Scheduling Healthcare Providers Using Optimization
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**Problem Statement**

The University of Michigan Medical School (UMMS) offers comprehensive training programs across many disciplines. Coordinating the long- and short-term schedules for all these trainees is a complex challenge.

**Traditional Approach:**

Hand-made schedules built by the Chief Resident or some other administrator

**Benefits:**
1) Intimate knowledge of problem
2) Administrative consolidation
3) Streamlined approval process

**Drawbacks:**
1) Time-consuming construction
2) High cognitive demand
3) Limited tradeoff consideration

**Benefits**

- Patient access, care quality, safety, and satisfaction
- Training quality and burnout rates
- Clinical/administrative workflow

**Importance of Schedule Quality: Schedule quality impacts**

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**The Problem:**

The construction process is resource-intensive yet often fails to satisfy the individual & collective needs of stakeholders for long- and short-term schedules

**Objective:**

Develop decision support systems (DSS) to enable fast construction of high-quality rotation & monthly schedules while improving measures of quality.

**Annual Blocks: Solution Approach**

1. **Formulate**
   Two models, each customized to specific needs of the program(s)

2. **Encode**
   Written in C++ using CPLEX 12.4, implemented in Visual Studio 2012

3. **Load**
   Inputs provided in a collection of .txt, .csv, and .xls files

4. **Solve**
   Software solves to optimality under input conditions

5. **Review**
   Schedule and metric reports generated for presentation to administrators

**Monthly Schedules: Solution Approach**

**Metrics:**
- Total Shift Equity (TSE)
- Night Shift Equity (NSE)
- Post-Continuity Clinic Shifts (PCC)

**Feasibility Optimization Problem:**

- Quantifying objective weights \( w_i \) is difficult due to
  - Non-linearity
  - Subjectivity

**Iterative Improvement:**

Engage Chief Resident to review, revise and finalize the schedule

**Implementation Results:**

- Statistically significant improvement in 3 of 4 metrics
- Reduced schedule creation time

**Next Steps:**

- Generalize models into universal formulation
- Extend models to address other residency programs’ needs
- Apply algorithm to apply maximally feasible sets of requests

**Acknowledgements**

This work was generously supported by:

- UMHS Department of Pediatrics & Communicable Diseases
- UMHS Department of Surgery
- The Doctors Company Foundation
- Seth Bonder Foundation

We also express our gratitude to the former chief residents and many students who have contributed to these projects.