DSO 570 (TTh 5-6:20pm Section): Assignment #5
Due: Thursday, April 15 by 5PM

There are 2 questions in this assignment, and each question has multiple parts. The detailed description of each question is given in the next page of this document. Please uploads your final Excel spreadsheet file via Blackboard. The upload link will disappear after 5pm on Thursday, April 15.

You can work on your own or you can work in a team. Each team can have at most two students. Only one submission per team is required.

Please download the Excel file "Assignment5_TEMPLATE.xlsx" from Blackboard. After you download the template file, change the filename so that it contains your full names. The template Excel file will have 3 tabs: Member(s), Q1, and Q2. Please list the member name(s) on the first worksheet, the sheet labeled "Members(s)". Only those students listed on the first worksheet will receive a grade.

In Q1 and Q2 tabs, the data for both questions are provided in an Excel table format for your convenience (so you do not have to copy the data from the document into an Excel file). Each question has multiple parts, to get full credits, please make sure that you answer all parts of the questions.

After saving your work, click on "Browse My Computer" to select your file, and then "Submit." Note: You have not only to "Browse My Computer" and select the file, but also to "Submit."

You can save your work-in-process within Blackboard. Attach your file and click on "Save as Draft" to save your WIP. When you come back, click on "Continue Current Submission" to retrieve your previous work.

If your work is complete, attach your file and click on "Submit." You should see Attempt #1 under Submission History. Click on it and make sure you can see the attached file(s). If you don't see the file here, neither will the grader.

In case you find an error in your initial submission, multiple attempts are allowed. If there are multiple attempts, only the latest attempt will be graded. All the others will be ignored.

Note: Certain versions of Microsoft IE are known to have issues with Blackboard. If you are using the Microsoft browser and encounter a problem, try Firefox, Chrome, Opera, etc.

Question 1: [Adapted from Exercise 9.3 in the textbook]. Belmont Bank is considering placing ATM machines in the town centers of some of the following six-communities: Arlington, Belmont, Cambridge, Lexington, Concord, and Winchester. The bank would like to purchase the minimum number of ATM machines needed to ensure that at least one ATM machine is within a ten-minute drive from the center of each of these six communities. The times required to drive between the communities are shown in the following table:

Driving Time (in minutes)	Arlington	Belmont	Cambridge	Lexington	Concord	Winchester
Arlington	0	5	10	15	20	15
Belmon	5	0	8	10	15	12
Cambridge	10	8	0	15	20	10
Lexington	15	10	15	0	10	12
Concord	20	15	20	10	0	12
Winchester	15	12	10	12	12	0

(a) Construct a discrete optimization model of the problem faced by Belmont Bank. **IMPORTANT:** The objective function and constraints must be LINEAR in the decision variables.

(b) Solve your model using Excel Solver on the computer. What is the optimal number of ATM machines that Belmont Bank needs to purchase? What is an optimal placement of these ATM machines? **IMPORTANT:** You must use SIMPLEX LP as your solution method.

(c) How many optimal solutions does this problem have? Describe how to add constraints to your optimization problem, so that can you identify all the optimal solutions. **IMPORTANT:** Each of your added constraint must eliminate **exactly one (and only one)** optimal solution that you have previously found. Your constraint must also be linear in the decision variable. Please create a separate worksheet that shows each optimal solution and the additional constraints that you use.

Question 2: [Adapted from Exercise 9.4 in the textbook] Tom Pritchett is the program scheduling manager for a local TV station. He would like to plan the schedule of television shows for next Wednesday evening. Of the 9 possible 30-minute television shows listed in the following table below, Tom must schedule exactly 5 of these shows for the period from 8pm to 10:30pm next Wednesday evening. For each television show, its estimated advertising revenue (in $ million) is shown in the second column of the table. Furthermore, each show has been categorized into one or more of the categories of “Public Interest”, “Contains Violence”, “Comedy”, and “Drama”.

Television Show	Advertising Revenue ($ million)	Public Interest	Contains Violence	Comedy	Drama
Cheers	6			Yes	Yes
Dynasty	10		Yes		Yes
L.A. Law	5	Yes	Yes		Yes
Jake	8		Yes		Yes
Bob Newhart	7			Yes	
News Special --- the Middle East	9	Yes	Yes		
Focus on Science: The Fusion Issue	4	Yes			Yes
Beaches	5			Yes	
Urban Actions for Education	3	Yes			

Table: Estimated advertising revenue and television show categories for 9 television shows.

Tom would like to determine a revenue-maximizing schedule of television shows for next Wednesday evening. However, he must be mindful of the following considerations.

- There must be at least as many shows scheduled that are categorized as public interests as there are shows scheduled that are categorized as containing violence.
- If Tom schedules "Focus on Science: The Fusion Issue", then he must also schedule either Jake or L.A. Law (or both)
- Tom cannot schedule both "Focus on Science" and "Urban Action for Education", as both of these shows are considered a bit on the dry side.
- If Tom schedules two or more shows in the comedy category, then he must schedule at least one show in the drama category.
- If Tom schedules more than three shows in the "Contains Violence" category, he will lose an estimated $5 million in advertising revenues from family-oriented sponsors.

Please answer the following three questions:

(a) Construct an optimization model of Tom's scheduling problem. **IMPORTANT:** The objective function and constraints must be LINEAR in the decision variables.

(b) What is an optimal schedule of television shows for next Wednesday evening? What is the optimal revenue? **IMPORTANT:** You must use SIMPLEX LP as your solution method.

(c) How many optimal solutions does this problem have? Describe how to add constraints to your optimization problem, so that can you identify all the optimal solutions. **IMPORTANT:** Each of your added constraint must eliminate **exactly one (and only one)** optimal solution that you have previously found. Your constraint must also be linear in the decision variable. Please create a separate worksheet that shows each optimal solution and the additional constraints that you use.