

COMP3821 Homework 4

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Question 2.

2.1 Variables.

1. n is the number of distinct toy i 's that can be produced.
2. m is the number of factories f_j available for producing toys.
3. C_i is the setup cost for a toy i .
4. P_i is the profit for selling each toy i .
5. H_j is the total production hours for factory j , h_j is the hours used.
6. A_{ij} is the production rate (toys/hour) of toy i at factory j .
7. S is the resulting map of factories to tuples containing the number of toys e.g. (toy 1: 4, toy 2: 5).
8. k_i is the number of toys i 's made at a factory.

2.2 Constraints.

1. $(\sum_{i=1}^n k_i \times P_i - C_i) \geq 0$ to make a net profit at factory j . If a factory is not being used, i.e. it is not worth it to make toys there, then its profit margin is simply 0.
2. $h_j \leq H_j$ for all $0 \leq j \leq m$.

2.3 Objective.

Maximize the net profits per factory to obtain the maximum total profit from selling toys. Hence the goal is to maximize,

$$\sum_{s_j \in S}^m profit(s_j)$$

where profit() sums up the net profit of made at a factory j .

2.4 Polynomial-Time Solution.

Since this is an integer LP problem, it is fundamentally NP-hard with no deterministic polynomial-time solution. However, a polynomial solution may exist for specific instances of the integer LP problem. This could be one, although, it is not known.