Prescriptive Analytics in R

Course Project

Instructions:

This document is the second part of the two-part Course Project. Part One was completed in RStudio within the online version of the course. In this document, you will not be working in RStudio. Rather, you will be using the skills you have gained in Module Two of the course to determine an optimization approach to a problem.

Except as indicated, use this document to record all your project work and responses to any questions. At a minimum you will need to turn in a digital copy of this document to your instructor as part of your project completion. You may also have additional supporting documents that you will need to submit. Your instructor will provide feedback to help you work through your findings.

Note: Though your work will only be seen by those grading the course and will not be used or shared outside the course, you should take care to obscure any information you feel might be of a sensitive or confidential nature.

A submit button can be found on the Course Project assignment page. Information about the grading rubric is available on any of the course project assignment pages online. Do not hesitate to contact your instructor if you have any questions about the project.

PART TWO

Determine and Formulate an Optimization Approach

You are a logistics manager for a large company that makes dog food. You are tasked with figuring out the best way to ensure sufficient supply at your eight distribution centers from three of your manufacturing facilities.

As their logistics manager, you need to figure out how to supply each of the three distribution centers with enough dog food to meet their demand in the best way possible. The three tables below show the data you'll need to make this decision. Note that not every manufacturing plant can reliably send dog food to every distribution center, and that these cases are marked as NA in Table Three.

Table One illustrates the demand at each of your eight distribution centers:

TABLE ONE

Distribution Center	Demand
Seattle	33,913
Atlanta	202,677
Denver	74,160
Louisville	45,108
Madison	99,146
Salt Lake	123,802
New Orleans	74,497
Pittsburgh	56,947

In Table Two, we show the capacity and manufacturing costs at three available plants:

TABLE TWO

	Buffalo	Tampa	Fort Worth
Capacity	206,704	255,446	325,524
Manufacturing Cost	$300	$334	$329

Table Three displays shipping costs per unit between each distribution center - plant pair. Note if the value is missing that indicates no reliable shipper if available for that route:

TABLE THREE

	Buffalo	Tampa	FortWorth
Seattle	$ 115.08	$ 127.23	$ 118.71
Atlanta	$ 91.75	$ 27.79	$ 62.64
Denver	$ 108.94	NA	$ 94.53
Louisville	$ 66.56	$ 59.14	$ 64.14
Madison	$ 70.66	$ 83.29	$ 72.56
SaltLake	$ 101.29	$ 119.77	$ 130.72
NewOrleans	NA	$ 53.08	NA
Pittsburgh	$ 31.79	$ 79.65	$ 78.79

What objective are you, the logistics manager, trying to achieve in this situation?

Minimize total cost of shipping products produced in the three plants to meet the demand of the eight distribution centers

What is your objective function? Please give this answer in the form in which you'd input it into R.

General answer textbox…

```
LP <- OP(c(115.08, 91.75, 108.94, 66.56, 70.66, 101.29, 0, 31.79, 127.23, 27.79, 0, 59.14, 83.29, 119.77, 53.08,
           79.65, 118.71, 62.64, 94.53, 64.14, 72.56, 130.72, 0, 78.79)
```

How many constraints do you have, and what are they?

14.

- Eight demand constraints for each of the eight distribution centers
- Three supply constraints for each of the three plants
- Three constraints for the decision variables that represent how much to ship from Buffalo to New Orleans, Tampa to Denver and FortWorth to New Orleans. These all have to be 0 as it is not possible to ship reliably
- No negative decision variable values

Submit the R code that defines your objective function, constraint matrix, dir vector, and rhs vector.

```
LP <- OP(c(115.08, 91.75, 108.94, 66.56, 70.66, 101.29, 0, 31.79, 127.23, 27.79, 0, 59.14, 83.29, 119.77, 53.08,
           79.65, 118.71, 62.64, 94.53, 64.14, 72.56, 130.72, 0, 78.79)
   L_constraint(L= matrix(c(1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,  #supply: Buffalo
                           0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, #supply: Tampa
                           0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, #supply: FortWorth
                           1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, #demand: Seattle
                           0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, #demand: Atlanta
```

```
0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, #demand: Denver
0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, #demand: Louisville
0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, #demand: Madison
0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, #demand: Salt Lake
0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, #demand: New Orleans
0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, #demand: Pittsburgh
0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, #None from Buffalo to NewOrleans
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, #None from Tampa to Denver
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, #None from FW to NewOrleans
1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
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                  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
                  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, #Non-negative
                  ncol=24, byrow=TRUE),
      dir = c("<=", "<=","<=",">=",">=",">=",">=",">=",">=",">=",">=", "=","=","=", ">=",">=",">=",">=",">=",
          ">=",">=",">=",">=",">=",">=",">=",">=",">=",">=",">=",">=",">=",">=",">=",">=",">=",">=", ">="),
      rhs = c(206704, 255446, 325524, 33913, 202677, 74160, 45180, 99146, 123802, 74497, 56947, 0,
          0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,0,0,0)
```

To submit this assignment, please refer to the instructions in the course.