ALY6050 Module Six (Final) Project

Project: *Two Optimization Problems:*
(i) A Transshipment Problem
(ii) A Risk Minimizing Problem

The Module 6 Final Project consists of two parts. If using Excel, complete each part in a separate worksheet of the same Excel workbook (Name your worksheets: "Part 1" and "Part 2"). If using R, complete each part in a separate R script file. The submission of this project will consist of an Excel workbook (or two R script files if R has been used) and a Word document. For each part, write a minimum of 1500 words in the Word document describing your methods and your findings. Furthermore, the Word document should be according to the APA standards, i.e., it consists of a title page (including student's name, assignment title, course number and title, the current academic term, instructor's name, and the assignment completion date), and a reference page. The Word submission of each project will consist of three sections:

(i)   Introduction
(ii)   Analysis
(iii)   Conclusion

Part 1: *Rockhill Shipping & Transport Company*

Allen, a manager of the South-Atlantic office of the Rockhill Shipping & Transport Company(RSTC) is negotiating a new shipping contract with Chimotoxic, a company that manufactures chemicals for industrial use. Chimotoxic wants Rockhill to pick up and transport waste products from its six plants to three waste disposal sites. Allen is very concerned about this proposal arrangement. The chemical wastes that will be hauled can be hazardous to humans or the environment if they leak. In addition, some of the communities in the regions where the plants are located may prohibit hazardous materials from being shipped through their municipal limits. Thus, not only the shipments have to be handled carefully and transported at reduced speeds, but they may also have to traverse in circuitous routes in some cases.

Allen has estimated the cost of shipping a barrel of waste from each of the six plants to each of the three waste disposal sites as shown in the following table.

	Waste Proposal Site		
Plant:	*Orangeburg*	*Florence*	*Macon*
Denver	$11	$10	$11
Morganton	11	10	10
Morrisville	13	12	11
Pineville	11	12	11
Rockhill	12	12	13
Statesville	14	13	14

Table 1: Shipping costs, per barrel of waste from six plants to three waste disposal sites

The plants generate the following amounts of waste products each week:

Plant:	Waste per Week (bbl)
Denver	55
Morganton	35
Morrisville	45
Pineville	60
Rockhill	50
Statesville	55

Table 2: Total Waste generated by each plant

The three waste disposal sites at Orangeburg, Florence, and Macon can respectively accommodate a maximum of 110, 80, and 115 barrels per week.

In addition to shipping directly from each of the six plants to one of the three waste disposal sites, Allen is also considering using each of the plants and the waste disposal sites as intermediate shipping points. In this case, trucks would be able to drop a load at a plant or a disposal site to be picked up and carried on to the final destination by another truck. Furthermore, RSTC would not incur any handling costs because Chimitoxic has agreed to take care of all the handling costs at the plants and at the disposal sites. In other words, RSTC's only cost will be the transportation cost. Therefore, Allen wants to be able to consider the possibility that it may be cheaper to drop and pick up loads at intermediate points rather than ship them directly.

Allen has estimated the shipping costs per barrel between each of the six plants to be as follows:

	Plant					
Plant:	Denver	Morganton	Morrisville	Pineville	Rockhill	Statesville
Denver	$---	3	5	5	4	3
Morganton	3	$---	3	3	3	5
Morrisville	5	3	$---	4	5	4
Pineville	5	3	4	$---	3	4
Rockhill	4	3	5	3	$---	3
Statesville	3	5	4	4	3	$---

Table 3: Shipping costs, per barrel of waste from each plant to another plant

The estimated shipping cost per barrel between each of the waste disposal sites is as follows:

	Waste Proposal Site		
Waste Disposal Site:	Orangeburg	Florence	Macon
Orangeburg	$---	5	3
Florence	5	---	4
Macon	3	4	---

Table 4: Shipping costs, per barrel of waste between the three waste disposal sites

Allen wants to determine the shipping routes that will minimize RSTC's total cost in order to develop a contract proposal to submit to Chimotoxic for waste proposal. He particularly wants to know if it would be cheaper to ship directly from the plants to the waste sites or if he should drop and pick up some loads at the various plants and waste sites.

In the word document, explain the details of the solutions obtained for the optimal routes and their respective optimal costs for both cases. In particular for the case when loads are dropped and picked up at various plants and waste sites, explain how many barrels, in total, will be transported each week from a source to a destination.

If Chimotoxic agrees to increase the capacity of each of three waste disposal sites by **10** barrels per week – Orangeburg(120), Florence(90), and Macon(125), what will happen to the shipping costs? Hint: please discuss under above two scenarios(**direct shipping & transshipment**).

Part 2: *Investment Allocations*

An investor has selected the following asset types in his portfolio. The expected return for each asset type has been estimated by using the historical data:

	Expected Returns
Bonds	6%
High tech stocks	26%
Foreign stocks	27%
Call options	18%
Put options	19%
Gold	7%

Table 5: Expected returns of Investments

The following table indicates the covariance matrix of the assets' returns. Each diagonal entry is the variance of an asset and non-diagonal entries are the covariances between any pairs of assets.

	Bonds	High tech stocks	Foreign stocks	Call options	Put options	Gold
Bonds	0.002	-0.0009	0.0007	0.0008	-0.0005	0.003
High tech stocks		0.09	0.0055	0.0055	-0.005	0.005
Foreign stocks			0.08	0.004	-0.035	-0.006
Call options				0.045	-0.005	-0.004
Put options					0.055	-0.005
Gold						0.010

Table 6: The Covariance matrix of assets' returns

(i)   Suppose that our investor wishes to invest $500,000 in this portfolio. Determine how we should allocate this investment to the individual assets in this portfolio in order to have a minimum baseline expected return of **20%**, and at the same time, at a minimum risk.

(ii)   Let the solution pair be denoted by (r, e), where "r" denotes the minimized risk(variance) and "e" denotes the expected portfolio return after the problem is solved. Use the following values of **7%, 10%, 13%, 16%, 19%, 22%, and 25%** as the baseline return values to obtain seven pairs of solutions (r, e). Plot "e" versus "r" ("r" should be the x-axis). Explain whether there exists a pattern in this plot. In other words, explain, in your opinion, the type of mathematical relationship that "r" and "e" may have.

Northeastern University
ALY6050 2023 Fall B

Final Project Rubric

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Criteria	Ratings				Pts
Excel (or R): Problem Modeling & Set-up	**48 pts** Completely and concisely modeled the problem in Excel (or R) for each method	**38.4 pts** Accurately modeled the problem in Excel (or R) for each method	**24 pts** Correctly modeled the problem in Excel (or R) for each method, but the model lacks detailed insight into the problem or the set-up is awkward.	**12 pts** Modeled the problem in Excel (or R) for each method, but there are some gaps in the problem modeling and setup	48 pts
Excel (or R): Problem Solution & Accuracy	**72 pts** Efficiently obtained correct and accurate solutions in Excel (or R) by using the appropriate analytic tools of the software	**57.6 pts** Obtained complete and accurate solutions in Excel (or R) by using the appropriate analytic tools of the software	**36 pts** Obtained correct solutions in Excel (or R) using the appropriate analytic tools of the software, but the application of the tool is awkward.	**18 pts** Obtained a solutions in Excel (or R) by using the appropriate analytic tools of the software, but the solution is not complete.	72 pts
Word/Report: Problem Description & Introduction	**8 pts** Provides a thorough and concise summary of the problem descriptions and introduced the problem using rich and significant ideas	**6.4 pts** Provides an accurate and succinct summary of the problem descriptions and problem introduction	**4 pts** Provides an accurate summary of the problem descriptions and problem introduction, but the description is too wordy or not succinct	**2 pts** Provided a summary of the problem descriptions and problem introduction, but it is inaccurate or incomplete	8 pts
Word/Report: Description of Problem Analysis	**12 pts** Provides a thorough and precise description of the analytic concepts and theories used in analyzing the problem	**9.6 pts** Accurately describes the analytic concepts and theories used in analyzing the problem	**6 pts** Describes the analytic concepts and theories used in analyzing the problem, but description lacks appropriate detail or precision	**3.01 pts** Describes the analytical concepts and theories used in analyzing the problem, but descriptions are incorrect or the analytical concepts and theories are incorrect	12 pts
Word/Report: Description of Conclusions	**12 pts** Provides conclusions and results obtained in the project using a high level of critical thinking and reasoning	**9.6 pts** Provides relevant conclusions and results obtained in the project that reflect critical thinking and reasoning	**6 pts** Provides conclusions and results obtained in the project, but not all conclusions or results are relevant to the problem or not all conclusions reflect good reasoning	**3.01 pts** Provides conclusions and results obtained in the project, but they are irrelevant and reflect a lack of critical thinking	12 pts
Word/Report: Writing Mechanics, Title Page, & References	**8 pts** Completely free of errors in grammar, spelling, and punctuation; and completely correct usage of title page, citations, and references. The report contains a minimum of 1000 words	**6.4 pts** There are no noticeable errors in grammar, spelling, and punctuation; and completely correct usage of title page, citations, and references. The report contains a minimum of 1000 words	**4 pts** There are very few errors in grammar, spelling, and punctuation; and completely correct usage of title page, citations, and references. The report contains a minimum of 1000 words	**2 pts** There are more than five errors in grammar, spelling, and punctuation; or the usage of title page, citations, and references are incomplete; or the report contains less than 1000 words	8 pts
				Total Points: 160	