MASTER THESIS PROPOSAL

TITLE

A stochastic/robust approach to deal with uncertainty in the home health care scheduling and routing problem

CANDIDATE CHARACTERISTICS

The thesis is for a master student (*tesi di laurea magistrale*).
The ideal candidate is a Master student of either Mathematical Engineering (with an Optimization Curriculum).

STATE OF THE ART

Home health care (HHC) is a relatively new service offering a wide range of care (i.e., medical, paramedical, and social services) that is provided to patients in their homes rather than in hospitals. The main aim of HHC is to improve patients' quality of life while reducing hospitalization costs. The demand for HHC is increasing around the world because of population aging, new support technologies, and increases in chronic pathologies. Decision-makers must deal with many optimization problems including capacity planning, districting, resource dimensioning, the allocation of resources to districts, the assignment of nurses (operators) to patients (or to visits), and the scheduling and routing of nurses. The work focuses on the joint assignment, scheduling, and routing problems. Given a planning horizon (e.g., one week) and a set of patients with specific care requests (i.e., weekly care plans), the goal is to assign nurses to patients, schedule patient requests during the planning horizon, and determine daily routes for nurses.

Typical constraints and characteristics are the availability of nurses, patient care requests (frequency of visits), expected visit durations, possible visit schedules (patterns) for patients, and continuity of care (i.e., the nurse-to-patient assignment is not altered during the planning horizon).

Sometimes, the uncertainty nature of the problem is included in the literature, considering uncertain durations of visits or uncertain travel times.

WORK PROPOSAL

Many random events affect the service delivery. The main randomness stems from unexpected changes in patient conditions, expressed as variations in the number, frequency, and duration of visits, which makes the activity of the HC service provider highly uncertain. Other unexpected events are changes in patient visiting hours, operator and material resource unavailability, scheduling problems, and random events perturbing the transportation of human and material resources.

The goal of this thesis is to develop a stochastic/robust framework to deal with some of these events within a planning horizon.

It is expected to develop a linear programming model to describe the problem, both a deterministic model and a stochastic/robust counterpart, and to evaluate the benefits of including the uncertainty by applying both versions of the model to a set of realistic instances.

DURATION

The expected duration of the thesis is about 6-8 months.

PARTNERSHIP

This is a joint Thesis Project in collaboration with:

- **Politecnico di Milano, Milan, Italy;**
- **Consiglio Nazionale delle Ricerche (CNR), Istituto di Matematica Applicata e Tecnologie Informatiche (IMATI), Milan, Italy;**
- **Polytechnique Montréal, Montreal, Canada;**
- **Yeditepe University, Istanbul, Turkey.**

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