Using Optimization Techniques to Improve the Shift Scheduling of Operating Room Staff

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Problem Statement

Each month the Operating Room Clinical Nurse Supervisors at the University of Michigan Health System determine the monthly shift schedules for **200 surgical nurses and surgical technicians** by hand. Due to the many requirements and restrictions governing the shifts that each individual staff member is allowed work, as well as the hospital policies regarding the composition of operating room staff that must be working at any particular time, this is a very time-intensive process that results in each of the Operating Room Clinical Nurse Supervisors spending roughly **a quarter of their time** on the scheduling process. Additionally, it is also often difficult to satisfy all of the necessary scheduling conditions when creating the schedule manually.

Types of Staff

Surgical Nurse   Surgical Technician

Types of Specialties

➢ Nurses & techs are trained in certain specialties (collectively called a pod)

➢ Need an adequate number of staff from each pod scheduled

Pod 1	Pod 2	Pod 3
➢ Neuro	➢ Orthopedic	➢ Urology
➢ Ear, Nose, Throat	➢ Sports	➢ Gyn
➢ Oral Maxillofacial	➢ General	➢ General
➢ Plastic		

Types of Shifts

23 Shifts

7a-11a	7a-7p	9a-9p	11a-11p	3p-7p	7p-11p
7a-1p	9a-3p	11a-3p	12p-8p	3p-9p	9p-11p
7a-3p	9a-5p	11a-7p	12p-10p	3p-11p	11p-7a
7a-5p	9a-7p	11a-9p	1-p-9p	5p-11p	

Requirements

For each individual:

➢ Can only be assigned to a subset of shifts

➢ At most 1 shift/day

➢ At most 2 different shifts/week

➢ Certain # of hours/week

➢ Certain # of days/week

➢ Adequate time off between shifts

Overall:

➢ Target # scheduled for a particular time

➢ Nurse/Tech Ratio

➢ Off-shift equitability

➢ At least as many nurses as techs

Note: *These requirements need to be met for each individual pod and all pods collectively at specific times of the day*
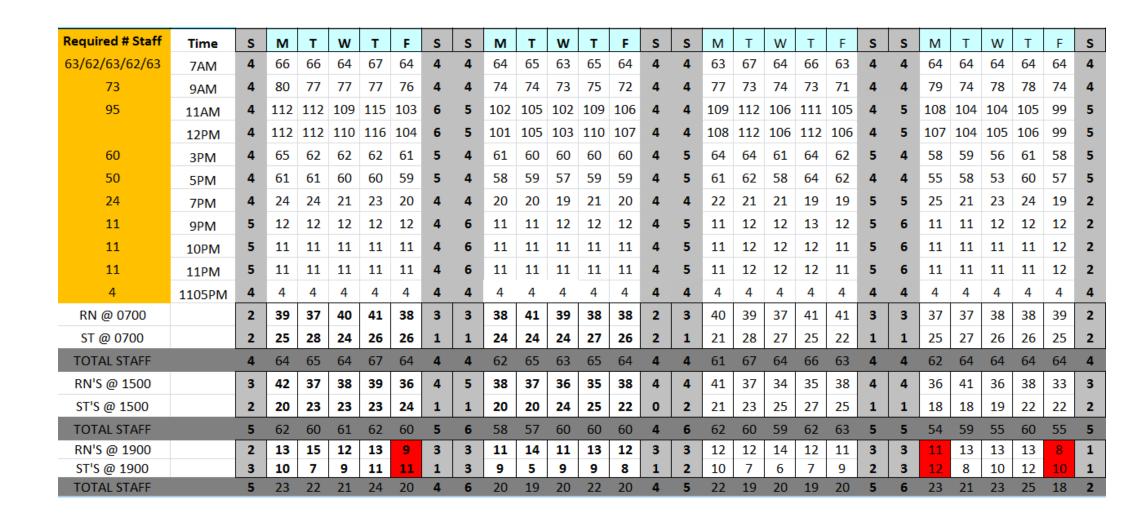
Creating a Schedule by Hand

Key Issues

Time consuming
Each nurse supervisor spends 1 week /month creating the schedule

Difficult to satisfy all requirements

Example

Optimization Model

Goals & Methods

Goals:
1) Reduce time to create schedule
2) Improve schedule quality

Mixed-Integer Linear Programming Formulation
➢ **Objective:**
  Minimize weighted deviations from requirements
➢ 130,000+ Variables
➢ ~3,000,000 Constraints

Implemented in MS Excel
Solved using Solver Studio with AMPL/CPLEX

Impact

Significantly reduces the time to create schedule

➢ Provides a monthly schedule for 200 staff members in approximately 10 minutes

➢ Allows clinical nurse supervisors more flexibility in designing a schedule

➢ Allows the clinical nurse supervisors to spend more time on other duties, including patient care

Future Work

➢ Continue to work with the clinical nurse supervisors to ensure the model captures the necessary requirements

➢ Develop a user interface

➢ *Work with clinical nurse supervisors to implement model*

Contact Information

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