

國立臺灣科技大學

九十二學年度碩士班招生考試試題

系所組別：工業管理系碩士班甲組

科目：作業研究

總分 100 分。Show all calculations.

1. ABC Copy Center uses several copy machines that deteriorate rather rapidly in terms of the quality of copies produced as the volume of the copies increases. Each machine is examined at the end of each day to determine the quality of the copies being produced, and the results of that inspection are classified as follows.

Classification	Copy Quality	Maintenance cost per day
1	Excellent	\$ 0
2	Acceptable	100
3	Marginal	400
4	Unacceptable	800

The costs associated with each classification are for maintenance and repair and redoing unacceptable copies. When a machine reaches classification 4, and copies are unacceptable, major maintenance is required (resulting in downtime), after which the machine resumes making excellent copies. The transition matrix showing the probabilities of a machine's being in a particular classification state after inspection from the end of a day to that of the next day is as follows.

$$P = \begin{matrix} & \text{State} & 1 & 2 & 3 & 4 \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} & & \begin{bmatrix} 0 & .8 & .1 & .1 \\ 0 & .6 & .2 & .2 \\ 0 & 0 & .5 & .5 \\ 1 & 0 & 0 & 0 \end{bmatrix} \end{matrix}$$

Determine the expected daily cost of machine maintenance (25%).

2. A company is trying to determine whether to rent a slow or a fast fax machine. The company believes that an employee's time is worth \$15 per hour. The slow machine rents for \$4 per hour, and it takes an employee an average of 10 minutes to complete sending (exponentially distributed). The fast machine rents for \$15 per hour and it takes an employee of 6 minutes to complete sending. An average of 4 employees per hour need to use the fax machine (interarrival times are exponential). Which machine should the company rent (25%)?
3. Orient Express is a global distribution company that transports its clients' products to customers in Hong Kong, Singapore and Taipei. All of the products Orient Express ships are stored at three distribution centers, one in Los Angeles, one in Savannah and one in Galveston. For the coming month the company has 450 containers of computer components available at the Los Angeles center, 600 available at Savannah, and 350 available in



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Galveston. The company has orders for 600 containers from Hong Kong, 500 from Singapore, and 500 from Taipei. The shipping costs per container from each U.S. port to each of the overseas port are shown in the following table.

U.S. Distribution Center	Overseas Port		
	Hong Kong	Singapore	Taipei
Los Angeles	\$300	210	340
Savannah	490	520	610
Galveston	360	320	500

The Orient Express as the overseas broker for its U.S. customers is responsible for unfulfilled orders, and it incurs stiff penalty costs from overseas customers if it does not meet an order. For each container of unfulfilled demand, the Hong Kong customers charge a penalty cost of \$800, Singapore customers charge \$920 and Taipei customers charge \$1,100. Formulate and solve a transportation model to determine the shipments from each U.S. distribution center to each overseas port that will minimize total shipping costs. Indicate what portion of the total cost is a result of penalties (25%).

4. Consider the following linear programming problem and its partial optimal tableau solved initially by the Big-M method:

$$\begin{aligned} \text{Maximize } & Z = 20x_1 + 10x_2 \\ \text{Subjective to } & x_1 + x_2 = 150 \\ & x_1 \leq 40 \\ & x_2 \geq 20 \\ & x_1, x_2 \geq 0 \end{aligned}$$

Basis \ x_j	x_1	x_2	s_2	e_3	a_1	a_3	rhs
e_3	0	0	p	1	1	-1	90
x_1	1	0	1	0	0	0	40
x_2	0	1	-1	0	1	0	110
$c_j - z_j$	0	0	q	0	r	t	1900

where s_2 is the slack variable for constraint 2, e_3 is the surplus variable for constraint 3, and a_1 and a_3 are the respective artificial variables for constraints 1 and 3. It is required that $c_j - z_j \leq 0$, for all j for the tableau to be optimal.

- (a) Determine the values of p, q, r, t (10%)
 (b) Find the dual problem and its optimal solution (15%).

