# Final Technical Report
# Self-Service Laundry Scheduling

Joshua Hales

5 May 2023

## Public Executive Summary

Interaction with a self-service laundry is not an uncommon experience for many people. These interactions include management and users of a facility. Performance increases may be especially beneficial when this interaction is a regular activity due to reoccurring costs. This project provides an analysis of usage and a starting point for performance improvements.

The methods analyzed are likely feasible to implement as they require little change or extra knowledge from any given actor within the system. The first method uses rules that management may implement for facility use. The second method uses expected wait times for users. The third method uses expected performance when some users do not follow rules. These methods provide estimates of performance given a range of factors. Actors can then make decisions based on the range of estimates.

## Acknowledgements

Dr. Mario Harper for assigning this project in CS 5060 Decision Making: Algorithms Under Uncertainty

Dr. Chad Mano for teaching essential knowledge for the scheduling algorithm in CS 3100 Operating Systems

## Accomplishments and Objectives

The focus of this project was on analyzing factors that influence the performance of a self-service laundry facility. The following were main components of this project:

1. The effect of rules on performance for FCFS-like scheduling.
2. Using a stopping algorithm to find when a user should choose to do laundry.
3. The effect of user strategies on performance.

These tasks and milestones were laid out at the beginning of the project. The actual performance against the stated milestones is summarized here:

**Table 1. Key Milestones and Deliverables.**

| Tasks | Milestones and Deliverables |
|---|---|
| **Task 1: Scheduling**<br>1.1 Time Window<br>1.2 Time Before Removal<br>1.3 Concurrent Use Limits | **Q1:** Find factors to improve performance<br>**Actual Performance:** (5 May 2023)<br>1.1 A time window to simulate when a facility is open was implemented.<br>1.2 A time limit before forced removal from a complete machine was not implemented.<br>1.3 A limit on the number of concurrent machines used by a single user was not implemented. |
| **Task 2: Stopping**<br>2.1 Expected Wait<br>2.2 Latest Start | **Q1:** Find optimal wait times for users<br>**Actual Performance:** (5 May 2023)<br>2.1 A report of a user's expected wait was not implemented, but a report of process waits was implemented.<br>2.2 An estimate of the latest time a user could feasibly start was not implemented. |
| **Task 3: Game Theory**<br>3.1 Rules Violations<br>3.2 Other Strategies | **Q1:** Find strategies that are disruptive or fair<br>**Actual Performance:** (Incomplete)<br>This task required completion of the previous tasks and is therefore incomplete. |

## Project Activities

This project mainly focuses on scheduling and factors on performance. Due to limited time, later tasks were not completed as proposed. This project assumes that a user will transfer their laundry immediately upon completion of a cycle. This gives an optimistic perspective that is unrealistic. However, this may be useful for comparison with more realistic scenarios.

## Project Outputs

### *Description of Code*

The **README** file of the project contains instructions for running the code and the expected outputs.

### *Results*

Example scatter plots of process wait time using the defaults are included in the project. They show that wait time tends to increase over time as more processes are added. The wait time is also more variable when the number of dryers is less than the number of washers (**8-6.png**). The plotted wait time shows more of a linear relationship as the system becomes saturated with processes (**8-6-5ppu.png**).

The wait time for dryers includes the washer wait time and the washer cycle time. Note that when a window is used some users may not complete or have processes scheduled as the window passes while they are waiting.