



# **DATA 604**

# **Final Project**

# **Presentation**

*Modeling and Simulation*

*Queuing in the Bank*

*Melvin Matanos*



**The presented projects simulates a hypothetical bank that provides 2 simple services in the bank premises:**

**Teller services : Deposit, withdrawal, and others.**

**Foreign Exchange services: This service takes longer due to a rigid regulations that requires verification of a lot of documents to complete the service.**

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**There is only one queue that provides both types of services. Below are the given service time:**

**Teller services follow a triangular model with a mean of 4 minutes, a lower end of 3 minutes, and an upper value of 5 minutes**

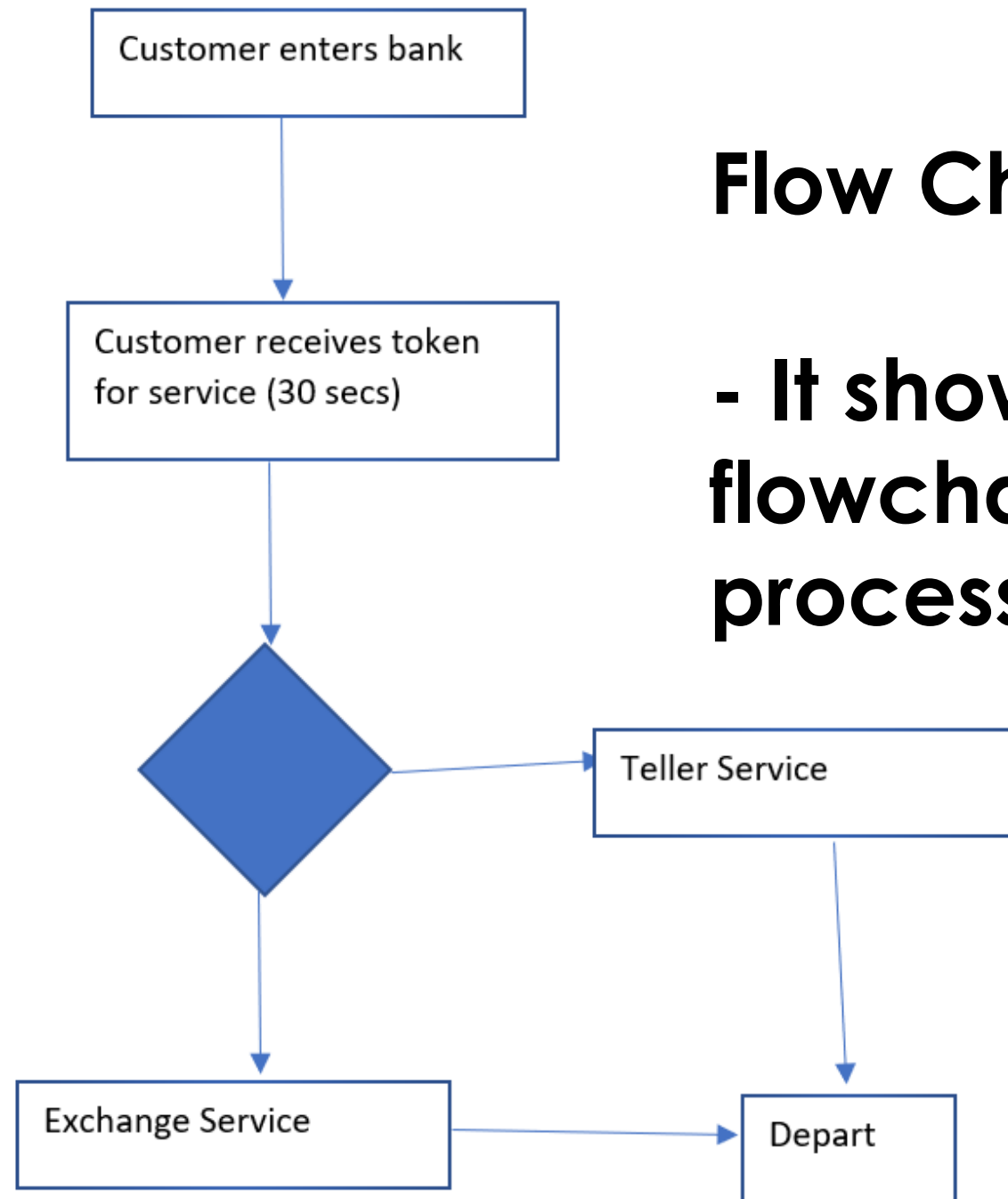
**Exchange services follow a triangular model with a mean of 15 minutes, with a low of 10 and high of 20**

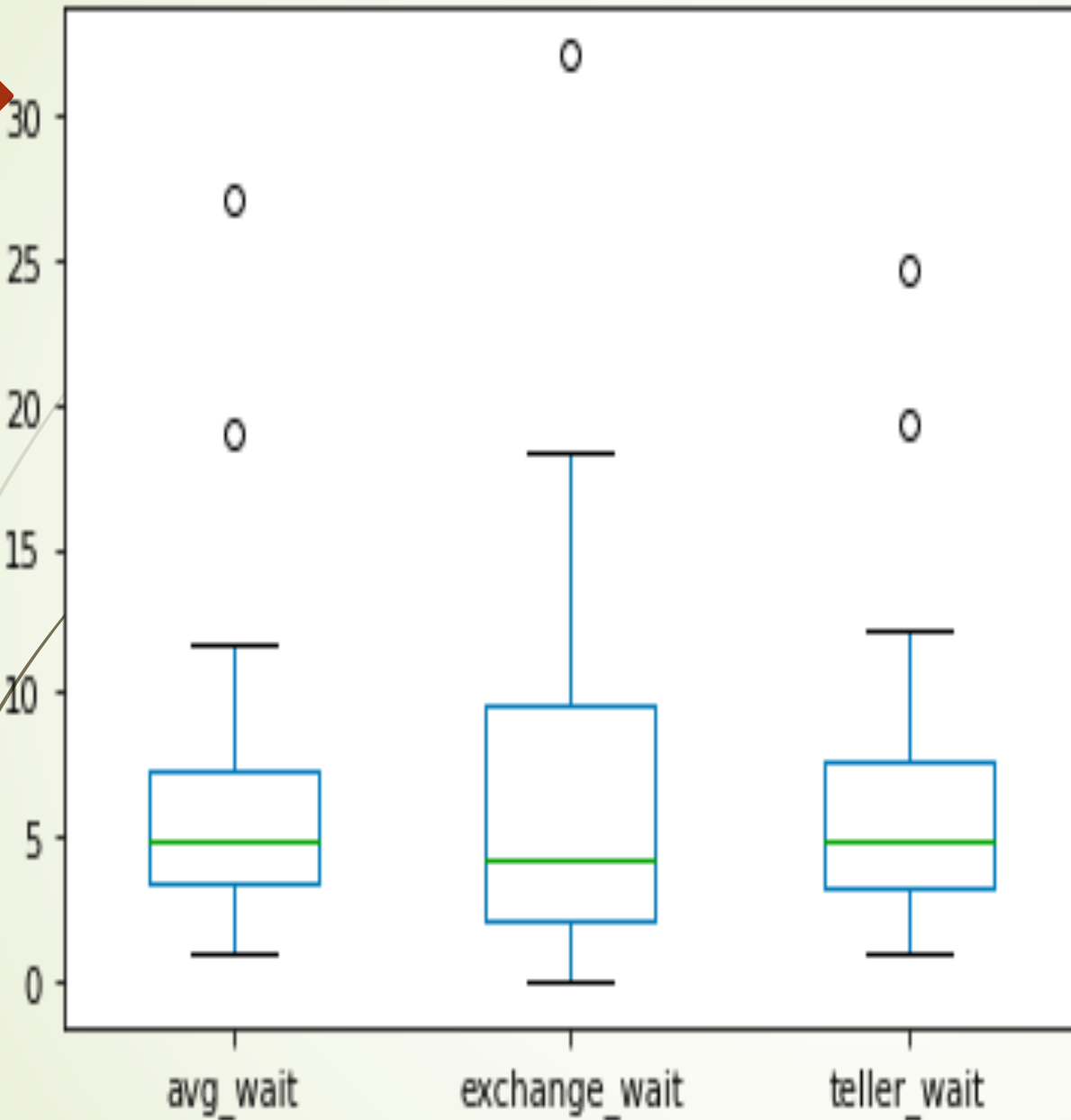


**The customer arrival rate is generated randomly using an exponential distribution with an arrival rate of 5 to 10 customers every hour. Each run of the simulation covers 6 hours (open hours of the bank)**

# Flow Chart Model

- It shows the flowchart of the process.





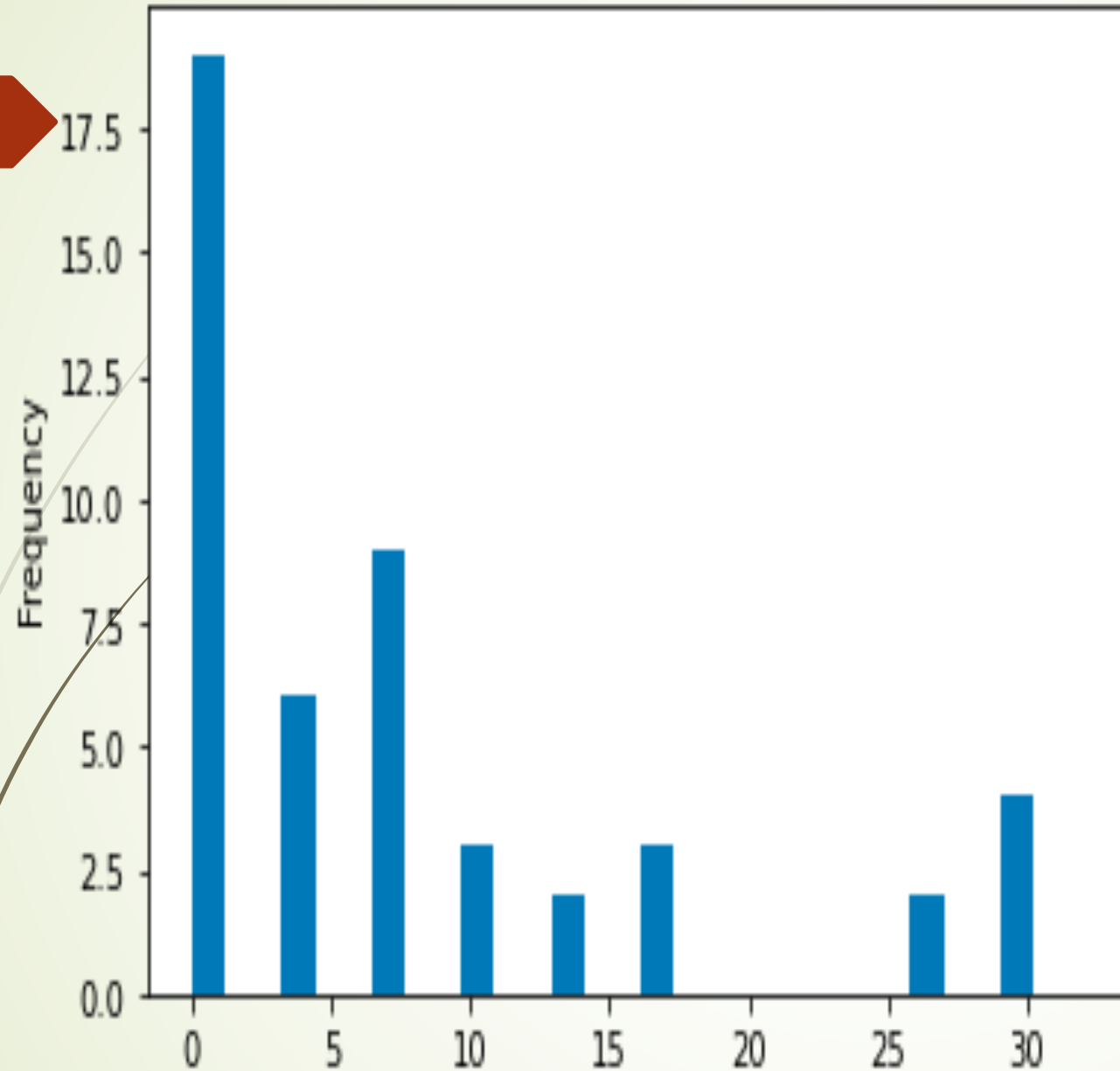
**The simulation is run 22 times to mimic the number of working days in a month.**



# Verification and Validation

The model was verified by printing and checking intermediate outputs while writing the code. Each run of the simulation generates a report. The service stop time is compared with the service start of the next customer and do not overlap. Given the time frame, it makes sense that 27-32 customers are being served in each run of simulation. There are several other variables I tested during each run to make sure there were no absurd values.

Validation was tougher as this is a hypothetical situation and I do not have a dataset to compare the results to. The flow of the customers in the report however closely mimic wait times in my personal experience in a bank.



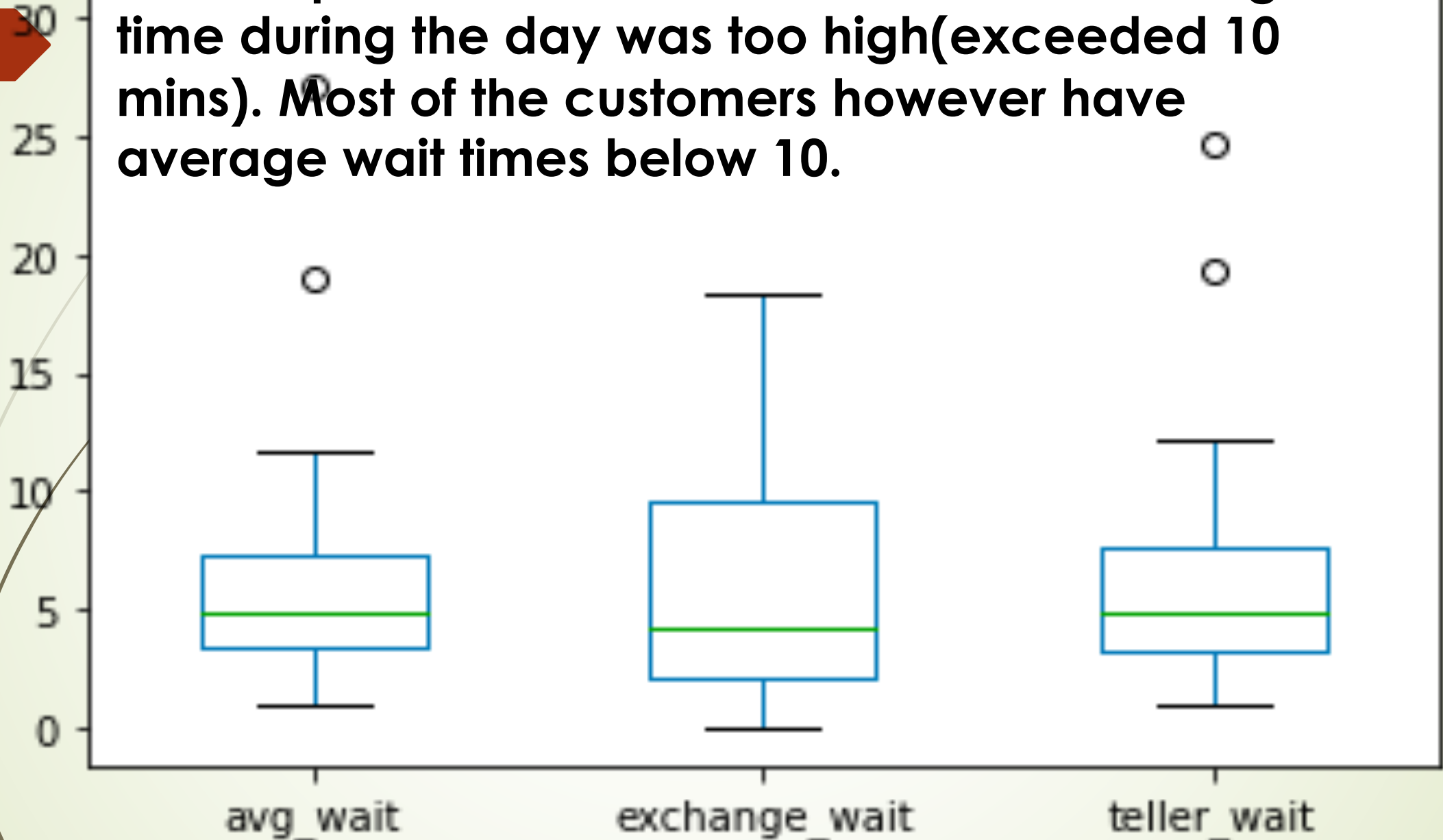
**Out of 31 customers served, 2 had a wait time of over 10 minutes which is in acceptable range.**



**The plot shows with the wait times. It is easy to identify which customers has a higher wait times**



The boxplot shows the instances where the avg wait time during the day was too high(exceeded 10 mins). Most of the customers however have average wait times below 10.



# CONCLUSION

Through this model, an attempt was made to mimic the service quality of a bank by constructing a simple simulation model. The model proved its capability in investigating how the service waiting times has been process and completed without imposing the cost of physical changes. It was constructed using SIMPY based on the data and conceptual model related to the process flow of the bank. After validation and verification of the model, the approach shows output reports and their output representation was compared. The results of comparison, shows that an average wait time of more than 10 minutes which is unacceptable while waiting in a queue at a bank. Most of the customers however have average wait times below 10. Based on the simulation I believe that the addition of a new counter and standardizing of the shift of all counters are recommended in terms of waiting time of customers.