

Executive Summary

XYZ café serves breakfast and lunch foods alongside coffee, tea, and specialty beverages in Saint Paul. The café employs a single cashier, along with a barista for preparing specialty drinks (each at \$16 per hour). Between the cashier and barista queues, congestion can become an issue. This leads to balking and lost revenue. The café decided to hire research analysts to investigate business optimization through decreasing queue lengths and balking to maximize profits.

The objectives of this project were twofold. The first was to create a model that replicated the activities of a normal day at XYZ given the data provided – three weeks of incoming business, Monday through Friday between 10:30 am and 1 pm. Second, was to perform a cost-benefit analysis on two potential modifications to the current employment strategy of one cashier and one barista:

- Adding a second cashier– “Second Cashier” model.
- Having the barista double as a second cashier when not making drinks – “Floating Barista” model.

Statistical measures were performed in Excel to determine arrival rates of parties, party size frequencies, balking probabilities, order type frequencies, order duration distributions, average pricing of orders, and barista duration distributions. A replication model (one cashier, one barista) was coded in C# to simulate a normal day of data based upon these parameters to perform Monte Carlo simulations.

10,000 simulated days of this model were run to calculate the average parties served per day, balks, lost revenue from balking, and total profits. This model was validated with four criteria, all of which were satisfied. Then, 10,000 simulated days were run for each of the Second Cashier and Floating Barista models to compare against the replication model.

The Second Cashier model changed the one cashier strategy by:

- Decreased balking to 27.4% of the Base model, serving an additional 2.25 parties per day
- Decreased average profit earned during the 2.5-hour period by 1.5% (-\$5.5)
- Increased the average maximum barista queue size by 1.17

The Floating Barista model:

- Decreased balking to 44.8% of the Base model, serving an additional 1.6 parties per day
- Increased average profit earned during the 2.5-hour period by 6.4% (+\$25)
- Increased the average maximum barista queue size by 0.84

In either case, a second point of sale (POS) system will cost approximately \$1,000. Perhaps, too, there will be training time for the barista to learn the duties of a cashier. Thus, there would be additional costs to implementing either the Second Cashier or Floating Barista model.

However, the additional \$16 per hour for the Second Cashier renders average daily profits about \$6 less than the replication model (\$375.81 to \$370.37). Simply put, the expected average money gained by the reduction in balking doesn't offset the cost of an additional employee's wages. Coupled with the \$1,000 POS cost, adding a second cashier would be negatively costly for XYZ. In addition, the increased rate of

ringing up customers causes greater congestion in the barista queue, which must also be taken into consideration.

On the other hand, even with the \$1,000 for the new POS system, the Floating Barista model would significantly benefit XYZ. The café would average more than \$6,500 in additional profits annually, and not increase congestion in the barista queue as much as the Two Cashier model.

As such, it is highly recommended to implement the Floating Barista model.