Simple Topic Assignment Tool

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Abstract

At many university seminars, students have to form teams in order to tackle one of several offered topics. Each topic is offered by a supervisor and can only be tackled by one team exclusively. The goal is to match students with topics while best meeting students' preferences and ensuring a high degree of fairness. A team usually consist of two students. Only if the number of seminar participants is odd, there is one team of three. Some students form a team beforehand, other do not. Furthermore, the workload between supervisors should be distributed fairly. To that end, students submit their preferences by ranking all topics. These ranks are then used in an integer linear model to assign students.

Notation

Table 1 summarizes the notation used in the model.

Sets, parameter, ...	
$\mathcal{N} = \{1, \ldots, N\}$	set of single students
$\mathcal{G} = \{1, \ldots, G\}$	set of work groups
K_g	size of work group $g \in \mathcal{G}$ (dues, except for one trio)
$\mathcal{T} = \{1, \ldots, T\}$	set of topics
$\mathcal{S} = \{1, \ldots, S\}$	set of supervisors
$\mathcal{T}_s$	set of topics of supervisor $s \in \mathcal{S}$
L_s	minimum number of topics for supervisor $s \in \mathcal{S}$
U_s	maximum number of topics for supervisor $s \in \mathcal{S}$
r^{s}_{it}	rank of student $i \in \mathcal{N}$ for topic $t \in \mathcal{T}$
r^{g}_{it}	rank of group $i \in \mathcal{G}$ for topic $t \in \mathcal{T}$
Decision variables	
x^{s}_{it}	one, if student $i \in$ is assigned to topic t; 0 otherwise
x^{g}_{it}	one, if work group i is assigned to topic t; 0 otherwise
y_{tn}	one, if topic $t \in \mathcal{T}$ is used and is tackled by $n = 2, 3$ students; 0 otherwise

Table 1: Notation

Model

$$\min \sum_{i \in \mathcal{N}} \sum_{t \in \mathcal{T}} \left(r^{\mathrm{s}}_{it}\right)^2 x^{\mathrm{s}}_{ij} + \sum_{i \in \mathcal{G}} \sum_{t \in \mathcal{T}} \left(r^{\mathrm{g}}_{it}\right)^2 K_i x^{\mathrm{g}}_{ij} \tag{1}$$

subject to

$$\sum_{t \in \mathcal{T}} x^{\mathrm{s}}_{it} = 1 \qquad \forall i \in \mathcal{N} \tag{2}$$

$$\sum_{t \in \mathcal{T}} x^{\mathrm{g}}_{it} = 1 \qquad \forall i \in \mathcal{G} \tag{3}$$

$$\sum_{i \in \mathcal{N}} x^{\mathrm{s}}_{ij} + \sum_{i \in \mathcal{G}} K_g x^{\mathrm{g}}_{i} = \sum_{n=2,3} n y_{tn} \qquad \forall t \in \mathcal{T} \tag{4}$$

$$\sum_{n=2,3} y_{tn} \leq 1 \qquad \forall t \in \mathcal{T} \tag{5}$$

$$\sum_{t \in \mathcal{T}} y_{t3} \leq 1 \tag{6}$$

$$L_s \leq \sum_{t \in \mathcal{T}_s} \sum_{n=2,3} y_{tn} \leq U_s \qquad \forall s \in \mathcal{S} \tag{7}$$

$$x^{\mathrm{s}}_{it} \in \{0, 1\} \qquad \forall i \in \mathcal{N}, t \in \mathcal{T} \tag{8}$$

$$x^{\mathrm{g}}_{it} \in \{0, 1\} \qquad \forall i \in \mathcal{G}, t \in \mathcal{T} \tag{9}$$

$$y_{tn} \in \{0, 1\} \qquad \forall t \in \mathcal{T}, n \in \{2, 3\} \tag{10}$$

Objective function (1) minimizes the sum of the squared ranks. Constraints (2) and (3) ensure that each student and each team is assigned to a topic, respectively. Constraints (4) ensure that each topic is either treated by two or three students or not at all. Constraints (5) make sure that each topic gets either two or three students assigned.

Constraint (6) limits the number of topics with three students to a single one. Constraints (7) guarantee that each supervisor gets enough, but not too many topics. Finally, constraints (8) to (10) define the variable domains.