CEE 3804 Exam2 (Spring 2024)

Computer Applications in Civil Engineering

Open Book and Notes (Take Home - Due April 17, 2024)

Your Name _____

Your Signature * _____

* The answers in this exam are the product of my own work. I certify that I have not received nor I have provided help to others while taking this examination.

Directions:

Solve the problems. Copy and paste the computer code and solutions such as graphs in a Word Document and convert to a single PDF file. **Make sure your code is not too small for me to be able to read it.** Minimum font size 10.

Problem 1 (30 points)

Electric and natural gas-powered vehicles require charging stations along highways in the United States. Figure 1 shows sample data for several types of charging stations including electric (ELEC) and natural gas (CNG) stations.

	A	B	C	D	E	F	G	H
1	Fuel Type Code	Station Name	Street Address	ntersection Direction:	City	State	Latitude	Longitude
2	CNG	Arkansas Oklahoma Gas	2100 S Waldron Rd		Fort Smith	AR	35.36	-94.38
3	CNG	Clean Energy - Logan Inte	1000 Cottage St Ext	From Route 1, take the	East Boston	MA	42.37	-71.03
4	CNG	Clean Energy - Everett - N	16 Rover St	Rt 16, exit to Rt 99, to D	Everett	MA	42.39	-71.06
5	CNG	Clean Energy - Greenpoin	287 Maspeth Ave	I-278/Brooklyn Queens	Brooklyn	NY	40.72	-73.93
6	CNG	Canarsie - National Grid	8424 Ditmas Ave	From Shore Pkwy, take	Brooklyn	NY	40.65	-73.92
7	CNG	Con Edison - Van Nest Se	1615 Bronxdale Ave	Hutchinson River Park	Bronx	NY	40.84	-73.86
8	CNG	Con Edison - Rye Service (	178 Theodore Fremd Ave	I-95/New England Thru	Rye	NY	40.98	-73.69
9	CNG	Con Edison - College Poin	124-15 31st Ave	From I-678/Whiteston	Queens	NY	40.77	-73.84
10	CNG	CNG Source Fueling - Gre	111 W Raymond St	I-65, exit onto Raymon	Indianapolis	IN	39.74	-86.16
11	CNG	Black Hills Energy	1301 W 24th St	From I-25 take exit 10,	Cheyenne	WY	41.14	-104.83
12	CNG	Clean Energy - City of San	2931 Rufina St		Santa Fe	NM	35.66	-105.99
13	CNG	Kansas Gas Service	11401 W 89th St	Station located in Serv	Overland Park	KS	38.97	-94.72
14	CNG	Kansas Gas Service	200 E 1st Ave		Topeka	KS	39.06	-95.67

Figure 1. Sample Car Power Station Data.

a) Create a Matlab script to read the data. Label the variables appropriately and include their units if applicable as part of the variable name.

b) Add code the Matlab script created in part (a) to extract all electric charging stations (designated as ELEC in the fuel type code. Provide a list of the first 15 station names so that I can verify that the code works.

c) Use the US map provided in assignment 7 to plot the locations of the electric charging stations. Label them with a red circle.

d) Add code to item (b) to calculate the number of CNG stations in the data. The calculation should be done in code. Display the answer in the Command window.

e) Add code to item (b) to calculate the number of electric stations in the state of New York. The calculation should be done in code. Display the answer in the Command window.

Problem 2 (40 points)

The Manning equation is an empirical relationship used by civil engineers to estimate the flow characteristics inside pipes and channels. Figure 2 shows a simple rectangular channel.

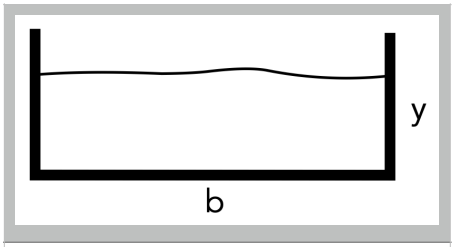

Figure 2. Simple Rectangular Channel.

For a rectangular channel, the following formulas apply.

$A = b\,y$ % Area of the flow (ft²)

$P = b + 2y$ % Wetted perimeter (ft)

$R = \dfrac{b\,y}{b + 2y}$ % Hydraulic radius (ft)

The hydraulic radius, R is the quotient of the cross sectional area to the wetted perimeter, $R = A/P$.

The basic Manning Equation is:

$Q = [1.486A * R^{2/3} * S^{1/2}]/n$

Where:

Q is the discharge (cu. feet per second)

R is the hydraulic radius in feet (area of section / wetted perimeter)

S is the slope of the pipe (ft/ft)

A is the cross-sectional area of the flow (ft²)

n is the pipe roughness coefficient (see table below).

Type of Pipe	Roughness Coefficient
Concrete and asbestos	0.012
Corrugated metal	0.023

a) Create a Matlab script to estimate the values of *A, P, and R* given the dimensions of b and y (in Figure 2). Test the code with values of b=30 feet and y=6 feet.

b) Add code to part (a) to estimate Q (discharge) using the Manning equation given all four parameters (A, R, S and n). Test the script for a concrete rectangular channel with the following parameters: S=0.002 ft/ft.

c) Add code to (a) to estimate the discharge (Q) for values of slope ranging from 0.001 to 0.008 (ft/ft).

D) In a single graph, plot the values of discharge (Q) for various slopes.

Problem 3 (30 points)

An engineer formulates a linear programming problem to estimate the number of tons to be produced of two types of concrete mixtures. Figure 3 shows the initial sketch showing a delivery constraint and a production constraint. Both concrete mixes are manufactured with the same equipment. The standard concrete sells for $1,560 per ton. The premium concrete sells for $1,635 per ton.

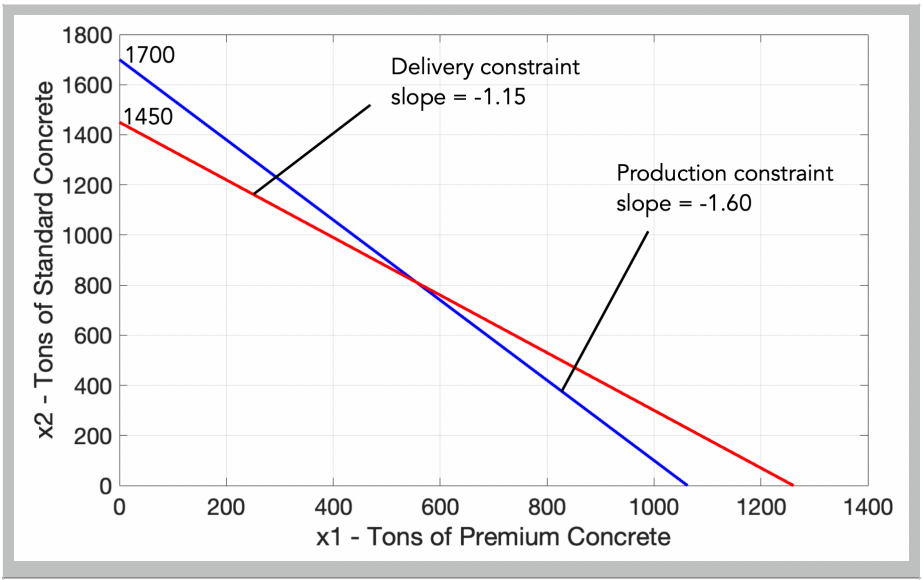

Figure 3. Graphical Representation of Concrete Production and Distribution.

a) Write the equations of the linear programming problem. Assume the company wants to maximize the revenue for the company.

b) Solve the problem using Excel Solver. Tell me how many tons of each concrete type should be produced to maximize the profit.

c) Solve the problem by hand using the Simplex Method. Clearly show your tables and indicate which variables are the basic variables in the current solution.