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Research article

Rescheduling involving due dates on a single machine due to the arrival of new jobs with rejection

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Appendix A: MILP formulation

This appendix presents the mixed-integer linear programming formulation used in the computational experiments for $1|rej, \delta_{\max} \le \Delta|L_{\max} + \mu\delta_{\max} + \sum_{j\in\mathcal{J}_N^R} e_j$. Let $\mathcal{J} = \mathcal{J}_O \cup \mathcal{J}_N$ be the set of all jobs and let $n = |\mathcal{J}|$. The positions in the sequence are indexed by $t = 1, \ldots, n$. For each original job $j \in \mathcal{J}_O$, let C_j^0 denote its completion time in the original schedule. Let M be a sufficiently large positive constant.

The decision variables are defined as follows. Let $x_{jt} = 1$ if job j is assigned to position t, and 0 otherwise. For each new job $j \in \mathcal{J}_N$, let $z_j = 1$ if job j is accepted, and 0 otherwise. Let C_t denote the completion time of position t, C_j the completion time of job j, $L_{\max}$ the maximum lateness, and $\delta_{\max}$ the maximum disruption.

$$\min \quad L_{\max} + \mu\delta_{\max} + \sum_{j\in\mathcal{J}_N} e_j(1 - z_j) \tag{A.1}$$

$$\text{s.t.} \quad \sum_{t=1}^{n} x_{jt} = 1, \qquad j \in \mathcal{J}_O, \tag{A.2}$$

$$\sum_{t=1}^{n} x_{jt} = z_j, \qquad j \in \mathcal{J}_N, \tag{A.3}$$

$$\sum_{j\in\mathcal{J}} x_{jt} \le 1, \qquad t = 1, \ldots, n, \tag{A.4}$$

$$C_1 = \sum_{j\in\mathcal{J}} p_j x_{j1}, \tag{A.5}$$

$$C_t = C_{t-1} + \sum_{j\in\mathcal{J}} p_j x_{jt}, \qquad t = 2,\dots,n, \tag{A.6}$$

$$C_j \geq C_t - M(1 - x_{jt}), \qquad j \in \mathcal{J},\ t = 1,\dots,n, \tag{A.7}$$

$$C_j \leq C_t + M(1 - x_{jt}), \qquad j \in \mathcal{J},\ t = 1,\dots,n, \tag{A.8}$$

$$L_{\max} \geq C_j - d_j - M\left(1 - \sum_{t=1}^{n} x_{jt}\right), \qquad j \in \mathcal{J}, \tag{A.9}$$

$$\delta_{\max} \geq C_j - C_j^0, \qquad j \in \mathcal{J}_O, \tag{A.10}$$

$$\delta_{\max} \geq C_j^0 - C_j, \qquad j \in \mathcal{J}_O, \tag{A.11}$$

$$\delta_{\max} \leq \Delta, \tag{A.12}$$

$$x_{jt} \in \{0,1\}, \qquad j \in \mathcal{J},\ t = 1,\dots,n, \tag{A.13}$$

$$z_j \in \{0,1\}, \qquad j \in \mathcal{J}_N, \tag{A.14}$$

$$C_t \geq 0,\ C_j \geq 0,\ \delta_{\max} \geq 0, \qquad t = 1,\dots,n,\ j \in \mathcal{J}. \tag{A.15}$$

Constraint (A.2) ensures that each original job must be processed exactly once, while Constraint (A.3) indicates that each new job is either accepted and processed once or rejected. Constraint (A.4) allows at most one job to be assigned to each position. Constraints (A.5)–(A.6) define the completion time of each position, and Constraints (A.7)–(A.8) link the completion time of each job with the completion time of its assigned position. Constraint (A.9) defines the maximum lateness of all accepted jobs. Constraints (A.10)–(A.11) define the maximum absolute completion-time deviation of the original jobs, and Constraint (A.12) imposes the disruption limit.



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