -> refers to the warehouse in Salt Lake City, Utah  
ALB -> refers to the warehouse in Albuquerque, New Mexico  
CHI -> refers to the warehouse in Chicago, Illinois  
NYC -> refers to the warehouse in New York City, New York

### **Steps on Using DIVOC Shipping Analysis Section**

1. Select the Simplex Method tab, then the DIVOC Shipping Analysis Tab
2. Provide the demand of each warehouse, supply of each plant, and the shipping cost of each plant to each warehouse in the Demand inputs, Supply inputs, and Shipping cost inputs.
3. Click the Solve button to calculate the minimum cost using Simplex method and show the results of the calculations.