Mathematical Model

Parameters

- P: Number of parts

- M: Number of machines

- $TimeRequired_{m,p}$: Time required to produce one batch of part p on machine m

- $MachineCosts_m$: Cost associated with using machine m

- $Availability_m$: Availability of machine m per month

- $Prices_p$: Selling price of one batch of part p

- $MinBatches_p$: Minimum number of batches of part p to be produced

Decision Variables

- x_p: Number of batches of part p to be produced

Objective Function

Maximize the profit, which is the total sales minus the costs of using the machines:

$$\text{Maximize } Z = \sum_{p=1}^{P} Prices_p \cdot x_p - \sum_{m=1}^{M} MachineCosts_m \cdot \sum_{p=1}^{P} TimeRequired_{m,p} \cdot x_p$$

Constraints

1. Non-negativity constraint for the number of batches:

$$x_p \geq 0 \quad \forall p = 1, 2, \ldots, P$$

2. Machine time availability constraint:

$$\sum_{p=1}^{P} TimeRequired_{m,p} \cdot x_p \leq Availability_m \quad \forall m = 1, 2, \ldots, M$$

3. Minimum production requirement:

$$x_p \geq MinBatches_p \quad \forall p = 1, 2, \ldots, P$$