

國立中央大學八十六學年度碩士班研究生入學試題卷

所別： 工業管理研究所 丙組 科目： 作業研究 共 2 頁 第 / 頁

I. True/False 2 * 10 = 20 points

1. T F The more complicated the model, the more useful it generally is.
2. T F A model is thought of as a simplification of reality, thus there is only one correct way to build a model of a realistic problem.
3. T F A model is a good substitute for executive judgment and experience.
4. T F The parameters' values of an LP problem must be known and certain.
5. T F All of the points on an objective function line have the same value for Z.
6. T F In a minimization problem, the objective function refers to profit.
7. T F The sign of an artificial variable's coefficient in an objective function depends on whether it's a maximization or minimization problem.
8. T F It is possible to have more than one optimal solution for an LP model.
9. T F The graphical method can be used to an LP problem which contains any number of decision variables.
10. T F A slack variable is subtracted from a \geq constraint to convert it to an equality.

II. Multiple Choice (choose the most suitable one) 2 * 10 = 20 points

1. Which of the following is the order of the scientific method?
 1. Model construction 2. Observation 3. Model validation
 4. Problem definition 5. Implementation 6. Problem solution
 - a. 1-3-2-4-6-5
 - b. 2-4-1-3-6-5
 - c. 4-2-1-3-5-6
 - d. 2-4-6-1-3-5
2. Constrained optimization means
 - a. the value of the decision variables are subject to limitations.
 - b. maximization value of the objective function is not as large as it should be.
 - c. minimization value of the objective function is not as small as it should be.
 - d. the value of the objective function is subject to limitations.
3. Which of the following is a linear equation? (A, B, C are constants and X, Y, Z are variables.)
 - a. $AX^2 + BY^2 = C$
 - b. $A^2X - B^2Y = C^2$
 - c. $AX + BY + CXY = D$
 - d. $AX - BY/Z = C$
4. What is the interpretation of the surplus variable?
 - a. the amount of the resource which might not be used.
 - b. the amount by which the requirement might be exceeded.
 - c. the additional amount of variable X_i which might be produced.
 - d. the amount of variable X_i which is left over.
5. When is the simplex algorithm for maximization finished?
 - a. When the $c_j - z_j$ row consists of zeros and negative numbers.
 - b. When the $c_j - z_j$ row consists of zeros and positive numbers.
 - c. At the third iteration.
6. Number of basic variables in the simplex solution basis should be equal to
 - a. the number of decision variables.
 - b. the number of iterations.
 - c. the number of constraints.
 - d. the number of extreme points of the feasible region.
7. Which of the following is a proper mathematical operation on a row of a simplex tableau?
 - a. Multiply every element by a constant.
 - b. Add one row to another row.
 - c. Add a multiple of one row to another row.
 - d. All of the above.
8. The use of large M in an objective function occurs when this type of variable is involved:
 - a. slack
 - b. surplus
 - c. decision
 - d. artificial

9. Which of the following does NOT change when working through the simplex algorithm?
 - a. The coefficients of the objective function.
 - b. The coefficients of the constraints.
 - c. The right-hand sides of the constraints.
 - d. The variables in the basis column.
10. Shadow price in a maximization problem is
 - a. the $c_j - z_j$ value under the slack variable
 - b. the maximum additional price that would be paid to obtain more of the resource
 - c. implicit value of the resource in gaining the profit
 - d. all of the above.

III. Quantitative Analysis 10*6 = 60 points

1. a. Shows the generalized LP model for a maximization problem with \leq constraints.
 b. Define $C_j, C_b, b_i,$ and $C_j - z_j$ in below tableau.
 c. What would be the basic variables in the initial tableau (define their nature)?

C_j		b_i	x_1	x_2	x_3	x_4
C_b	basis					
	z_j					
	$C_j - z_j$					

2. A small company produces two products daily - bowls and mugs. Given the limited amounts of two resources - clay and labor, the company desires to know how many bowls and mugs to produce each day in order to maximize profit. The Two products have the following resource requirements for production and profit per unit produced. There are 40 hours of labor and 120 pounds of clay available each day for production.

Product	Labor (hr/unit)	Clay (lb/unit)	Profit (\$/unit)
Bowl	1	4	4
Mug	2	3	5

- a. What properties are required that the LP model should contain?
 - b. Construct the model (define the decision variables; no need to solve).
 - c. What is the standard simplex form of the problem?
3. Given the below general primal form of the LP model, show its dual.

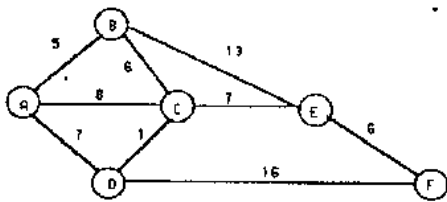
$$\begin{aligned}
 \text{Max} \quad & z_p = \sum_{j=1}^n c_j x_j \\
 \text{s.t.} \quad & \sum_{j=1}^n a_{ij} x_j \leq b_i \quad \text{for } i = 1, 2, \dots, n
 \end{aligned}$$

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4. Determine the shortest route from node A to node F.



5. The construction company has estimated the times as needed to complete the 10 tasks for building a second hall for the College of Management, NCU.

Activity	Description	Immediate predecessors	Expected time (months)
A	Foundation	-	3
B	Walls/ceiling	A	5
C	Roof timbers	B	2
D	Windows	B	2
E	Electric wiring	B	4
F	Roof sheathing	C	3
G	Exterior siding	D,E	5
H	Inside wall board	D,E	3
I	Roof shingles	F	8
J	Paints	G,H,I	2

- a. Draw network diagram.
- b. Identify the critical path by filling up below table.

Activity	ES	EF	LF	LS	Slack	Critical
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c. Determine the expected project completion time.

6. The air quality in Chungli is analyzed and classified as either good, unhealthy, or hazardous. The day-to-day change in the air quality classification is a stochastic process, and the air quality on any given day depends only on the air quality of the previous day. The transition probability matrix is shown below

Today's air quality	Tomorrow's air quality		
	Good	Unhealthful	Hazardous
Good	.75	.20	.05
Unhealthful	.25	.65	.10
Hazardous	.05	.75	.20

- a. Determine the steady-state probabilities of the air quality levels.
- b. During a year, how many days will the air be in hazardous state?
Note: $\pi = \pi P$