Optimizing Tuition Centres

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Multi-objective optimization strategy

- Both tasks are not computationally intensive MIP problems
- There are only two objectives for each problem
- We can explore the Pareto front without subjective weight selection using the epsilon constraint method
- We shall model the preference objective as epsilon constraints

Decision Variables

- Whether tutor is assigned to student (binary): x_{ts}
- Whether tutor is assigned to tuition centre (binary): x_{tc}
- Auxiliary variables to model Mean Absolute Deviation workload [0,∞): k_{t+}, k_{t-}
- Auxiliary variable to hold average preference score [0,∞): p

Constraints

- Tutor's capacity cannot be exceeded: $\sum_s x_{ts} \leq \text{CAPACITY}_t$
- Tutor cannot be assigned to more than one centre: $\sum_c x_{tc} \leq 1$
- Tutor cannot be assigned to student from another centre: $x_{tc} - x_{ts} \geq 0$
- Student can only have one tutor: $\sum_t x_{ts} = 1$
- Tutor's and student's skill must be appropriate: $x_{ts} = 0$, when tutor's skill is Normal and student's need is Extensive
- Preference score must be within bounds, epsilon constraint: $p_- \leq p \leq p_+$
- Definition of preference score: $p = \sum_{t,c} p_{tc}\, x_{tc}$, where p_{tc} is 2 for first preference, 1 for second preference, and zero if not in preferences
- (When optimizing for balanced workload) $\overline{w} = \sum_{s,t} x_{ts}\ /\text{NUM\_TUTORS}$, $k_{t+} - k_{t-} = \sum_s x_{t,s} - \overline{w}$

Objective

Since preference is modeled in the constraints, it will not be in the objective function.

Task A

$$\text{Minimize} \sum_c x_{tc}$$

Task B

$$\text{Minimize} \sum_t k_{t+} + k_{t-}$$

Preference Score Selection

Each matched preference is awarded a score of 2 for first preference, 1 for second preference, and zero if not in preferences

This provides an easy and intuitive way to model and understand the results of the optimization

A score close to zero means most tutors did not get what they want while a score close to two means most tutors got close to their first preference