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Reducing The Waiting Time In Line by Robots – Data Analysis

Overview

This analysis uses the data collected by The U.S. Postal Service Office of Inspector General (OIG) in 2017 at Merrifield Post Office location.

- According to the report, the Merrifield is the busiest retail location in Northern Virginia District. The number of customers who came to this location from April-19-2017 through May-2-2017 was 24,151, whereas there were only 11,806 transactions that had been made at retail windows which were about 48.89% total foot traffic. Therefore, we have:

$$Total\ numbers\ of\ transactions\ =\ 48.89\%\ *\ total\ numbers\ of\ visitors$$

Method

We have designed a queue simulation to calculate the average waiting time in the line of customers between April-19 and May-2 (14 days) at Merrifield Post Office. To narrow the scope of measurement, we will only consider transactions that were made during the busiest time of each day which is between 11 am and 2 pm (a total of 3 hours):

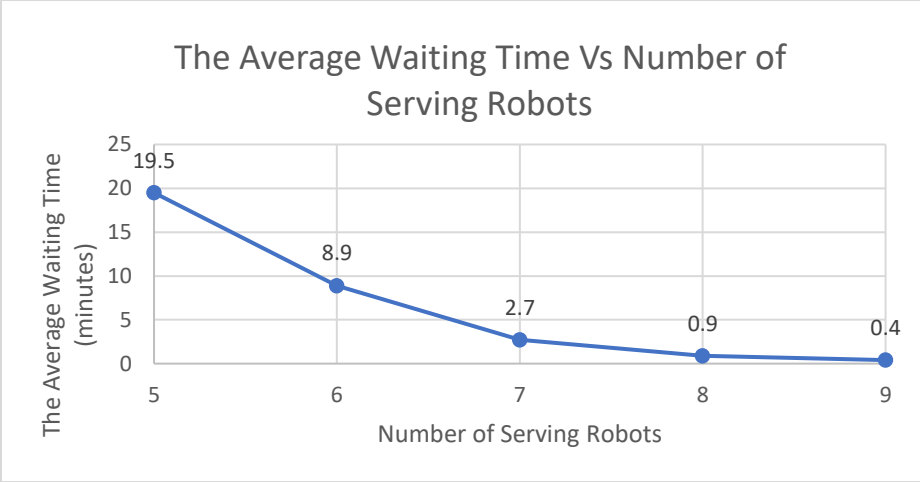
- Within the period of 14 days mentioned above, the total number of visitors during the busiest hours was 6,479. Therefore, the number of transactions that were made would approximately be $48.89\% * 6479 = 3168$. In order words, there were roughly $\frac{3168}{14} \approx 227$ transactions that were performed during the 3 busiest hours of each day.

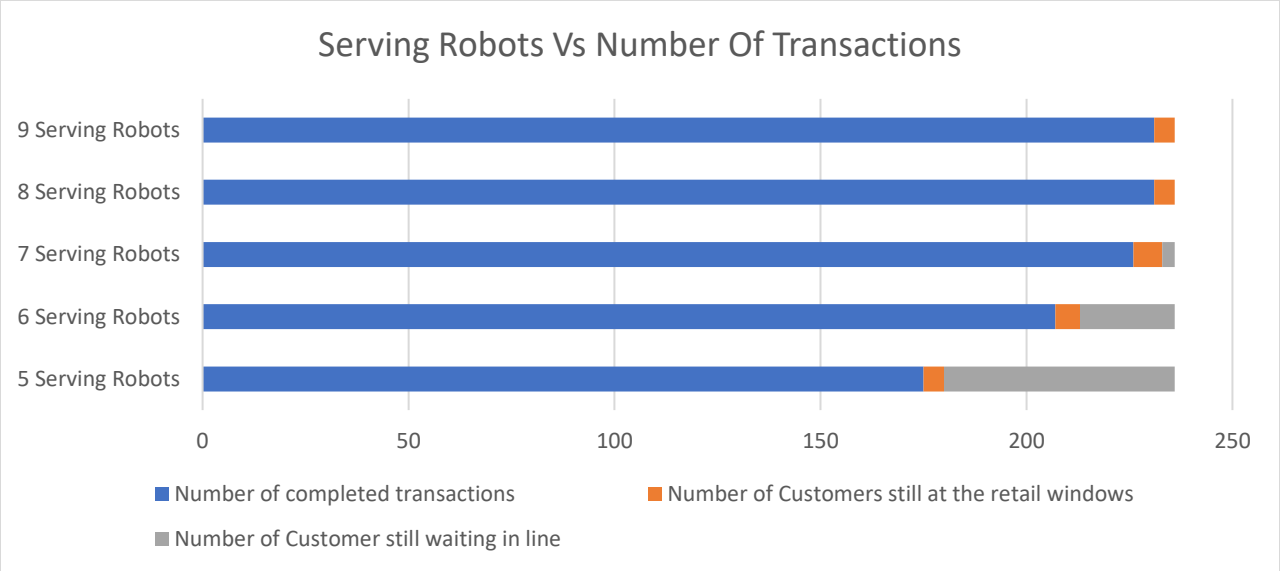
⇨ Putting the matter differently, one transaction should be made at a retail window every 47 seconds, and the goal of completed transactions every 3 hours should be ≥ 227.

- We let the stimulation run for 3 hours of time units with a specific number of serving robots. After the stimulation finished running, we will measure the total number of customers who already completed a transaction, the total number of customers who were still at the retail windows, and the total number of customers who were still in the waiting line accordingly.
- We assume that each transaction would take an average of five minutes and the average time arrival between customers would be 47 seconds.

Result Data

Number of Serving Robots	Number of completed transactions	Number of Customers still at the retail windows	Number of Customers still in the waiting line	The average waiting time (minutes)
5	175	5	56	19.5
6	207	6	23	8.9
7	226	7	3	2.7
8	231	5	0	0.9
9	231	5	0	0.4





- This result shows that utilizing only 5 serving robots would result in the worst waiting time which was about 19 minutes. Comparatively, using 6 robots would produce a waiting time of 8.9 minutes. Considering the goal of the U.S Postal Service is to limit the waiting time to under 5 minutes, the only viable options are to employ either 7, 8, or 9 robots.

- As shown in the result of employing 8 and 9 robots, the waiting time was significantly reduced. However, during the downtime, using 8 or 9 serving robots may be too redundant. Reasoning from that, the option of using 7 robots seems to be the most efficient and adequate solution since it acceptably reaches the goal of 227 transactions with a waiting time of only 2.7 minutes.

Conclusion

As we are aware, the typical number of workers at the retail windows is 4. Having a limited number of workers serve a huge amount of customers, the excessive waiting time in line is definitely inevitable. Besides that, human errors could also be a factor contributing to this matter. As a result, hiring more workers might not effectively solve the problem. On the other hand, robots, unlike humans, possess the power of performing preprogrammed tasks precisely and constantly with a limited amount of errors. If that is the case, using serving robots would be an appropriate and practical choice.

In order to choose a sufficient number of serving robots, it all depends on the size and the number of visitors of each specific Post Office location. This analysis was done based on the data of a mega-size Post Office. And according to the analysis above, employing 7 serving robots would effectively solve the labor shortage issue while simultaneously lowering customers' waiting times to less than 5 minutes, which is also what the U.S Postal Service seeks to achieve.