Course Name: Algorithm Design and Analysis
Course ID: 180086081200P1002H

Chapter Name: Linear Programming

For problems 1-5, you should do at least the following things:

1. You only need to model the following questions, without the need for solving them or providing specific solving algorithms, and there's no need to discuss time complexity and space complexity.

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1. Question1

   You want to determine the quantities $x_1, x_2, ..., x_n$ of n different foods, each containing m types of nutrients. The amount of the i-th nutrient in the j-th food is represented as a_n, and the prices of the n foods are $c_1, c_2, ..., c_n$. Your goal is to find a recipe where the content of each of the m nutrients is at least $b_1, b_2, ..., b_m$, while minimizing the total cost.

2. Question2

   You now need to pack dormitory items. You have m items and n boxes, with enough boxes to accommodate all items. The space occupied by the i-th item is C_i, and the capacity of the j-th box is S_j. Your goal is to pack all items using as few boxes as possible.

3. Question3

   On a farm, there are two different crops: wheat and soybeans. Planting one acre of wheat requires 5 units of fertilizer and 2 units of water, while planting one acre of soybeans requires 3 units of fertilizer and 4 units of water. The farm has 30 units of fertilizer and 20 units of water available. Each acre of wheat can be sold for 150 dollars, and each acre of soybeans can be sold for 120 dollars. The farm owner wants to maximize the total income.

4. Question4

   The company manufactures three products, A1, A2, and A3, utilizing resources such as metal sheets, labor, and machinery. The quantities of various resources required to manufacture one unit of each product are provided in the table below. Without considering fixed costs, the unit profits for each product are 40,000 yuan, 50,000 yuan, and 60,000 yuan, respectively. Available resources include 500 tons of metal sheets, 300 workers per month, and 100 machines per month. In addition to production, fixed costs must be paid: 1 million yuan for A1, 1.5 million yuan for A2, and 2 million yuan for A3. Develop a production plan for the company to maximize profits.

Resources	A_1	A_2	A_3
Metal sheets/t	2	4	8
Labor force (person/month)	2	3	4
Machinery (units/month)	1	2	3

5. Question5

   The company plans to open branches in four districts in the urban area, with a total of 10 locations to choose from. Taking into account the consumption levels and residential density of residents in each district, the following rules are established:

In District 1, at most two points can be selected from A_1, A_2, and A_3;
In District 2, at least one point must be selected from A_4 and A_5;
In District 3, at least one point must be selected from A_6 and A_7;
In District 4, at least two points must be selected from A_8, A_9, and A_{10}.
The investment and annual profit for each point A_j vary depending on the location, as shown in the table below. The total investment of the company should not exceed 7.2 million yuan. Which sales points should be selected to maximize the company's annual profit?

	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}
Investment	100	120	150	80	70	90	80	140	160	180
Profit	36	40	50	22	20	30	25	48	58	61