CB-312 System Analysis for Construction Engineers
7th week Exam

F2015

Name:_____ **ID:**_____

Question 1: Select

a. A solution that satisfies all the constraints of a LP problem except the non-negativity constraints is called
   i. optimal
   ii. feasible
   iii. infeasible
   iv. semi-feasible

b. Which of the following statements is true and which is false?

i.	A redundant constraint is a binding constraint?	T	F
ii.	The point (3, 2) is feasible for the constraint $2x1 + 6x2 \leq 30$?	T	F
iii.	An optimal solution to a LP problem can be found at an extreme point of the feasible region	T	F

Question 2: Solve graphically

Identify the optimal solution and the optimal value then perform sensitivity analysis.

$$\begin{aligned} \min \quad & z = 5x_1 + 10x_2 \\ \text{s. t.} \quad & x_1 + x_2 \leq 50 \\ & x_1 + x_2 \geq 25 \\ & x_1 - 2x_2 \leq 0 \\ & x_1 \geq 0, x_2 \geq 0 \end{aligned}$$

Question 3:

A company makes three products and has available 4 workstations. The production time (in minutes) per unit produced varies from workstation to workstation (due to different manning levels) as shown below:

		Workstation			
		1	2	3	4
Product	1	5	7	4	10
	2	6	12	8	15
	3	13	14	9	17

Similarly the profit (£) contribution (contribution to fixed costs) per unit varies from workstation to workstation as below

		Workstation			
		1	2	3	4
Product	1	10	8	6	9
	2	18	20	15	17
	3	15	16	13	17

If, one week, there are 35 working hours available at each workstation how much of each product should be produced given that we need at least 100 units of product 1, 150 units of product 2 and 100 units of product 3. **Formulate this problem as an LP.**

Question 4:

The LP problem whose output follows determines how many necklaces, bracelets, rings, and earrings a jewelry store should stock. The objective function measures profit; it is assumed that every piece stocked will be sold. Constraint 1 measures display space in units, constraint 2 measures time to set up the display in minutes. Constraints 3 and 4 are marketing restrictions. The optimal solution printout is given below. Answer the questions that follow:

MAX 100X1+120X2+150X3+125X4
S.T.
1) X1+2X2+2X3+2X4 ≤ 108
2) 3X1+5X2+X4 ≤ 120
3) X1+X3 ≤ 25
4) X2+X3+X4 ≥ 50
5) ALL VARIABLES ARE NONNEGATIVE

Target Cell (Max)

Cell	Name	Original Value	Final Value
G5	Objective	0	7475

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
C4	X1	8	0	100	1E+30	12.5
D4	X2	0	-5	120	5	1E+30
E4	X3	17	0	150	12.5	25
F4	X4	33	0	125	25	5

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
G7	Constraint 1	108	75	108	15.75	8
G8	Constraint 2	57	0	120	1E+30	63
G9	Constraint 3	25	25	25	33	17
G10	Constraint 4	50	-25	50	4	8.5

A. How many necklaces should be stocked?
B. How many bracelets should be stocked?
C. How many rings should be stocked?
D. How many earrings should be stocked?
E. How much space will be left unused?
F. How much time will be used?
G. By how much will the second marketing restriction be exceeded?
H. What is the profit?
I. To what value can the profit on necklaces drop before the solution would change?
J. By how much can the profit on rings increase before the solution would change?
K. If it is decided to add 1% extra profit for all products would the optimum solution change? If no what is the new profit?