Clinic Scheduling for a Dermatology Residency Program

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Collaborators

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Presentation outline

1. Motivation
2. Model
3. Solution approach
4. Conclusions
Michigan Medicine

1,199 trainees

105 training programs

25 residencies

80 fellowships
Dermatology residency

3-year program (after PGY1 transitional year)

8 residents per class

Extensive inpatient/outpatient practice, didactic teaching schedule, and research opportunities
Monthly shift scheduling

Chief residents build monthly shift schedule

Assignment of residents to activities for every morning and afternoon of every weekday in a month

Must meet:

• Resident educational requirements
• Service coverage demands
Scheduling residents

Monthly block schedule

Research, continuity clinics

Vacation, holidays

Admin time, limited travel between clinics

Clinics must also satisfy gender balances and meet experience requirements
Residents often have conflicting requirements:

- Primary assignment
- Ad hoc assignments
- Vacation

Dermatology clinics change frequently:

- Openings and closures
- Staffing level changes
Traditional approach

Schedules are **hand-built** by chief residents

Takes **multiple days** to work through creating a monthly schedule

Schedules are often **not equitable** between residents, and they do not satisfy resident preferences
Research objectives

Increase accuracy and quality by taking into account monthly requirements and changes.

Free chief residents to spend more time caring for patients and advocating for resident needs.

Create a computerized decision support tool to aid in generating each month’s schedule.
1. Motivation

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Model parameters

Sets

$R$: set of residents
$A$: set of activities
$D$: set of days in a given month

Decision variables

$$x_{rad} = \begin{cases} 1, & \text{if assigning resident } r \text{ to activity } a \text{ on day } d \text{ in the morning} \\ 0, & \text{otherwise} \end{cases}$$

$$y_{rad} = \begin{cases} 1, & \text{if assigning resident } r \text{ to activity } a \text{ on day } d \text{ in the afternoon} \\ 0, & \text{otherwise} \end{cases}$$
Constraints

Basic Assignment: \( \sum_{a \in A} x(y)_{rad} = w_d \quad \forall r \in R, d \in D \)

Coverage: \( lb_{ad}^P \leq \sum_{r \in R_c} x(y)_{rad} \leq ub_{ad}^P \quad \forall a \in A, d \in D, c \in C \)

AM/PM prohibitions: \( x_{ra}a_n a_n + y_{ra}a_n a_n \leq 1 \quad \forall n \in N \)

AM/PM requirements: \( x_{ra}a_c a_c - y_{ra}a_c a_c = 0 \quad \forall c \in C \)

Resident prohibitions: \( x(y)_{pa} a_p d_p = 0 \quad \forall p \in P^x \)

Preassignments: \( x(y)_{ra}a_h d_h = 1 \quad \forall h \in H^x \)
Objectives

Consider numerous metrics

- Weekly admin
- Balanced admin
- Travel
- Deviations from block schedule

Work with chief residents to determine optimal balance
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## Problem size

<table>
<thead>
<tr>
<th></th>
<th>October 2017</th>
<th>November 2017</th>
<th>December 2017</th>
<th>January 2018</th>
<th>February 2018</th>
<th>March 2018</th>
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Encode the model in C++, using CPLEX 12.4

Design robust input file formats to match potential needs

Gather rules and requests each month from chief residents

Model solves in < 1 minute
Improving the value of one metric can worsen the value of another.

We work with the chief residents to determine an appropriate balance.
# Sample schedule

<table>
<thead>
<tr>
<th>Name</th>
<th>Time</th>
<th>1-Mar Thu</th>
<th>2-Mar Fri</th>
<th>5-Mar Mon</th>
<th>6-Mar Tue</th>
<th>7-Mar Wed</th>
<th>8-Mar Thu</th>
<th>9-Mar Fri</th>
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<tbody>
<tr>
<td>Resident 1</td>
<td>AM</td>
<td>Consults</td>
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<tr>
<td></td>
<td>PM</td>
<td>Consults</td>
<td>Consults</td>
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<td>Consults</td>
<td>Consults</td>
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<tr>
<td>Resident 2</td>
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<td>VA-Path</td>
<td>UHS</td>
<td>CDLC</td>
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<td>CDLC</td>
<td>VA-Path</td>
<td>Admin-Gen</td>
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<td>DF-CC</td>
<td>CDLC</td>
<td>CDLC</td>
<td>CDLC</td>
<td>CDLC</td>
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<tr>
<td>Resident 3</td>
<td>AM</td>
<td>Admin-ThuAM</td>
<td>DF</td>
<td>DF</td>
<td>DF</td>
<td>DF</td>
<td>Admin-ThuAM</td>
<td>DF</td>
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<tr>
<td></td>
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<td>DF</td>
<td>DF</td>
<td>Admin-Gen</td>
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<td>DF</td>
<td>DF</td>
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<td>SRPC</td>
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<td>Admin-Gen</td>
<td>UHS</td>
<td>TC</td>
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<td>Admin-ThuAM</td>
<td>Admin-Gen</td>
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# Metric deficits

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<tr>
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<tbody>
<tr>
<td>Weekly Admin</td>
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<td>Balanced Admin</td>
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<td>0</td>
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<td>57</td>
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</tbody>
</table>
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Summary

Created tools and processes to assign dermatology residents to shifts during a monthly planning horizon

Afforded leadership greater specificity of scheduling needs compared to manual construction

Improved satisfaction among residents regarding measures of schedule quality

Freed chief residents to focus on more important tasks related to caring for patients and advocating for resident needs
Impact

- Rapidly-Generated, High-Quality Schedules
- Less Review Time Required By Chief Residents
- Improved Patient Experience
Ongoing work

Implement functionality to modify existing schedules with new requirements, applying minimal changes

Implement new infrastructure to more efficiently handle resident pre-assignments and clinic coverage requirements
Acknowledgements

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Questions and comments

Thank you!

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