Applying Multi-Objective Programming And Local Search In Scheduling Model Design Of Logistics Service Supply Chain

Scheduling Model Design

Without Relationship Between Two Time Windows

- 2-echelon service supply chain
- MC-mode and CODP Selection
- Scheduling without stagnation

Understanding Problem Nature

Mathematical Formulation

Multi-Objective Programming

$$\text{Min} \quad X_1 = \sum_{i=1}^{k-1} \int_{a_i}^{b_i} (c_i \cdot t_i - |t_i - T_i^e| \cdot P_i) f(t_i) dt_i + \sum_{j=1}^{N} \sum_{i=k}^{N_j} \int_{a_i}^{b_i} (c_{ij} \cdot t_{ij} - |t_{ij} - T_{ij}^e| \cdot P_{ij}) f(t_{ij}) dt_{ij}$$

$$\text{Min} \quad X_2 = \sum_{j=1}^{N} \left| \sum_{i=1}^{k-1} T_i^e + \sum_{i=k}^{N_j} T_{ij}^e - T_j^r \right|$$

$$\text{Max} \quad X_3 = \frac{\sum_{i=1}^{k-1} S_i + \sum_{j=1}^{N} \sum_{i=k}^{N_j} S_{ij}}{k - 1 + \sum_{j=1}^{N} (N_j - k + 1)}$$

$$\begin{cases} T_j^r - c_{j1} \le \sum\limits_{i=1} T_i^e + \sum\limits_{i=k} T_{ij}^e \le T_j^r + c_{j2} & \forall j,\ \forall 1 \le k \le N_j \\ L_{i+1}^a \le T_{ij}^e - T_{ij} \le L_{i+1}^p & \forall i, j \\ T_i^e \in [a_i, b_i] & \forall i < k \\ T_{ij}^e \in [a_i, b_i] & \forall i \ge k, \forall j \end{cases}$$

Ideal Point Method

Single-Objective Programming

$$\text{Min} \quad X = \sqrt{w_1 \cdot (1 - \frac{X_{1\min}}{X_1})^2 + w_2 \cdot (1 - \frac{X_{2\min}}{X_2})^2 + w_3 \cdot (1 - \frac{X_3}{X_{3\max}})^2}$$

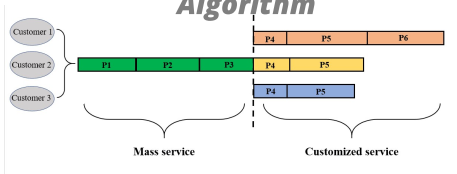
Convert to Discrete Problem

Local Search

- Define Neighborhood
- Finding Feasible Solution $O(n^3)$
- Moving and Optimizing $O(c^2n^4)$

$$\underbrace{O(n^3) \quad O(c^2n^4)}_{O(c^2n^{4.5})}$$

Testing and Visualization



Evaluation: Compare with Genetic Algorithm

With Relationship Between Two Time Windows

- Allowing Out-of-Range, Extra Cost

Algorithm Still Works!