淡江大學九十三學年度碩士班招生考試試題

系別：管理科學研究所　　　　科目：作　業　研　究

| 准帶項目請打「〇」否則打「×」 |
| :---: |
| 〇　簡單型計算機 |
| 〇 |

1. **Please list and brief discuss the phrases of an OR study.** (5% each, 10% total)

2. The Gutchi Company manufactures purses, shaving bags, and backpacks. The construction of the three products requires leather and synthetic material, with leather being the limiting raw material. The production process uses two types of skilled labor: sewing and finishing. The following table gives the availability of the resources, their usage by the three products, and the profits per unit.

| Resource | Resource requirements per unit | | | Daily availability |
| :--- | :---: | :---: | :---: | :---: |
| | Purse | Bag | Backpack | |
| Leather (ft$^2$) | 2 | 1 | 3 | 42 |
| Sewing (hr) | 2 | 1 | 2 | 40 |
| Finishing (hr) | 1 | 0.5 | 1 | 45 |
| Profit ($) | 24 | 22 | 45 | |

**Formulate the problem as a linear program and find the optimum solution. Next, if available leather is decreased by 1 ft$^2$ in the resource, please determine the new optimum solution.** (5% each, 15% total)

3. **Develop the branch-and-bound tree for the following problem.** For convenience, always select $x_1$ as the branching variable at node 0. (15%)

   Maximize $z = 2x_1 + 3x_2$

   subject to

   $$5x_1 + 7x_2 \leq 35$$
   $$4x_1 + 9x_2 \leq 36$$
   $$x_1, x_2 \geq 0 \text{ and integer}$$

4. **(A Cargo-loading Model)** A 4-ton vessel is loaded with one or more of three items. The following table gives the unit weight, $w_i$, in tons and the unit revenue in thousands of dollars, $r_i$, for item $i$. **How should the vessel be loaded to maximize the total return?**

| Item $i$ | $w_i$ | $r_i$ |
| :---: | :---: | :---: |
| 1 | 2 | 31 |
| 2 | 3 | 47 |
| 3 | 1 | 14 |

Note that because the unit weights $w_i$ and the maximum weight $W$ are integer, the state $x_i$ must assume integer values only. (15%)

5.　McBurger orders ground meat at the start of each week to cover the week's demand of 300 lb. The fixed cost per order is $20. It costs about $0.03 per lb per day to refrigerate and store the meat.

(1) Determine the inventory cost per week of the present ordering policy. (5%)

(2) Determine the optimal inventory policy that McBurger should use, assuming zero lead time between the placement and receipt of an order. (5%)

(3) Determine the difference in the cost per week between McBurger's current and optimal ordering policies. (5%)

6.　Consider a capacitated network $G = (N, A)$, where $N$ is the set of nodes, and $A$ is the set of arcs and define

$x_{ij}$ = amount of flow from node $i$ to node $j$
$u_{ij}$ $(l_{ij})$ = upper (lower) capacity of arc $(i, j)$
$c_{ij}$ = unit flow cost from node $i$ to node $j$
$f_i$ = net flow at node $i$

The linear programming for the minimum-cost capacitated flow problem is given as

Minimize　$z = \sum_{(i,j)\in A}\sum c_{ij}x_{ij}$

subject to

$$\sum_{\substack{k \\ (j,k)\in A}} x_{jk} - \sum_{\substack{i \\ (i,j)\in A}} x_{ij} = f_j, \quad j \in N$$

$$l_{ij} \le x_{ij} \le u_{ij}$$

Assume a positive (negative) value when a net supply (demand) is associated with node $i$. In addition, three assumptions are given as

(i) A (nonnegative) unit flow cost is associated with each arc.

(ii) Arcs may have positive lower capacity limits.

(iii) Any node in the network may act as a source or as a sink.

Please answer the following questions:

(1) Explain the meanings of the objective function and constraints..(10%)

(2) Explain the relationship between the minimum-cost capacitated flow problem and the shortest-route (or shortest-path) problem. (5%)

7. For the upcoming planting season, Farmer McCoy has four options:

   $a_1$ = Plant corn;　　$a_2$ = Plant wheat;　　$a_3$ = Plant soybean; and　　$a_4$ = Use the land for grazing.

   The payoffs associated with the different actions are influenced by the amount of rainfall, which could be one of four states:

   $s_1$ = Heavy rainfall;　　$s_2$ = Moderate rainfall;　　$s_3$ = Light rainfall; and　　$s_4$ = Drought season.

   The payoff matrix (in thousands of dollars) is estimated as

   |  | $s_1$ | $s_2$ | $s_3$ | $s_4$ |
   | --- | --- | --- | --- | --- |
   | $a_1$ | −20 | 60 | 30 | −5 |
   | $a_2$ | 40 | 50 | 35 | 0 |
   | $a_3$ | −50 | 100 | 45 | −10 |
   | $a_4$ | 12 | 15 | 15 | 10 |

   **Develop a course of action separately for Farmer McCoy based on the criterion of Laplace, Savage, and Hurwicz, respectively.** Note that please select the middle value if necessary. (5% each, 15% total)