Simulation of patient scheduling for colonoscopy

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Problem Statement

Background
- Colorectal cancer (CRC) is the second leading cause of cancer-related deaths in the U.S.
- Colonoscopy can both identify existing cancers, so treatment can be started, and prevent future cancers, through the detection and removal of polyps.
- Largely due to the pre-procedure bowel prep, there can be significant variability in procedure time.
- This negatively impacts providers and capacity utilization. More importantly, long delays for patients can have negative health effects.

Patient Flow Overview

![Patient Flow Diagram](image)

Figure 1: Typical flow of a single patient on the day of colonoscopy and major sources of variability highlighted

Objectives
- Develop a simulation-based framework for evaluating patient schedules under multiple criteria
- Analyze and compare several heuristic scheduling and sequencing rules

Methods
- Monte Carlo simulation to evaluate 8 different scheduling heuristics.
- Evaluated results under 4 (potentially conflicting) metrics:
  1. Overtime.
  2. Idle time.
  3. Waiting time.
  4. Patient total time in the unit.

Table 1: Tested Heuristics

<table>
<thead>
<tr>
<th>Heuristics</th>
<th>Ordering method</th>
</tr>
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<tbody>
<tr>
<td>SPF:</td>
<td>Schedule procedures in ascending order of duration mean.</td>
</tr>
<tr>
<td>LPF:</td>
<td>Schedule procedures in descending order of duration mean.</td>
</tr>
<tr>
<td>SVF:</td>
<td>Schedule procedures in ascending order of duration variance.</td>
</tr>
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<td>LVF:</td>
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</tr>
<tr>
<td>INP:</td>
<td>Schedule procedures in an ascending order of probability of no-show.</td>
</tr>
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<td>Schedule procedures in an ascending order of probability of no-show x duration variance.</td>
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Basic Flow Logic

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**Preliminary Results**

- **Figure 2:** Monte Carlo simulation logic for each heuristic
- **Figure 3:** Average procedure and recovery rooms overtimes per day.
- **Figure 4:** Average idle time per day
- **Figure 5:** Average waiting time for intake and for procedure per day over all patients
- **Figure 6:** Average total time spent in the unit per day over all patients

**Acknowledgements**

- The Seth Bonder Foundation
- Summer Undergraduate Research in Engineering–SURE (for UM undergraduate students)
- We also express our gratitude to Dr. Jackob Kurlander, Dr. Sameer Saini and all CHEPS students who have contributed to this project

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