Annual Block Scheduling for Medical Residents
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Problem Statement
The University of Michigan Medical School (UMMS) offers postgraduate medical training programs across many disciplines. Ensuring adequate resident education and proper service coverage requires many training programs to integrate schedules.

3-year program 4-year program 3-year program
72 residents 33 residents 140 residents
15 services 8 services 84 services

Coordinating the long-term block schedule – assigning every trainee to services over the year – is a complex challenge.

Traditionally, program leadership (chief residents and program directors) constructs the block schedule by hand.

The construction process is resource-intensive yet often fails to satisfy the individual & collective needs of stakeholders.

Importance
Schedule quality impacts:

Research Objective
Develop a decision support system to enable fast construction of high-quality block schedules while improving measures of quality

Quality | Time

Solution Approach

Model

Basic assignment

\[ x_{st} = \sum_{s \in S} \sum_{t \in T} x_{st} \]

Rotation Duration

\[ x_{st} = \sum_{s \in S} \sum_{t \in T} y_{st} \]

Service coverage

\[ \lambda \leq \sum_{s \in S} \sum_{t \in T} x_{st} \]

Resident education

\[ \mu \leq \sum_{s \in S} \sum_{t \in T} x_{st} \]

Service sequencing

\[ 0 \leq \sum_{s \in S} \sum_{t \in T} \max \{x_{st} - x_{sp}, 0\} \]

Service spacing

\[ y_{st} + \sum_{s \in S} \sum_{t \in T} \max \{x_{st} - x_{sp}, 0\} \leq 1 \]

Pre-assignments

\[ x_{st} \leq \mu \]

Prohibitions

\[ x_{st} \leq 0 \]

Problem Size

245 residents | 107 services | 24 time periods

Total Variables

1,346,520

Total Constraints

1,992,897

Solve Time

> 8 hours

Solve Time Reduction Strategies

A. Decompose senior and intern scheduling

B. Sequential scheduling

C. Two-stage IM scheduling

D. Warm-starting solver

Conclusions

Impact

Introduced schedule synchronization across 3 residency programs

Enabled greater specificity of resident and service needs, relative to manual construction

Improved satisfaction (relative to prior years) regarding:

- vacation requests
- schedule fairness
- elective/research matching
- pacing and challenging rotation sequences
- fellowship interview and graduation conflicts

Provided significant real-world impact on quality of schedules and patient care

Lessons Learned

Collaboration is key to getting the details right, obtaining buy-in, and implementing successfully

Variable definition dictates tractability as scope expands

Iterative rule construction produces overall solve time reduction

Ongoing Work

Speed | Evaluating alternative formulations for impact on solve time

Quality | Implementing additional metrics based on leadership feedback

Efficiency | Streamlining administrative and schedule revision processes

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