Office Realignment Project
SCMA 645 Management Science
Virginia Commonwealth University
Fall 2024

We have discussed mathematical optimization modeling techniques and implementation. Our focus turns now to a real-world project where we will put what we have learned into practice. The project will give us the opportunity to use our modeling, software, and written communication skills.

You are to form four-person teams with another member of the class. Send an email with your team members to the instructor at `jpbrooks@vcu.edu` by October 22nd, or indicate that you have no team and you will be assigned one.

All groups will be working on the same case; however, there should be no communication between groups. You may do research to understand the case better, but the model you develop should be your own.

1 Milestones

1. **Phase I.** Provide answers to the questions in Part A. Include a summary of the steps taken to obtain answers. Provide essential components for a solution for Part B with a spreadsheet implementation.
2. **Phase II.** Provide a report that includes an executive summary, essential components for a solution for Part B with an AMPL implementation, answers to Part C, and recommendations for the client.

2 Timeline

1. October 22nd. Email group members to instructor.
2. October 31st. Phase I report due.
3. December 5th. Phase II report due.

3 Evaluation

Reports for both phases should contain all of the "Essential Components of an Optimization Solution," consistent with other homework assignments.

The Phase II report is limited to 10 pages (double spaced, 12 point font) excluding the appendix. The report should be written in narrative form using complete sentences and correct grammar. Avoid creating a report comprised only of bulleted lists. Submit your

report in pdf format via Canvas. Provide a link to your code and submit data as a separate file. Include interactions with generative AI in an appendix.

The Phase II report should have the following format:

1. A one page executive summary with an introduction to the problem, an introduction to you and how you came to work on the project (i.e., explain that you are students and that this was assigned as a class project and a general timeline for your work on the project), a description of the problem, a summary of the approach, and a summary of the results and recommendations. The executive summary should explicitly state all major findings - do not save them for the body of the report.

2. A presentation of the model with all of the "Essential Components of an Optimization Solution." To address the nuances of the problem and explain assumptions, it will be necessary to expand on the essential components beyond what is typically provided for a homework assignment and provide further explanation.

3. Additional information about the modeling methodology and results.

4. Conclusions and recommendations.

5. An appendix with interactions with generative AI.

The Phase II report should describe the problem, summarize results, and make recommendations for the client. Write the report in a manner that allows the reader to understand the outcomes without needing to understand the mathematical details of your model (though the details should be in the report as well). When describing the methodology, describe the software tools that you use, how they can be obtained, and how you use them.

Your project grade will be comprised of the following: Phase I 25%, Phase II 75%.

4 Project Overview

The Ram Wireless home office is responsible for supporting its stores around Virginia. Among other services, they provide assistance in assessment of inventory, payroll, hiring, local marketing, and merchandising. These services are performed by staff in regional offices, and many services require staff to spend a significant amount of their work hours on-site at the stores. To facilitate communication with the home office, each office is assigned to a single regional office.

Melissa Jones and Vance Larson sat down one day to evaluate the performance of the Division. As the manager of one of the regional offices, Vance's objective was to evaluate the workload placed on her staff. She was also acting as a representative for the other regional managers. Melissa, as the COO, was primarily concerned with productivity, cost, work quality, and employee satisfaction.

"How are things going here in the Warrenton Office, Vance?" asked Melissa.

"We're spending a lot of time in the D.C. area, and boy is traffic awful!" replied Vance. "I hear the folks over in the Staunton office are having it even worse right now. From what I understand, they spend most of their time driving up and down I-81! They spend so much time driving that they don't have enough time to actually do the work. Why have they been assigned work in areas that are so far from the office, anyway?"

Melissa went on to explain that stores assigned to the various regional offices had been developed over time. Early in the formation of the company, stores operated more independently so the division of labor was easy. As more and more stores opened and demanded support, they needed the help of the regional offices and were assigned to a regional office's service territory. Thus these territories were created incrementally over time, with little assessment of whether or not this was the most efficient distribution of labor and need. About ten years ago, they were realigned based on a demographic model—that is, stores were assigned to regional offices based on which of Virginia's larger localities affected the market of that store the most.

"Maybe," Melissa said, "it's time for us to re-evaluate these service areas again. Our demographic model worked well ten years ago, but now it seems to be leading us to waste lots of our time on the road. I'm just not sure where to start."

After some discussion, Melissa and Vance decided to bring in a consultant to evaluate the issues. They called on Verve Consulting, your employer, to assist with their problem. Not knowing exactly what kinds of analysis would be required, your supervisor, Sasha Saban, scheduled a meeting with Melissa and Vance to discuss the issues, and asked you to observe the conversation.

Melissa began by pointing out that they currently have eight regional offices, located in Abingdon, Dublin, Clarksville, Staunton, Warrenton, Richmond, Tappahannock, and Suffolk. Each of the regional offices have support staff in each of five areas: inventory, payroll, hiring, marketing, and merchandising.

In anticipation of this meeting with you and Sasha, Vance spent several months collecting data from all eight regional office managers on the number of full-time employee hours available in each area in each office, and noted that some offices use part-time employees to handle some of their less-demanding areas. He also asked employees in each area in each regional office to provide data on stores that they are currently serving. In particular, he asked them to estimate for each store the number of hours they spent and the number of trips they made each year. This information is provided in the sheets labeled "Regional Office Data" and "Store Data", which are in an Excel file that is posted on Canvas.

Vance also collected data on travel times and distances between various stores and regional offices. This data combined information acquired from the Rand McNally website (www.randmcnally.com) with staffers' knowledge of traffic congestion in metropolitan areas across the state. After some discussion, he and Melissa eliminated certain assignments, deciding that some assignments were simply too far, although they did not share their criteria for these decisions with you. The resulting data is provided in the sheet labeled "Travel," and assignments not to be considered are reflected by an entry of "–".

Part A

Vance and Melissa are particularly interested in the realignment of the Staunton, Richmond, Warrenton, and Tappahannock regional offices, and thus have provided data only for those regional offices and the stores that should be collectively assigned to them. They tell Sasha that they are interested in an assignment of each of these stores to one of the four given regional offices, and that this assignment should minimize cost. After speaking with them at some length, you and Sasha are able to determine that by "cost," they really mean travel cost. Travel cost has two primary components: a mileage component, and a salary component.

The mileage component includes gasoline and wear and tear on vehicles. This cost is captured in the state mileage rate, which is currently \$0.585 per mile. The salary component reflects the amount of salary being paid to employees while driving. Essentially, hours that an employee spends in transit between the regional office and the store are hours that cannot be devoted to substantive work for all stores. Vance and Melissa indicate that most of their employees are paid roughly \$26 per hour.

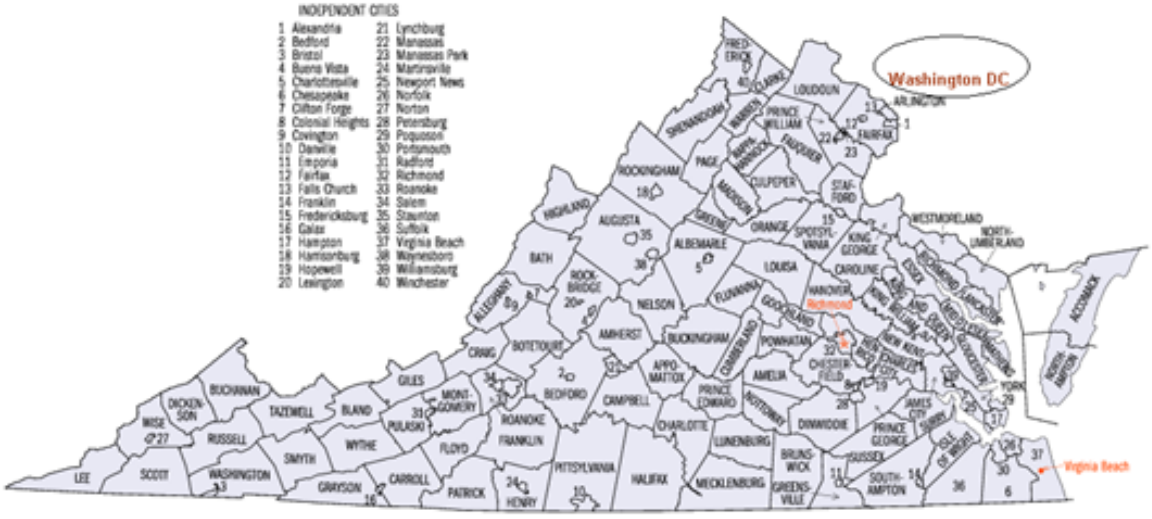
Vance and Melissa wonder what would happen if each store were simply assigned to the closest regional office (based on mileage). What is the cost of this assignment? Is it feasible?

Part B

Create a model that will find the lowest cost assignment of all stores to a regional office that respects area availability in each office. What is this assignment? How does it differ from the assignment in Part A? How is it the same?

Part C

Consider the solution you found in Part B. Does this solution make sense? That is, when you consider the geographic regions demarcated by the regional office assignments, do you notice anything unusual? Why do you think this happened? How would you "fix" this, and what are the ramifications of your remedy? A map of Virginia is included below.



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