Adding Ties and Lecturer Targets

The Student-Project Allocation Problem with lecturer preferences over Students (SPA-S)

- A set of students $S = \{s_1, s_2, ..., s_n\}$.
- Projects $P = \{p_1, p_2, ..., p_m\}$ and lecturers $L = \{l_1, l_2, ..., l_k\}$.
- Each project is offered by a unique lecturer.
- Students have preferences over projects, lectures have preferences over students.
- Projects and lecturers have upper quotas.

Stable Matching

A stable matching in SPA-S is an assignment of students to projects such that capacities are respected and there is no student-project pair $(s, p)$ where $s$ and $l_0$, the lecturer offering $p$, have an incentive to deviate from the assignments (if any) and form a pairing.

- Every instance of SPA-S must admit a stable matching [1].
- A stable matching can be found in linear time [1].

New Integer Programming Model

Integer Programming (IP) is a computational technique which can deal with hard problems. Finding a maximum stable matching in an instance of SPA-STL is NP-hard and so an IP model was developed for instances of SPA-STL with the aim of investigating the scalability of the IP model with changes in instance complexity and size, and also investigating changes in matching characteristics when altering instance parameters such as preference list length and probability of ties.

- New integer inequalities and objective functions created for stability constraints and load balancing optimisations.

Java Application

- Integer Program accessed by Java application.
- Optimisations can be performed in any order.

Linear constraints

- Order of optimisations:
  1. Stability
  2. Maximum sized
  3. Minimum cost
  4. Minimum Max LeC Diff
  5. Minimum Sum LeC Diff
  6. Minimum Q min Sum LeC
  7. Minimum Q min Sum LeC ranks
  8. Minimum Q min Sum LeC and ranks
  9. Minimum Q min Sum LeC Var

Quadratic constraints

- Minimises the number of students assigned to the worst ranked project, and subject to this, the second worst, and so on.
- Minimises the sum of the absolute difference between lecturer occupancy and targets.
- Minimises the sum of the squares of student-project pair ranks in the matching.
- Minimises variance of the proportion of lecturer occupancy compared to targets.

Conflicting Objectives Example

<table>
<thead>
<tr>
<th>s_1</th>
<th>p_1</th>
<th>l_1</th>
</tr>
</thead>
<tbody>
<tr>
<td>s_2</td>
<td>p_2</td>
<td>l_2</td>
</tr>
</tbody>
</table>

Objectives A:

- Opt 1: Stable
- Opt 2: Maximum size

$M = \{(s_1, p_1)\}$

Objectives B:

- Opt 1: Minimise the sum of lecturer differences
- Opt 2: Maximum size

$M = \{(s_1, p_1)\}$

References