IE 310 Assignment 4:

Fall 2020

1. Three plants located at Kocaeli, Erzurum and Bursa are producing and sending their products directly or via Kayseri and Trabzon to Istanbul, Antalya, and Izmir. The table below shows the cost of sending unit products between the cities. Plant capacities and the demands of the cities are also given.

	Kayseri	Trabzon	İstanbul	Antalya	İzmir	**Capacities**
Kocaeli	20	18	30	35	40	**500**
Erzurum	15	12	35	40	45	**500**
Bursa	18	20	33	35	30	**200**
Kayseri			5	8	10	
Trabzon			7	6	4	
Demand			**400**	**380**	**320**	

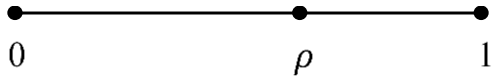
   a. Solve the problem as a transshipment problem.
   b. Solve the problem if Kayseri, besides being a shipment point, can serve 200 amounts of demand, and Trabzon, besides being a shipment point, has 50 demand of its own.

2. There are 4 new contracts available for tender and the municipality is collecting bids on each one of them. Five contractors have placed their bids on the contracts. Their bids (in thousands of dollars) are given in the table below (* indicates that the contractor did not bid on the given tender). Build an assignment table and determine the assignment with minimum cost.

   Note: Suppose, of course, that only one contractor can win the tender for every tender.

	Tender			
Contractor	1	2	3	4
1	50	50	*	20
2	70	40	20	30
3	90	30	50	*
4	70	20	60	70
5	60	45	30	80

3. Consider a line segment [0,1] that is divided into two parts as shown in the figure below.



The line segment is said to be divided into "Golden Section" if

$$\rho = \frac{\text{Length of whole line}}{\text{Length of larger part of line}} = \frac{\text{length of larger part of line}}{\text{length of smaller part of line}}$$

Show that, if we divide the search interval according to the property above, while applying an inaccurate line search in local optimization of a function, then:

$$\rho = \frac{\sqrt{5}-1}{2}$$

4. **Game Console Pricing Problem**: We will be launching our new game console in the upcoming quarter and we are trying to determine the selling price for our new console. According to our analyses, we have determined that producing one unit of the new console will cost us $250 to produce. After conducting a market research analysis, we have also determined the expected demand for prices of $200, $250, $350, and $400. The results of this analysis are also given in the table below. (We are considering our price range to be between $200 and $400)

Console Price ($)	Demand
200	2,000,000
250	1,200,000
350	600,000
400	200,000

We are also assuming that our company earns $10 in profit for each game that our customers (console owners) purchase.

a. Estimate the price-demand elasticity function using the given data. Assume a 2nd order polynomial function. You can estimate this function using Excel. Denote this function by $S(x)$, where x represents the price of the console.
b. Determine the optimal price and associated profit for the case in which an average customer buys 10 games.

(Hint: You can also use Excel for part b.)

5. Write a program which minimizes a given single variable, nonlinear function using the Bisection Method. You should write a computer program in R, C, C++, or Python which correctly implements this method.

   The function to be used in this assignment is as follows:

$$f(x) = 10 + 0.01x - 0.1x^2 + 0.8\cos(3x) \text{ , where } -4 \leq x \leq 4$$

   Since the Bisection method above gives a local minimum, you should choose a subinterval of [-4, 4] in which *f* is locally convex. Also, be careful about the initial point(s) chosen. (Do not choose directly the local optimum points so that your program stops before less than 5-10 iterations.) You can choose your ε as 0.0001 for stopping conditions if required.

   You need to report your initial point(s) and value(s), point(s) and value(s) at each iteration, and final local optimum point and value in a spreadsheet table preferably.

   Summarize your answers briefly in the report and include your tables for each method.

6. Write a program which minimizes the convex function with two variables by using the Steepest Descent Method. You should write a computer program in R, C, C++, or Python which correctly implements this method.

   The function to be used in this assignment is as follows:

$$f(x_1, x_2) = (5x_1 - x_2)^4 + (x_1 - 2)^2 + x_1 - 2x_2 + 12$$

   You need to use exact line search methods to determine the step length at each iteration.
   You might want to use your bisection code you wrote in the previous question. (You may need to modify your code because the function in this assignment has two variables.)

   You can choose your ε as 0.0001 for stopping conditions if required. You are free to choose any initial points as long as it leads you to the minimum of the function.

   Also, be careful about the initial point(s) chosen. (Please do not directly choose the optimum point so that your program stops before less than 5-10 iterations. Also, please do not choose points too far from the optimum point so that you have to report too many iterations.)

   You need to report your initial point(s) and value(s), point(s) and value(s) at each iteration, and final local optimum point and value in a spreadsheet table preferably. Summarize your answers briefly in the report which includes your tables and include your source code.

Questions	Points
1	15
2	10
3	10
4	15
5	25
6	25