A Scheduling Solution for Starbucks @ UW

By Tiffany Tian, Yimo Shen, Pranav Prabhakar

Introduction: Workplace scheduling has been an issue for small businesses for years. Somehow, as technology in the workplace advances, scheduling still seems to be done via outdated, manual methods. In the case of the three main Starbucks locations at the UW Campus, scheduling was done via student baristas handling digital paper copies of their availability and required manual entries by the administrative program assistant at the beginning of each quarter. This could be easily optimized by implementing an interactive system where various constraints could be processed and optimal schedules could be output and updated accordingly.

Community Outreach: The three Starbucks locations have been the busiest dining places on campus. This is not helped by the low staffing issues they have had recently, increasing customer waiting times. Many patrons we have consulted have agreed that the efficiency needs to be improved. We've consulted Linna Bounxayavong (linnab@uw.edu), the Program Assistant for Starbucks, who has agreed to allow us to further delve into this project with her.

Goal: The goal of this project is to create a schedule for Starbucks @ UW, which satisfies the minimum and maximum labor needs for all three locations while maximizing the number of baristas during peak hours and increasing barista satisfaction by prioritizing their preferences for working hours and locations.

Method: We are planning on using linear programming methods in R/Python by changing optimization and constraint equations into matrices, then performing matrix operations on them to find potential solutions. This is a problem that involves a variety of resource constraints, and a linear programming model can generate the best possible solution. In this situation, whether it's minimizing things like wait time, or maximizing factors like operating efficiency (number of transactions), using this tool is a quick and efficient way to structure the problem, and find a solution.

Mathematical Example: Baristas at Starbucks are divided into two main groups: part-time students and full-time workers. There are constraints in which they have certain requirements regarding the hours: for example, students have to work under 19.5 hours per week, and full-time employees usually work for 40 hours or more. Each of them would have different availability throughout the week, and there are constraints such as after working consequently for 4 hours, one must take a 15-minute break. Moreover, to ensure smooth operation of the store, there needs to be a certain minimum number of baristas working at each given hour. These could all be translated into several different mathematical equations and constraints, in which the goal would be to meet the minimum and maximum hours needed to ensure customer demands and to accommodate baristas' working preferences to our best ability.

Constraints:
- Parameters:
  $$F_{ijk}, S_{ijk}, US_{ijk} \text{ where } i \in employee\ number, j \in time\ and\ date, k \in location$$
  $$F \in Full\ Time, S \in Students\ (Trained), US \in Students\ (Untrained)$$
- Number of employees constraints
  - Number of Full-time Baristas is __
  - Number of Trained Student Baristas is __
  - Number of Untrained Student Baristas is __
- Hours of operation constraints
  - Suzzallo: 9am-5pm
  - HUB: 10am-2pm
  - Population Health: 8am-4pm
  - Note: opening shift begins 1 hour before operation, and closing 1 hour after
- Barista working hours constraints
  - All student shifts are 3-4 hours at one specific location
  - At any given hour, the number of baristas working should be between
    o Suzzallo: 4-10
    o HUB: 4-6
    o Population Health: 4-7
  - Dictated by baristas' availability

Preferences:
- During peak hours, we want to have the maximum number of baristas working with at least 1 full-time barista at each station.
  - Peak Hours Definition
    - Suzzallo: 9am-5pm
    - HUB: 11am-1pm
    - Population Health: ___
- Student Preferences:
  - Location: Students should be working in at least two different locations. Students can indicate a preference for specific locations.
  - Total working hours: between 10-19.5 hours.
  - Preferred dates and hours: Students can indicate a preference for specific day of week and timeframe of their shifts

References:
- Guido Cocchi, Alessandro Galligari, Federica Picca Nicolino, Veronica Piccialli, Fabio Schoen, Marco Sciandrone (2018) Scheduling the Italian National Volleyball Tournament. Interfaces 48(3):271-284. https://doi.org/10.1287/inte.2017.0932