CEE 3804 Exam2 (Spring 2022)

Computer Applications in Civil Engineering

Solution

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 VBA 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 is acceptable.

Problem 1 (50 points)

Civil engineering undergraduate students collected airport noise data in the summer of 2015 as part of a study abroad program (see Figure 1). Airport noise is important to mitigate environmental impacts around airports.

Figure 1. Virginia Tech students collecting airport noise data at the Punta Cana International Airport.

The data collected came from two noise recording instruments that recorded the information independently but during the same time period. A data file with the data collected is provided. The information in the file includes the instrument (Casela 240 or Casela 340), the time of day of the recording (in decimal hours) and the A-weighted equivalent continuous sound level (LAeq) in decibels - a measure of the noise produced by the aircraft. A screen capture of the data provided is shown below.

Instrument	Time of Day (hrs)	Laeq (dBA)
Casela 240	0.0000	46.53
Casela 240	0.0003	49.08
Casela 240	0.0006	49.06
Casela 240	0.0008	48.39
Casela 240	0.0011	49.50

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 to the Matlab script created in part (a) to plot the LAeq noise levels (asa function of time)recorded by the Casela 240 instrument (top plot) and the Casela 340 (bottom plot). Use the subplot command to partition the figure into two plots.

c) Add code to calculate the difference between every record of LAeq recorded by the Casela 240 and the Casela 340 instruments. Plot the difference as a function of time.

d) Calculate the mean and the standard deviation (using Matlab) of the difference in LAeq values recorded by both instruments.

e) Create a histogram of the difference produced by both instruments.

f) Find the number of times (in a 24-hour period) the noise level exceeds 60 dBA using the Casela 340 instrument.

Problem 2 (50 points)

The ACME company makes $850 for every metric ton of concrete mix of type A delivered. The company makes $900 for every metric ton of concrete mix of type B delivered. After formulating the problem as an optimization problem to maximize the revenue for the ACME company, the engineers produce the following linear programing problem.

Max $Z = 850x_1 + 900x_2$

subject to:

$x_2 \leq 85$

$260x_1 + 300x_2 \leq 41000$

$130x_1 + 350x_2 \leq 36000$

$350x_1 + 190x_2 \leq 43000$

x_1 and $x_2 \geq 0$

a) Convert the problem shown above into **standard (canonical) form** to be solved by hand using the Simplex Method. Write down the transformed equations and add slack variables as needed.

Max $Z - 850x_1 - 900x_2 = 0$

subject to:

$x_2 + x_3 = 85$

$260x_1 + 300x_2 + x_4 = 41000$

$130x_1 + 350x_2 + x_5 = 36000$

$350x_1 + 190x_2 + x_6 = 43000$

b) Find the optimal solution to the problem using the manual Simplex Method (tables and row operations) explained in class. Indicate the numerical values of all decision variables in every table. Indicate the value of the objective function Z in every table. This task requires calculations and row operations and you need to show me your row operations clearly.

c) Solve the problem using Excel Solver. Verify the solution obtained in part (a).

d) Show a graphical solution to the problem indicating the corner points. In the plot also show 2-3 lines of constant Z value (your choice of Z-values).

Optimization Problem for Exam 2			
Decision Variables			
x1	91.906475		Mix A
x2	57.014388		Mix B
Objective Function			
850 x1 + 900 x2	129433.45		
Constraint Equations			
	Formula		
x2 <= 85	57.014388 <=		85
260x1 +300x2 <= 41000	41000 <=		41000
130x1+350x2 <= 36000	31902.878 <=		36000
350x1 +190x2 <= 43000	43000 <=		43000

Optimal solution
(91.9 Mix A and 57.01 Mix B)
Z = 129,433