CENTER FOR
HEALTHCARE ENGINEERING & PATIENT SAFETY
UNIVERSITY OF MICHIGAN

Scheduling Medical Residents

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"The Team, The Team, The Team"

- Our thanks to the large group of CHEPS students who have helped design, implement, and build schedules with our tools over the years
- Thanks to the Chief Residents and Program Directors who have collaborated with us
- Special thanks to Dr. Steve Gorga, Paige Mollison, Zachary VerSchure, Marina Epelman, Brian Lemay, and Young-Chae Hong

What are residents?

- Residents are physicians who have completed medical school and are providing patient care while under the supervision of more senior *attending physicians* to continue their training
- College -> Med school -> Residency -> Fellowship -> Attending/Private practice

What is residency scheduling?

- Assigning residents to times and places to provide patient care and receive advanced training
- Many programs (e.g. Pediatrics, Internal Medicine, Surgery)
- Many residents (varying seniority, requirements, personal needs)
- Many services (e.g. NICU, PICU, OB/Gyn)
- All need to be matched together under many complex rules

Why is it difficult?

- Challenges of general scheduling problems
- **Plus** challenges of personnel scheduling (preferences, retention, quality of life)
- **Plus** challenges of educational requirements
- **Plus** challenges of patient care

Shift Scheduling: The Problem

- Context: University of Michigan Mott Children's Hospital Pediatric Emergency Department
- 7 shifts per day x 7 days per week x 365 days per year
- Residents from Pediatrics, Family Medicine, Emergency Medicine, Psychiatry, …

Shift Scheduling: The Problem

- One resident per shift (flex shifts may be uncovered)
- 10-hour rest
- Consecutive working days
- Total shifts / total night shifts per resident
- Unavailable shifts due to continuity clinic/conferences
- Senior-only shifts
- Paired peds shifts
- Start date/end date
- End-of-month optional coverage
- …

Shift Scheduling: The Challenge

Feasibility:

- Fairly straightforward IP
- Variable definition $x_{rsd} = 1$ if resident r works shift s on day d, else 0
- Constraints like: $\sum_r x_{rsd} = 1 \ \forall d \in D, s \in S$
- Approximately 2,000 binary variables
- Limited branching, solves in seconds

Shift Scheduling: The Challenge

Optimality:

- Given an objective function, slower (although tolerable) but …
- WHAT OBJECTIVE FUNCTION?
- Multi-criteria; ill-defined; non-linear
- Impossible to capture implicit weights

Shift Scheduling: Our Approach

- No one cares about “optimal” (except journal article reviewers)
- Chief Residents and Program Directors want high-quality schedules quickly
- They can easily discern what is good/bad
- And remember … feasibility problems solve in seconds!

Shift Scheduling: Our Approach

- Find a feasible schedule
- Review with the Chiefs
- Identify undesirable metrics
- Set bounds, re-solve, review again
- Repeat

Shift Scheduling: Our Approach

- We work in collaboration – **key to success**
- Typical review (monthly) takes about 1.5 hours
- We learn from their analysis; each month we can come a little closer in our initial schedule
- We identify enhancements and new project opportunities in the process

Shift Scheduling: Lessons Learned

- Collaboration is key
- “Optimality” is overrated
- Lots of feasibility problems may be easier than one hard optimization problem
- Scheduling can have impact in many ways (not just time saved, but solution quality; impact on education, pipeline, quality of care…)

Shift Scheduling: Next Steps

- Generating the Pareto frontier
- Finding maximally feasible and minimally infeasible sets of vacation requests (Brian Lemay speaking on Sunday at 8am in Salon 6)

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Questions and Discussion