科目：作業研究

1. (40%) The Wyndor Glass Co. produces high-quality glass products, including windows and glass doors. It has three plants. Aluminum frames and hardware are made in Plant 1, wood frames are made in Plant 2 and can be also outsourced to external vendors, and Plant 3 produces the glass and assembles the products. There are two products having sales potential: Product 1: an 8-foot glass door with aluminum framing, and Product 2: a 4×6 foot double-hung wood-framed window. Product 1 requires some of the production capacity in Plants 1 and 3, but none in Plant 2. Product 2 needs only Plants 2 and 3. The following data is also gathered:

Plant	Production Time Required per Batch (hours) Product 1	Production Time Required per Batch (hours) Product 2	Production Time Available per Week (hours)
1	1	0	4
2	0	2	∞ (with outsourcing)
3	3	2	18
Profit per batch	\$3,000	\$5,000	

a) Formulate a linear programming problem to determine the production rates (production rate is defined as the number of batches produced per week) such that the total profit is maximized.

b) Suppose the wood frames cannot be outsourced to external vendors anymore. Analyze how the capacity (available production time) in Plant 2 affects the optimum production rates obtained in (a).

c) Suppose a marketing strategy requires production of at least two batches of Product 1 per week. How does this marketing strategy affect the optimum production rates obtained in (a)

d) A management team intends to enhance the company profit by enlarging the plants' capacity. What would you suggest to the team?

2. (30%) Five jobs need to be done on a certain machine. However, the setup time for each job depends upon which job immediately preceded it, as shown by the following table:

		Setup Time Job 1	2	3	4	5
Immediately Preceding Job	None	4	5	8	9	4
	1	-	7	12	10	9
	2	6	-	10	14	11
	3	10	11	-	12	10
	4	7	8	15	-	7
	5	12	9	8	16	-

The objective is to schedule the sequence of jobs that minimizes the sum of the resulting setup times.

a) Design a branch-and-bound algorithm for sequencing problems of this type by specifying how the branch, bound, and fathoming steps would be performed.

b) Use this algorithm to solve this problem

3. (30%) A camera store stocks a particular model camera that can be ordered weekly. Let D_1, D_2,... represent the demand for this camera during the first week, second week, ..., respectively. It is assumed that the D_i are independent and identically distributed random variables having the following distribution:

r.v. D_i	0	1	2
Probability	0.5	0.4	0.1

On Saturday night the store places an order that is delivered in time for the opening of the store on Monday. If the stock level at the end of each week is less than or equal to 1 cameras, 2 additional cameras will be ordered. Otherwise, no ordering will take place. Assume that the insufficient stock results in lost sales. Also assume that there are two cameras at the beginning of the first week. Assume further that the following storage costs are charged for cameras remaining on the shelf at the end of the week:

$$\text{Storage Cost} = \begin{cases} 0 & \text{if no. of remaining cameras} = 0 \\ 2 & \text{if no. of remaining cameras} = 1 \\ 6 & \text{if no. of remaining cameras} = 2 \\ 10 & \text{if no. of remaining cameras} \geq 3 \end{cases}$$

a) Find the stationary probabilities of the stock levels at the end of each week. (You need to model a Markov chain to solve this problem.)

b) Find the long-run expected lost sales.

c) Find the long-run expected average storage cost per week.

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