Modello Tesi HCP

0 Version 0

This model represents a rudimentary approach to address a limited portion of the data and the constraints imposed by the actual problem at hand. However, let us proceed with its utilization.

0.1 Constants

- θ visit percentage threshold;
- τ time slot duration;
- σ minimum level of skill;
- Σ maximum level of skill.

0.2 Sets and properties

- O set of operators;
  - s_o operator skill level;
  - h_o operator contract time;
  - c_o operator wage;
- V set of visits;
  - s_v visit skill level;
  - h_v visit duration;
- P set of patients;
- T set of time slots.

0.3 Parameters

- $r_{p,t,v} \in \{0, 1\}$ request from patient p for visit v at time t;

0.4 Precomputation parameters

- μ_p (`minGlobalContinuity[Patients]`)+ - support parameter for care continuity.

0.5 Variables

- $a_{p,t,v,o} \in \{0,1\}$: 1 if operator o is assigned to patient p for visit v at time slot t.

0.6 Objective function

Minimize total wage expense:

$$\sum_{p,t,v,o} a_{p,t,v,o} \cdot c_o \cdot h_v$$

0.7 Constraints

1. Each visit must be handled:

$$\forall p, t, v \quad \sum_{o} a_{p,t,v,o} = r_{p,t,v}$$

2. For each patient, time slot, and visit, the skill of the operator must be greater than or equal to the skill of the visit they are assigned to:

$$\forall p, t, v \quad \sum_{o} a_{p,t,v,o} \cdot s_o \geq r_{p,t,v} \cdot s_v$$

3. For each time slot, the sum of visit times for all patients, visits, and operators should be less than or equal to the time slot duration:

$$\forall o \quad \sum_{p,t,v} a_{p,t,v,o} \cdot h_v \leq \tau$$

4. The operators must work at most as much as their contract states:

$$\forall p, t, v \quad \sum_{o} a_{p,t,v,o} \cdot h_v \leq h_o$$

5. *Care continuity* - for each patient, the same operator should handle all the requests for visits with the same skill level:

$$\forall p \quad \sum_{t_1,t_2,v_1,v_2,o_1,o_2} a_{p,t_1,v_1,o_1} \cdot a_{p,t_1,v_1,o_1} = 0$$

The formula has some constraints on the indexes: in particular, $o_1 \neq o_2$, $t_1 \neq t_2$, and at least one of $s_{v_1} \neq s_{v_2}$ and $\mu_p > \min(s_{v_1}, s_{v_2})$ holds. The equation makes it impossible for two different operators to handle visits with the same skill level and also enforces the *minimum global continuity* constraint - if a patient has more than θ requests, in percentage, for visits of a skill level $s > \sigma$, an operator with skill level s should also handle lower requests.

1 Version 1

This time, the request parameter $r_{p,t,v}$ was substituted by a set of tuples with the following fields:

- `id` - unique identifier;
- `patient` - patient identifier;
- `visit` - visit identifier;
- `timeSlots[TimeSlots]` - list of time slots when the visit can take place.

In this way, patients who do not require a specific time slot for their visit can provide a range of available time slots instead of a single one.

The assignment decision variable $a_{p,t,v,o}$ has thus been substituted with the decision variable $x_{r,t,o}$ called `scheduling`.

We also gave the operators the binary availability property $a_{o,t}$, and $a_{o,t} = 1 \iff$ operator o is available at time slot t.

We added a constant ξ that states the maximum daily number of hours that any operator is allowed to work. This could become useful later if we need to take into account extraordinary work.

Some constraints have been added:

- the operators must be available when they handle the visits;
- during each day the operators must work less than the maximum allowed;

We expressed the constraint with the OPL operator `=>` which is used to define logical implications.

The primary concern at this stage is that the care continuity constraint creates a quadratic constraint for each patient, which we aim to avoid. I attempted to modify the decision variables and parameters, but whenever I reached the care continuity aspect, quadratic constraints emerged. One potential solution could be to address two consecutive linear problems, as the quadratic issue seems to arise when attempting to compute everything together.