D605 Task 3: Solves an Optimization Problem

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A.

The code for the solver portion of the analysis is shown below. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A screenshot of a computer program

AI-generated content may be incorrect.

This code provides the output that is shown below in 2 screenshots, as the output is rather long.

A screenshot of a computer

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

B1.

There are 4 constraints to consider in this optimization problem. The 1st are the respective hub capacities, which are accounted for by the following screenshots. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A computer screen shot of a computer code

AI-generated content may be incorrect.

A computer screen shot of a computer

AI-generated content may be incorrect.

The test to see if the constraint is satisfied after the solver is ran is shown in a code snippet below. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A screen shot of a computer code

AI-generated content may be incorrect.

A computer screen shot of a computer code

AI-generated content may be incorrect.

The 2nd constraint is the quantity into each focus city must be less than or equal to their respective capacities. This is accounted by the following code. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A computer code with text

AI-generated content may be incorrect.

A computer screen shot of a computer screen

AI-generated content may be incorrect.

The test to see if the constraint is satisfied after the solver is ran is shown in a code snippet below. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A computer code with colorful text

AI-generated content may be incorrect.

A screen shot of a computer code

AI-generated content may be incorrect.

The 3rd constraint is that the quantity into each focus city must be equal to the quantity out. This is accounted for in the following code. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A computer screen shot of a computer code

AI-generated content may be incorrect.

The test to see if the constraint is satisfied after the solver is ran is shown in a code snippet below. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A screenshot of a computer

AI-generated content may be incorrect.

A screenshot of a computer code

AI-generated content may be incorrect.

The 4th and last constraint are the centers demand, which is that the demand required by each center is met. This is accounted for in the following code. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A computer screen shot of a computer code

AI-generated content may be incorrect.

A white screen with a black text

AI-generated content may be incorrect.

The test to see if the constraint is satisfied after the solver is ran is shown in a code snippet below. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A screenshot of a computer code

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

B2.

The decision variables are included in the solution, shown by the code below. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A screenshot of a computer code

AI-generated content may be incorrect.

The constraints, as mentioned in part B1, are included in the solution and shown in the code snippet below. This code is edited and paraphrased from the linear programming python example supplied by Real Python. (Real Python, *Hands-On Linear Programming: Optimization With Python)*

A screenshot of a computer

AI-generated content may be incorrect.

A screenshot of a computer program

AI-generated content may be incorrect.

The objective function is included in the solution and shown in the code below. This code is edited and paraphrased from the linear programming python example supplied by Real Python as well as the linear programming example provided by Rodriguez, T.S. (Real Python, *Hands-On Linear Programming: Optimization With Python*), (Rodriguez, T.S., *Linear Programming: optimizing solutions with Python using PuLP*)

A screenshot of a computer program

AI-generated content may be incorrect.

The decision variables, constraints, and objective function are included in the solution because of the way the pulp package works. We can add different criteria to the problem that we have, in this case ‘cargo\_prob’ and the solver will consider the variables, constraints, and the objective function when determining the optimal solution.

B3.

The expected output was a solution to the required optimization problem. The solution outputted by the code fits what was expected in that it properly gives a cargo amount for each hub and focus city and meets all the necessary requirements detailed in the initial problem.

C.

Initially I felt as though the programming part of the optimization problem would be easy, as I already had the data, constraints, objectives, and the variables. However, my first issue I ran into was bringing in the data. I found a useful resource from stack overflow to bring in tables from word documents, which is what was provided to me. However, I found that the tables in the word document were not properly formatted and contained some typos. I decided my easiest fix would be to edit the word document slightly, (turning 1 large table with 3 sections into 3 separate tables), and fixing the typos. After I got the data in, I realized that I needed to edit the data of each table to get it into a state to perform the analysis on. I renamed the columns of all the tables to be more standardized between them, and I also added a value of 99,999 to the missing values, as the model did not know how to interpret missing values, and low values could potentially return false optimizations.

My initial approach was amended by having to edit the data, wrangle the data into something workable, and then perform the analysis. I felt as though the optimization approach was relatively straightforward once the data was received correctly, but the most time-consuming aspect was making sure that the initial data was something worth using.

D.

Real Python (n.d.) *Hands-On Linear Programming: Optimization With Python* Retrieved April 7h, 2025 From <https://realpython.com/linear-programming-python/>

Rodriguez, T. S. (n.d.) *Linear Programming: optimizing solutions with Python using PuLP* Retrieved April 9th, 2025 From <https://medium.com/@telmosubirar/linear-programming-optimizing-solutions-with-python-using-pulp-e0c4379696c8>

Stack Overflow(Aug. 28th, 2024) *python-docx: Parse a table to Panda Dataframe* Retrieved April 2nd, 2025 From <https://stackoverflow.com/questions/58254609/python-docx-parse-a-table-to-panda-dataframe>

\*\* In-text citations are included in the Jupyter Notebook file provided and can also be seen in the code screenshots in this document \*\*