Bank Service Efficiency with Discrete Event Simulation

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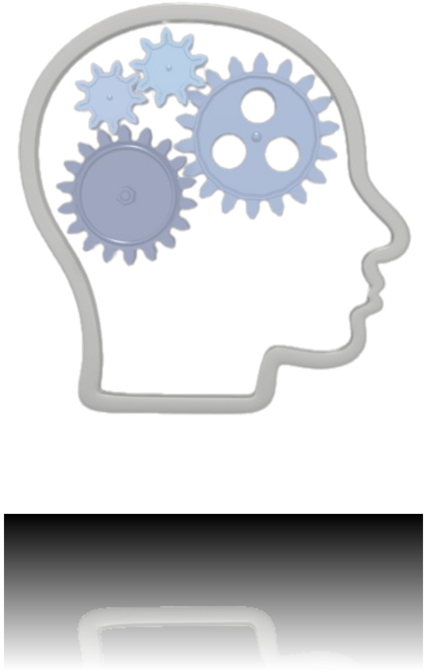
Motivation

- Banks face long customer wait times during peak hours
- Efficient resource (teller) allocation is key to improving service
- Real-world testing is costly — simulation provides a risk-free way to experiment.

Should we add tellers, prioritize small requests, or balance load differently?

Problem Statement



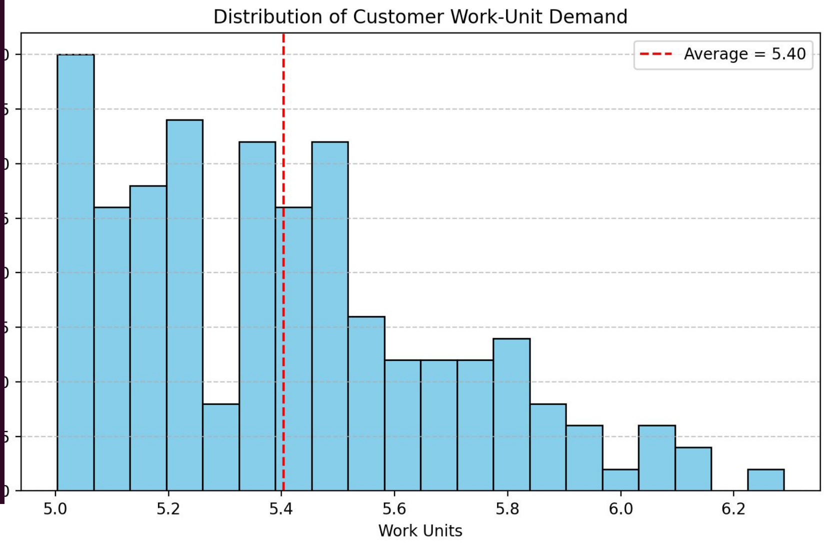
- There is a bank with 10 tellers, each processing 10 work-units/hour
- 160 customers arrive during an 8-hour day (uniform distribution)
- Each customer has a task requiring 5–15 work-units (from a truncated normal distribution)
- Customers wait in a FIFO queue if all tellers are busy
- Goal: Understand how different teller configurations and strategies affect:
    - Customer waiting time
    - Number of customers served
    - System efficiency

Approach

- A bank with 10 teller, each teller with a work efficiency of 10 Work-Unit/Hour (WU/H), or 6/10 = 0.6 hour for 1 work unit
- The tellers can be idle or busy for 8 hours in a day
- 160 customers arrive in a uniform distribution
- customers’ work-unit demand follow a normal distribution (mean: 10, std: 0.5. Truncated range: [5,15]

Approach (cont)

Work Unit Range	% of Customers
5.0 - 5.2	29.38%
5.2 - 5.4	24.38%
5.4 - 5.6	21.88%
5.6 - 5.8	12.50%
5.8 - 6.0	8.12%
6.0 - 6.2	3.12%
6.2 - 6.4	0.62%
6.4 - 6.6	0.00%



Distribution of Customer Work-Unit Demand

Approach (cont)

If a customer arrives and exist any idle window, no waiting

If all windows are busy, customer is put in queue:

First customer in the queue is assigned to the frist idle window, starting serving time -> waiting time = serving time - arrival

Average waiting time = sum(waiting time) / customers served

Experiment

- 10 windows (original)
- 11 windows
- 9 windows
- 1 speedy queue
- 10 teller who can serve 11 work-unit per hour

Results

	10 windows	9 windows	11 windows	10 window (1 speedy queue, light WU < 5.4)	10 windows (11 WU/H)
Average waiting time	**27.64**	48.36	9.31	32.92	9.49
Served	**140**	126	148	85	150
Not served	**20**	34	12	75	10

Discussion

The speedy queue is not efficient because most of customers' light work-unit request around 5, we put most of customers to 1 speedy line, which increase the waiting time -> It is not worth to have a speedy queue for light request in this case

If we push tellers' efficiency from 10 to 11 WU/H we can serve most of customers of the day.

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Conclusions

Adding window or push tellers' efficiency can serve most of customer of the day

Prioritizing 1 queue for light request is not efficient because most of customers have light WU request.