

Homework 3

Due Date: Wednesday, 4/26/23, 30mins before class on Blackboard

General Requirements

You should submit one Excel file including your answers, your model formulation, and excel output. Your answer should be in the order of the questions, and should be neat, clearly written, and concise. **Highlight your answers to the questions in yellow.** No credit will be given if I cannot easily find your answers.

You will be graded on readability and flexibility of Excel setup. **The Excel files must be executable.** I have seen output in answer submissions that were clearly not generated by the submitted Excel file. If I run your Excel file, it should give the same results you submit. That means the spreadsheet has correct embedded formulae and Solver dialog boxes have all the inputs. If 'Solve' is clicked and your spreadsheet does not produce the reported results, a minimum 50% penalty will be applied.

There are **four** problems. Must put each problem in a different worksheet.

- (i) Name each model worksheet by the problem #, for example, "Problem1", "Problem2".
- (ii) Name your file by last name and homework number, for example, LastName_Homework3.xlsx.

Problem 1

To graduate from Southeastern University with a major in operations research (OR), a student must complete at least two Math courses, at least two OR courses, and at least two Computer courses. Seven courses are offered, among which some courses can be used to fulfill more than one requirement, listed in the table below. (1 if it fills a requirement, 0 if not)

Offered Course Requirement	Calculus	Operations Research	Data Structures	Business Statistics	Simulation	Intro to Computer Programming	Forecasting
OR	0	1	0	1	1	0	1
Math	1	1	1	1	0	0	1
Computer	0	0	1	0	1	1	0

Some courses are prerequisites for others: *Calculus* is a prerequisite for *Business Statistics*; *Intro to Computer Programming* is a prerequisite for *Simulation* and for *Data Structure*; and *Business statistics* is a prerequisite for *Forecasting*. A course requiring prerequisite can be taken only if its prerequisite course is taken.

Determine how to minimize the number of courses needed to satisfy the major requirements.

- Formulate appropriately as an IP model. Provide the **algebraic model formulation** in your submission. Must be neatly presented.
- Input and solve the formulation using Excel.

Problem 2

Nash Auto has two plants, two warehouses, and three customers. The plants are in Detroit and Atlanta, the warehouses are in Denver and New York, and the customers are in Los Angeles, Chicago, and Philadelphia. Cars are produced at plants, then shipped to warehouses, and finally shipped to customers. No direct shipments are allowed from plants to customers. Detroit can produce 200 cars per week, and Atlanta can produce 160 cars per week. Los Angeles requires 80 cars per week, Chicago requires 70, and Philadelphia requires 60. Assume that during a week, at most 75 cars can be shipped from a warehouse to any particular city.

The costs of shipping a car between various cities are listed in the table below:

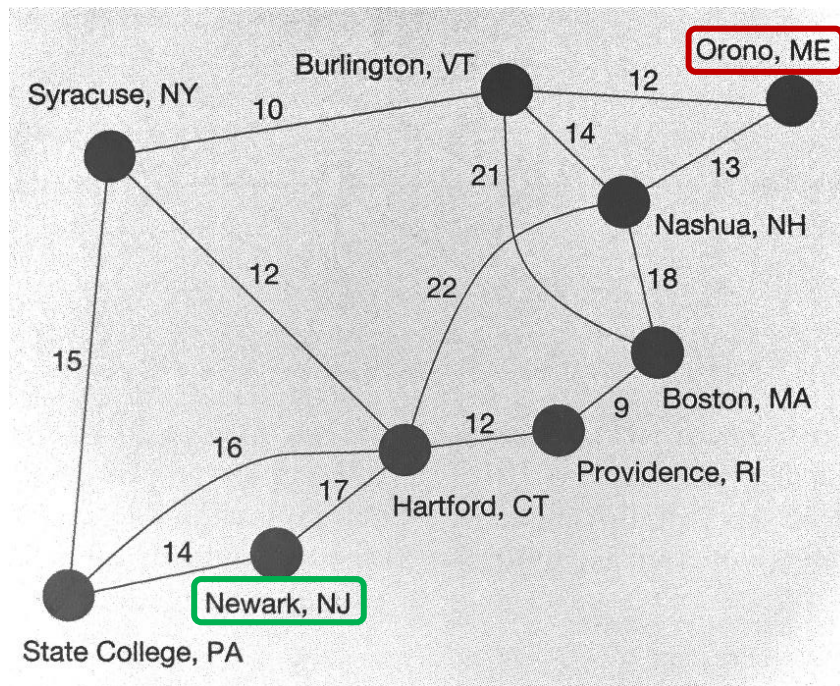
From \ To	Denver	NY	LA	Chicago	Philly
Detroit	\$1,253	\$637			
Atlanta	\$1,398	\$841			
Denver			\$1,059	\$996	\$1,691
NY			\$2,786	\$802	\$250

Use Excel model to determine an optimal shipping plan that meets Nash's weekly demands at minimum cost.

Problem 3

Northeastern Trucking company desires to arrange a shipment from **Orono, ME** to **Newark NJ**. The Transportation Management would like to find the minimum-cost route for this shipment. A network of the major highway links and cost between city pairs is show in the Figure below. Find the shortest route through the network by using the shortest route model taught in class. Input and solve the problem using Excel Solver. Must specify the least-cost route and the corresponding total cost.

Tip: In the excel model, use a single letter or number index to denote the cities instead of typing the full names. Otherwise, unmatching text values may cause errors in SUMIF.



Problem 4

Papa n Mama's Diner is a family-owned restaurant that opens 24 hours. A waiter can start a shift at 2am, 5am, 8am, 11am, 2pm, 5pm, 8pm, or 11pm, and each shift is 3 hours. The following table shows the minimum number of waiters needed during each 3-hour shift.

3-hour Shift	Number of Waiters Required
2A-5A	5
5A-8A	11
8A-11A	8
11A-2P	12
2P-5P	5
5P-8P	13
8P-11P	14
11P-2A	5

Waiters who start working at 11pm or 2am work two consecutive shifts. Otherwise, those who start working at other times work three consecutive shifts. Waiters who work between 8am and 11pm are paid \$15 per hour (i.e., \$45 per shift), and who work between 11pm and next-day 8am are paid \$20 per hour (i.e., 60 per shift).

Use Excel to determine how many waiters start working at the beginning of each shift to minimize the daily payroll while meeting the staffing requirements.