Scheduling Formulation

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Sets

D set of Days
T set of time slots
S set of shifts (for one day)
P set of people

Data

$hours_p$ Maximum hours person $p \in P$ can work
$available_{dtp}$ 1 if person $p \in P$ is available to work at time $t \in T$ on day $d \in D$, 0 otherwise
$consecutive_p$ Maximum consecutive hours person $p \in P$ can work
$length_s$ Length of shift $s \in S$
$contains_{ts}$ 1 if time slot $t \in T$ is contained in shift $s \in S$, 0 otherwise
$fixed_{psd}$ 1 if person $p \in P$ is fixed in shift $s \in S$ on day $d \in D$, 0 otherwise
w_1 weighting of days coming in
w_2 weighting of shifts worked
w_3 weighting of hours unallocated

Variables

X_{psd} 1 if person $p \in P$ takes shift $s \in S$ on day $d \in D$
Y_{pd} 1 if person $p \in P$ works on day $d \in D$

Objective

Minimize

$$w_1 \cdot \sum_{p \in P} \sum_{d \in D} Y_{pd} + w_2 \cdot \sum_{s \in S} \sum_{p \in P} \sum_{d \in D} X_{psd} - w_3 \cdot \sum_{s \in S} \sum_{p \in P} \sum_{d \in D} X_{psd} * length_s$$

Constraints

Tutors don't work more than maximum hours

$$\sum_{d \in D} \sum_{sinS} length_s \cdot X_{psd} \leq hours_p \forall p \in P$$

All time slots are covered by exactly one person

$$\sum_{p \in P} \sum_{s \in S} X_{psd} \cdot contains_{ts} \leq 1 \forall t \in T, d \in D$$

Only work shifts you have availability for

$$X_{psd} \leq contains_{ts} \cdot available_{dtp} \forall p \in P, t \in T, s \in S, d \in D$$

Respect fixed shifts

$$X_{psd} \geq fixed_{psd} \forall p \in P, s \in S, d \in Dif$$

Tutors don't work more than max consecutive

$$X_{psd} * length_s <= consecutive_p \forall p \in P, d \in D, s \in S$$

Y variable

$$Y_{pd} \geq \frac{\sum_{s \in S} X_{psd}}{|shifts|} \forall d \in D, p \in P$$

Availability

$$X_{psd} * contains_{ts} \leq available_{dtp} \forall p \in Pt \in T, d \in D, s \in S$$

No back-to-back shifts

$$X_{psd} + X_{ps'd} \leq 1 \forall p, \in P, (s, s') \in \{(s, s') \in S \times S | s_{start} = s'_{end}\}, d \in D$$