Middle School Course Scheduling as a Linear Programming Model

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Abstract

This is something we need to do eventually.

1 Model Formulation

1.1 Decision Variables

$$X_{s,c,p} = \begin{cases} 1, & \text{if student } s \text{ is assigned to course } c \text{ in period } p \\ 0, & \text{otherwise} \end{cases} \tag{1}$$

and

$$Y_{t,c,p} = \begin{cases} 1, & \text{if teacher } t \text{ is assigned to course } c \text{ in period } p \\ 0, & \text{otherwise} \end{cases} \tag{2}$$

Table 1: The data notation used in our formulation

$maxClassSize_c$	The maximum number of students permitted in class c
$numRequiredCore$	The number of required core classes per student

1.2 Constraints

The first constraint set deals primarily with capacity.

$$\sum_{c} X_{s,c,p} = 1 \quad \forall s, p \tag{3}$$

$$\sum_{t} Y_{t,c,p} = 1 \quad \forall c, p \tag{4}$$

Constrainst 3 ensures that every student is full scheduled (i.e. taking exactly one course every period of the day). Similarly, constrainst 4 ensures that at maximum only one teacher can be assigned to a given course and period.

$$\sum_{p} X_{s,c,p} \leq 1 \quad \forall s, c \tag{5}$$

Constraint 5 dictates that a student can't take a given class more than once per day.

$$\begin{aligned} \sum_{c,p} Y_{t,c,p} &\geq 1 \quad \forall t \\ \sum_{c,p} Y_{t,c,p} &\leq 5 \quad \forall t \end{aligned} \tag{6}$$

Constraint 6 is designed to limit the number of courses assigned to each teacher between 1 and 5.

$$\sum_{s} X_{s,c,p} \leq maxClassSize_c \quad \forall c, p \tag{7}$$

Constraint 7 restricts the maximum number of students assigned to a class and period to the maximum number of seats available (or some arbitrary upper bound).

1.3 Specific Course Requirement

$$\sum_{c,p} X_{s,c,p} \cdot core_c = numRequiredCore \quad \forall s \tag{8}$$

Constraint 8 ensures that every student is taking a set number of core classes per day. In our formulation, for an 8 period day $numRequiredCore$ is equal to 5.

$$X_{s,lunch,4} + X_{s,lunch,5} = 1 \quad \forall s \tag{9}$$

Constraint 9 dictates that each student is assigned to lunch during either period 4 or 5.