Scheduling Medical Residents

Amy E.M. Cohn and William Pozehl
University of Michigan
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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

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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