MA022

Queueing Theory: Optimisation of Queue Times at Grocery Stores

Abstract

The abstract is a concise summary of the report with no more than 250 words or less than 1800 characters, which will be used during project judging and for visitors during the public day. **It should not include acknowledgements (such as the name of the school, name of mentor or research institutions) or external endorsements.**

Queues are a crucial part of our life, being integrated into many services that we use daily such as banks, restaurants, public transport and retail. Despite this, scenarios in which we encounter frustratingly long queue times are still commonplace occurrences. While the seemingly obvious solution is to add more counters, it also incurs unnecessary expenses for companies. Thus, the aim is to find the perfect balance between service quality and operation costs. In this project, we aim to identify the optimal queuing model for the various queueing systems present at a FairPrice supermarket outlet. Queuing Theory was utilized to calculate the performance of different queue types (cashier-operated checkout and self-checkout) present for comparison. It was found that the expected waiting time in system for cashier-operated queues (G/G/1) was 142.276s, while self-checkout queues (G/G/c) performed significantly better with 75.481s. Additionally, we developed an interactive simulation, which is publicly available on Github, to find the best combination of how many of each of the 2 queues to use such that it achieves the lowest cost possible: defined as the sum of arbitrary functions for both operation costs and cost of customers waiting. Notably, for most of the simulated values the number of self-checkout counters, defined as c_2, in use, the minimum total cost was achieved when 4 cashier-operated checkout counters, defined as c_1, were in use ($c_1 = 4$). This is in line with the system in use at the FairPrice outlet, which used 4 cashier-operated and 14 self-checkout counters.