



Annual Rotation Scheduling for Medical Residents Through Optimization

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- I Our thanks to the students who have helped design, implement, and build schedules with our tools over the years
- I Our thanks to the Chief Residents and Program Directors who have collaborated with us

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



What is residency scheduling?

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

Traditional Scheduling Approach

1. Build rotation templates
2. Adjust for coverage and educational needs
3. Renegotiate after reaching a dead-end

JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APRIL	MAY	JUNE
BLUE	MAIZE	PLA	SVA	SICU	BLUE	WHITE	PLA	STX	VA G&V	VA CT	DSP
VA G&V	PLA	MAIZE	WHITE	ACS	BLUE	SICU	BLUE	PLA	STX	STX	VA CT
VA CT	PLA	BLUE	DSP	VA G&V	ACS	SICU	BLUE	MAIZE	WHITE	SVA	SVA
MAIZE	VA CT	VA G&V	BLUE	SVA	WHITE	ACS	SICU	BLUE	STX	PLA	DSP

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

Block Scheduling: The Problem

- I TK description of the block scheduling problem in general

Pediatric Block Scheduling at UM

I TK specific details about our peds problem, i.e.
size, types of residents, list of general rules

Peds Block Scheduling: Approach One

- | $x_{rsm} = 1$ if resident r is assigned to service for month m , else 0
- | Problem: In rare cases, months can be split between services
 - TK Examples

Peds Block Scheduling: Approach Two

- I $x_{rsh} = 1$ if resident r is assigned to service for half-month h (e.g. $h = \text{July } 1 - 15$), else 0
- I TK explain constraints to enforce valid half-month combinations
- I Problem: TK discuss number of constraints needed

Peds Block Scheduling: Approach Three

- | P is the set of valid “service pairs”
- | TK something about how many there are, relative to number of services (so how does number of variables change?)
- | $x_{rpm} = 1$ if resident r is assigned to service pair p for month m , else 0

Peds Block Scheduling: Approach Three



- I TK number of constraints
- I TK number of variables
- I TK run time for feasibility problems

Peds Block Scheduling: Approach Three

- I TK discuss how we solve using metrics and bounds
- I TK how many years we've solved, how long the process took, Chief response

IM/FM Block Scheduling

- I Internal Medicine Residency Program
 - 3-year program
 - 44 residents per year
- I Medicine-Pediatrics Residency Program
 - 4-year program
 - 8 residents per year
- I TK how they connect to Peds
- I TK Goals for this year
 - Solve IM and FM with the same approach
 - Integrate all three if possible

I TK experience: 1) Size of integrated model; 2) run times (feasibility, optimality); experience in building

Block Scheduling: Lessons Learned

- I Collaboration is key to getting the details right, buy-in, success of implementation
- I Variable definition key to tractability
- I Integer programming can have significant real-world impact on quality of schedules and therefore resident satisfaction and patient care

Next Steps

- I New modeling approaches to better accommodate all three programs (TK Let's not say what it is!)
- I Better tools for collecting data, interacting with the Chiefs and Program Directors
- I Tools for modifying schedules throughout the year

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Questions and Discussion



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