Limiting Water And Energy Use while Increasing Efficiency At Genuine Ice Cream
MPT2 Internship Case Study
Trevor Stewart
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Introduction

Genuine Ice Cream has been a Bozeman staple since 2018, when they opened their first seasonal storefront, which became permanent in 2020. Along with selling their ice cream from the storefront, Genuine also has partnerships with many local businesses that sell their ice cream. To fulfill both wholesale orders and meet demand from the storefront, Genuine invested in a factory to run their production. The Genuine Ice Cream factory has two 24-quart ice cream machines that run 5–6 days a week to keep up with demand.

Ice cream flavors are divided into five major categories: Classic flavors (e.g., Vanilla, Chocolate, etc.), Rotators 1, 2, and 3—Mint, Coffee, and Peanut Butter, respectively—which can change weekly based on demand. The final category is Random Rotators, which can be any flavor and are changed at the same pace as Rotators 1, 2, and 3. These categories significantly affect the time it takes to produce a single tub, the price of ingredients, and the energy and water needed to produce the ice cream.

The main goal of this project is to observe and record the differences in production time for various flavors produced by Genuine, with the aim of increasing production efficiency, reducing water and energy usage, and providing detailed data about specific flavors and styles of ice cream for use in a price audit planned for this winter.

Methodology

Data collection was done manually and recorded into an Excel file. The runtime of the machine was measured from when the machine was turned on until the tubs were covered and placed in the fridge. At that moment, time would stop and restart to record the turnover time, which was measured from when the previous tub was put away until the machine was turned on again with a new batch. To time the mixing of ice cream bases, the timer started when the mixer began acquiring materials and ended when the input tubs were fully mixed. If multiple tubs were mixed simultaneously, the time was divided by the total number of tubs.

Multiple variables were recorded for each batch that was mixed and run through the machine, including: flavor, operator, time in the machine, machine turnover time, machine clean time, time to mix the base, base mixing turnover time, total flavor time (the sum of all other timed variables), category (Classics, R1, R2, etc.), style (mix-in, regular), and machine type (old or new).

After data collection, I uploaded CSV files to R Studio. Using the Dplyr package and the group_by function, I was able to examine each variable individually and compare the median times of different variables, such as style and category. This allowed for a deeper analysis of the data, identifying differences in time and process due to the specific variables. Total flavor time, which is the culmination of each individual step involved in making a tub of ice cream, is the most important metric for evaluating which flavors, categories, or styles take longer than others.

Results

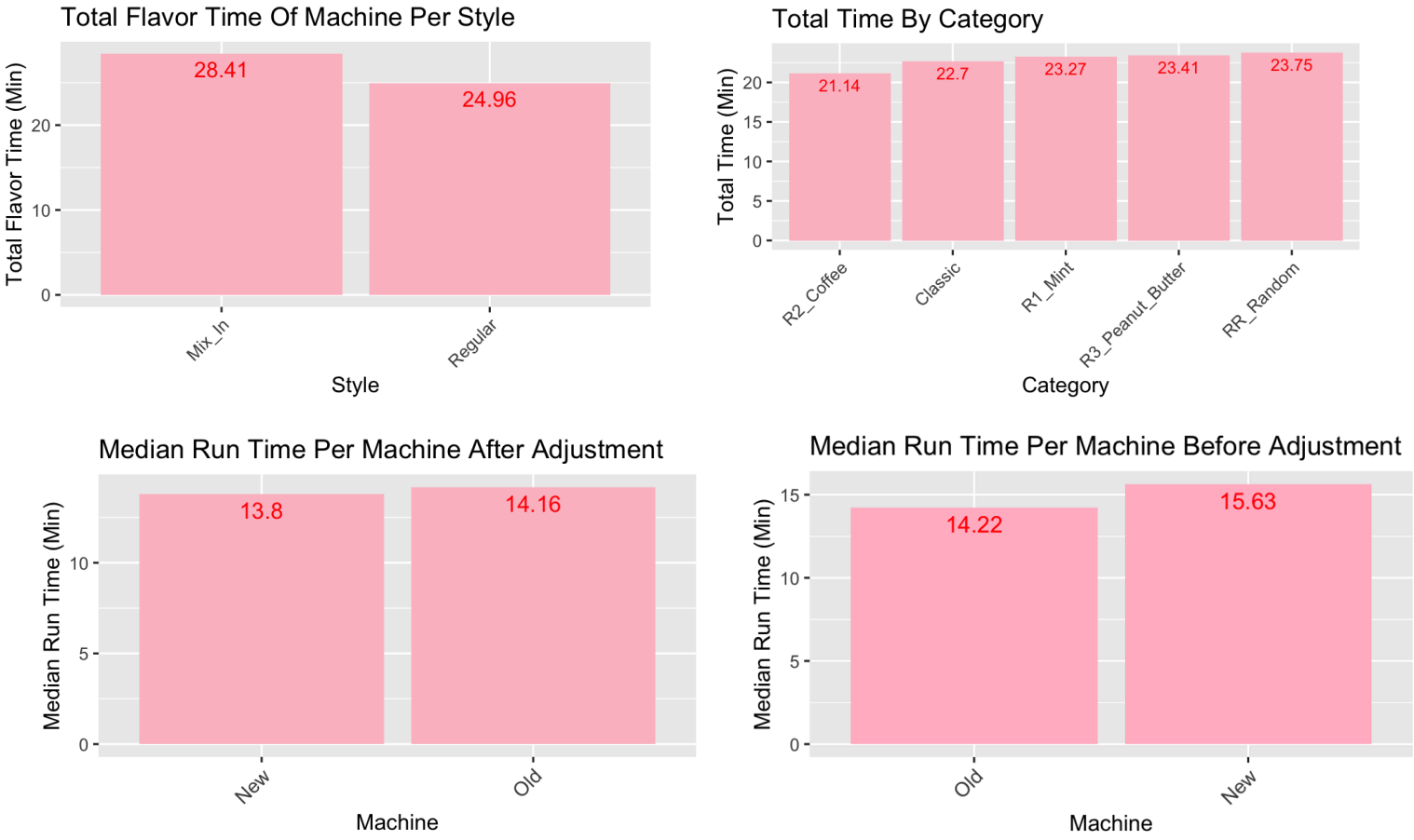

Figure 1 A,B,C,D: A.) Figure A shows the total time it takes to each style of ice cream (mix_in, regular). Figure B shows the total time it takes to make each category of ice cream (R1,R2,R3,RR, and classic). Figure C shows the median run time of each machine (new, old) after the adjustment was made. Figure D shows the median run time of each machine (new,old).

The largest difference is shown in Figure B, where the difference between R2_Coffee and RR_Random is 2.61 minutes. When comparing mix-in and regular ice cream in Figure A, the difference is 1.13 minutes. Finally, when comparing the pre-adjusted and post-adjusted machines in Figures C and D, the difference is 1.83 minutes.

When adding mix-ins, the machine needs to be stopped while the mix-ins are added to the tub of ice cream and manually mixed in—both at the halfway point of the draw and at the end before being put away. This adds 1.13 minutes to each tub made this way. The category of ice cream can illustrate how different components can add more time in the machine depending on what is added. For instance, ice creams with a peanut butter base take more time than ice creams with a coffee base due to the peanut butter that is added, which increases the freezing time.

To adjust the new machine, the water used to cool the engine was initially too hot and needed to be adjusted. This was done by turning a knob on the machine, which lowered the runtime of the new machine by 1.83 minutes. By adjusting the temperature of the water used to cool the motor of the new ice cream machine, roughly 49 kilowatt-hours of energy are saved each month.

Conclusion

Timing of each individual process revealed key differences in the production of ice cream due to the various components in each flavor. Ice creams that require a mix-in took roughly 4 minutes longer than ice creams without a mix-in. Coffee flavors took the least amount of time to produce, around 21 minutes, whereas the random rotators took the longest, around 24 minutes. Understanding the differences in production times will help Genuine Ice Cream adjust their pricing structure and refine their recipes to make training new employees easier while limiting waste from bad batches. The adjustment to the new machine also saved 49 kilowatt-hours of energy each month and $4,000 in factory costs each year.