

Using Linear Programming to Create Monthly Dermatology Resident Schedules

Riley McKeown, Justin Rogers, Muhammed Ugur, William Pozehl MSE, Amy Cohn PhD, Emilie Dore MD

Question

How can we produce higher-quality schedules in less time while satisfying the various educational and personal requirements of residents?

Problem Statement

Background

The Dermatology Residency Program at the University of Michigan requires each resident be assigned to two specific activities each weekday, one in the morning and one in the afternoon, within a month-long planning horizon. Each activity must meet staffing requirements, and the residents must adhere to educational requirements.



24 Residents



28 Activities



28-31 Dates

Traditional Approach

Chief residents typically create monthly schedules by hand. Due to the numerous rules chiefs must abide by, the process of building a feasible schedule typically requires numerous hours to complete, and building a high-quality schedule by hand is nearly impossible.

Feasible Schedule

A valid schedule that meets all of the hard requirements presented by the Dermatology chief residents.

High-Quality Schedule

A schedule requiring a minimal number of undesirable characteristics, such as intra-day travel and shortages of administrative time.

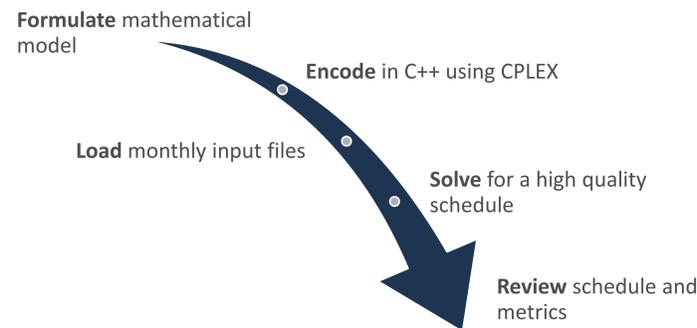
Challenges

- Chief residents spend valuable time creating schedules rather than focusing on patient care.
- Residents are given insufficient administrative time to balance their clinical duties.
- Residents are often required to travel between clinical sites, which wastes time finding parking, and can cause missing lunch.

Research Goals

- Work with chief residents to determine the scheduling rules and quality metrics.
- Formulate a mathematical model, and build a computerized tool which rapidly generates high-quality schedules.

Solution Approach



Decisions

Do we assign resident r to activity a on date d during shift types?

Rules

All of the rules, modeled as constraints, must be satisfied for a schedule to be feasible.

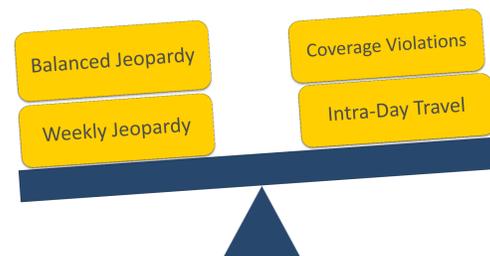


Resident Assignments: $1 \leq \sum_{a \in A} x_{rads} \leq 1 \quad \forall r \in R, d \in D, s \in S$

Clinic Staffing Requirements: $l(c) - v_c^l \leq \sum_{r \in R_c} x_{ra(c)d(s)c} \leq u(c) + v_c^u \quad \forall c \in C$

Metrics

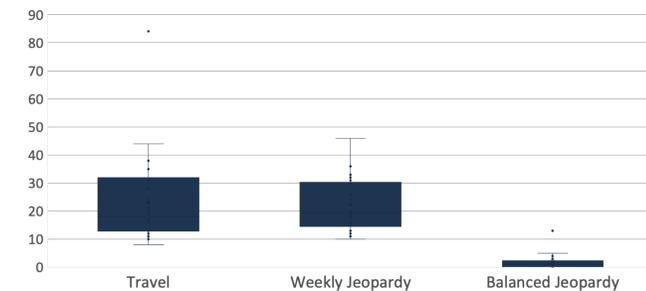
- After obtaining a feasible schedule, metrics are incorporated to find a high-quality schedule.
- Since optimizing one metric may result in other metrics being suboptimal, chief residents provide input to determine an acceptable balance.



Impact/Results

Data Tracking

- The tool enables the chief residents to track metric data on a monthly basis
- The metric data presented below corresponds to schedules produced for the months of April 2017 through January 2019.



Sample Output

The schedule reports are easier to interpret than the old documentation.

Name	Time	3-Sep	4-Sep	5-Sep	6-Sep	7-Sep
Resident_0	AM	Holiday	Didactics	Melanoma	Didactics	Continuity
MEL1/MEL1	PM	Holiday	Merkel	Continuity	Continuity	Jeopardy
Resident_1	AM	Holiday	Didactics	Jeopardy	Didactics	VA-ENT
VA1/VA1	PM	Holiday	Continuity	VA-PM	TC	VA-ENT
Resident_3	AM	Holiday	Time-Off	Time-Off	Time-Off	Time-Off
VAST/Clinic	PM	Holiday	Time-Off	Time-Off	Time-Off	Time-Off
Resident_4	AM	Holiday	Didactics	Continuity	Didactics	TC
MEL2/MEL2	PM	Holiday	Merkel	Melanoma	CPU	CPU

Discussion

Implementation of the computerized tool has allowed for schedules to be produced in significantly less time while satisfying all schedule requirements and improving schedule quality across several metrics.

Rapidly-Generated, High-Quality Schedules

Less Time Required By Chief Residents to Create Schedules

Improved Patient Experience

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