AI Enhanced Scheduling for Affordable Neighborhood Caregiving Model

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Introduction

Problem: US seniors in need of care are growing faster than workforce of caregivers

- Over 600,000 seniors are currently on waitlists for home-based care
- By 2040 satisfying the needs means **one caregiver must care for 6 seniors**, but current capacity is less than 1:2
- Seniors who receive long-term care support at home incur **lower health care costs**

Solution: a new neighborhood model of staffing

- The neighborhood model that breaks from the constraints of time is a **proven alternative**
- It can increase the productivity to 1:15

Challenges: high-dimensional complexity

- Flexibility and variety of types of visits makes scheduling highly complex
- **AI** is required to efficiently solve the neighborhood model of home care

AI Overview

AI: Mixed Integer Optimization Model

We formulate a scheduling and assignment problem for home-care services, where tasks are matched to caregivers under various constraints. The optimization solver searches for a schedule that balances various objectives terms, including:

Objectives

1) **Consistency** (minimize how often a client's caregiver is switched – primary goal!)
2) **Downtime time between tasks** (reduce idle time between a caregiver's tasks)
3) **Caregiver utilization** (balance workload)
4) **Travel time** (minimize total drive time between clients)

Constraints

1) **Task movable windows** (each task needs to happen within a certain time window)
2) **Task sequencing** (optimally plan the caregiver's day by sequencing all the tasks they need to perform during that day)
3) **Caregiver availability** (respect daily schedules of caregivers)
4) **Breaks/Lunch** (ensure break periods are scheduled (no back-to-back tasks).)

Results

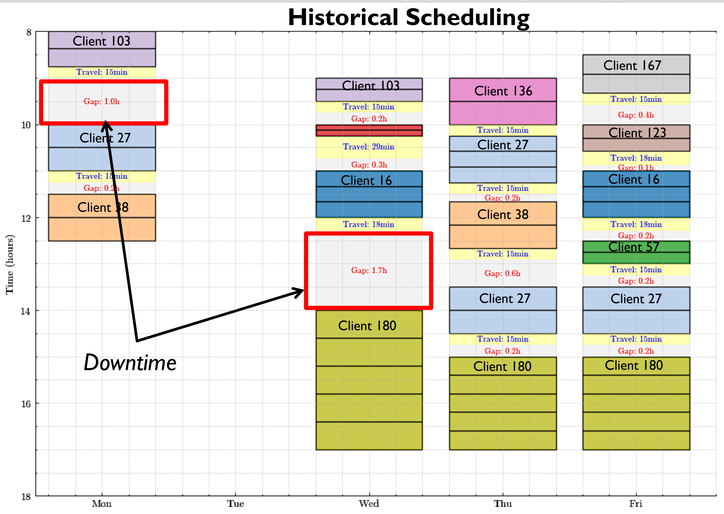
AI Smart Scheduling vs Historical Schedules achieves:

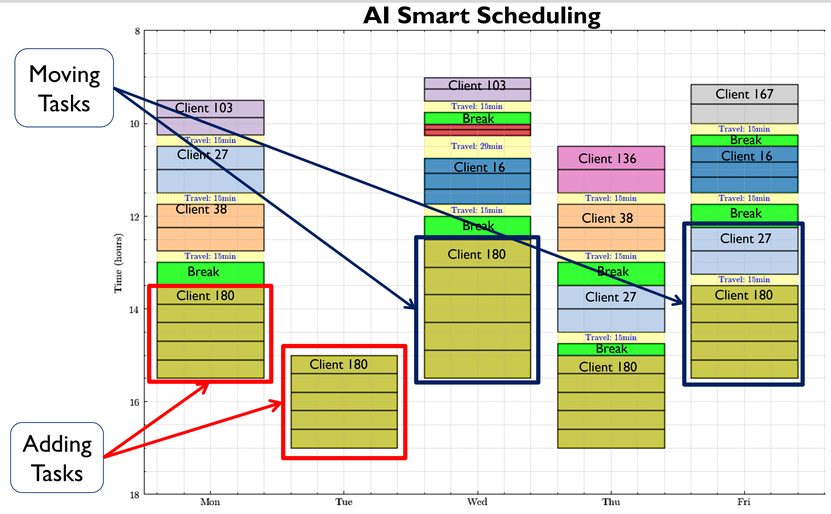
1. Increased utilization rate and capacity to serve new clients – Sec 1
2. Significantly lower downtime to almost zero – Sec 2
3. Improved care consistency for clients to 91% from 85% – Sec 3

Data

A sample historical scheduling data to optimize using smart scheduling and compare consistency, downtime time, and utilization rate.

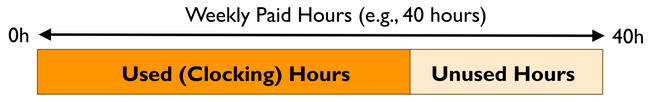
Historical vs. AI Smart Scheduling (A Sample Day)



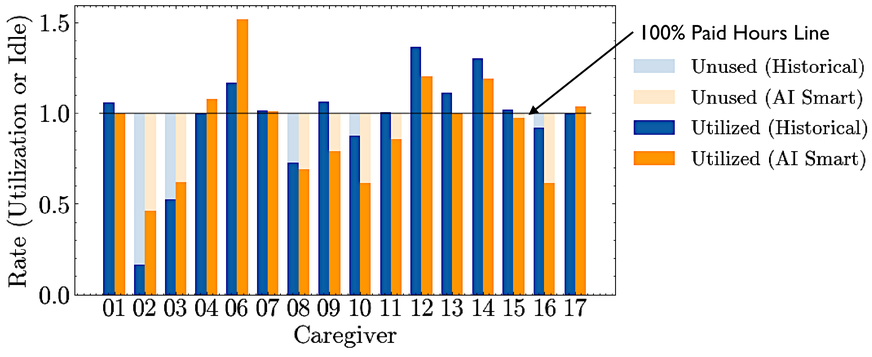


1. Weekly Utilization/Unused Rate

From the paid hours, unused time refers to a large block of time that could be used to serve other clients, as opposed to utilized time that is already in use or is a small gap needed to commute to the next client.



The clock time utilization for each caregiver is shown for Historical (orange) and AI Smart (navy) schedules in the figure below. The dark shade shows the utilized time and the light shade, the unused time. The AI Smart Schedule identified 15% of time as unused blocks to recruit new clients compared to 11% in the historical schedule.



2. Improved Downtime Time

The average daily idle time or downtime for each caregiver reduced to almost zero in the AI Smart Scheduling model, compared to 116-370 minutes (No Break) in the historical schedule.

	Mon	Tue	Wed	Thu	Fri	Sta	Sun
AI Smart Sched	0	0	0	0.2	0	0	0.5
Historical (No Break)	116	130	120	131	146	167	370
Historical (<1-hr Break)	61	74	68	81	89	133	310

3. Consistent Care

The AI Smart Schedule can maintain a higher consistency of care with **91%** of clients seeing the **same caregiver** consistently, compared to 85% under the historical schedule. Only 9% of clients have to see 2 or 3 caregivers compared to 14% in the historical schedule

# of Caregivers one Client Sees	Clients %	
	Historical Sched	AI Smart Sched
1	**85%**	**91%**
2	8%	8%
3	6%	1%
4	1%	0%

Conclusion

The AI smart scheduling system dramatically increases the unused capacity (from 11% to 15%), offering greater flexibility to handle **increasing demand** while maintaining efficient and consistent care delivery.

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