FINAL PROJECT REPORT
ON
SUBWAY TICKET QUERY SYSTEM

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System Simulation

MIS 54011-002

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Executive Summary:

This report presents a detailed study of the rail metro ticket queuing system at metro station using various simulation methods. The study aimed to optimize the queuing system for purchasing tickets, which aimed to reduce waiting times and enhance passenger experience the first example highlighted the challenges faced by passengers due to queuing therefore, which resulted in long wait times and possible ticket cancellations Passengers can go to the station and choose their queue.

The simulation results showed significant improvement over the new model. Increasing queuing strategies from one to two significantly reduced queuing time and number of queues per minute. These improvements are expected to improve the overall efficiency of the ticketing process, reduce wait times, and improve customer satisfaction The findings of this study provide valuable insights for Subway to improve its queuing process and improve service delivery.

Based on the results, it is recommended to implement the proposed multi-queue scheme in the subways. This solution has proven effective in reducing queue length and enhancing the passenger experience. The model parameters can be further analyzed and optimized to tailor the queuing process to meet specific business requirements. By embracing these improvements, the station can better manage passenger flows, deliver a seamless ticketing experience, and ultimately increase customer satisfaction.

Objective:

The objective of this simulation observation is to optimize the queuing device for price ticket purchases at a Subway. The cutting-edge device experiences long queues, main to passenger dissatisfaction and ability price tag cancellations. The aim is to improve the queuing system, lessen ready instances, and beautify overall efficiency to provide a higher passenger enjoy. By making use of discrete occasion simulation in Arena software, the study objectives are to advocate and examine alternative scenarios that can optimize the queuing machine and discover the handiest solution for implementation. The results of the simulation will offer insights into the potential improvements and manual choice-making to streamline the ticketing system on the Subway.

Overview:

This report focuses on the design of ticket queuing systems on the subways. The aim of the study is to model the overall experience of passengers from entry to exit during their stay at the ticket counter. The current system faces challenges with long queues, leading to passenger frustration and possible ticket cancellations. Using Arena software to simulate scenarios, the analysis seeks to analyze the queuing process and propose improvements to optimize the process and prevent queuing congestion The findings provide valuable insights value to improve the ticketing system, improve passenger satisfaction and improve overall efficiency in the Subway.

Scope:

The scope of this study encompasses the queuing gadget for ticket purchases at a Subway. The study specializes in addressing the demanding situations posed by long queues, which could result in passenger dissatisfaction and ability price ticket cancellations. By making use of discrete event simulation with Arena software, they have a look at objectives to optimize the queuing device and improve the general passenger revel in.

The study will analyze the imbalance between the wide variety of passengers and to be had provider centers, leading to queues. The aim is to discover possibilities for optimizing the queuing system and reducing queue lengths. By simulating different eventualities, the look at will examine the effect of proposed enhancements, such as increasing the range of queues, on key performance indicators. The findings will guide choice-making and offer suggestions for streamlining the ticketing manner to keep away from long queues and beautify passenger delight on the Subway.

Model Setup:

The model setup for the simulation of the Metro ticketing queue machine at Subway consists of the entities, resources, stations, routes, schedules, expressions, sets, attributes, and variables necessary to duplicate and examine the queuing procedures and search opportunities for optimization. It is defined as follows:

Entities:

The entities worried inside the simulation version consist of **passengers, Ticket Issuer 1, and Ticket Issuer 2.** Passengers represent the individuals in search of tickets to purchase, while Ticket Issuer 1 and Ticket Issuer 2 are accountable for issuing tickets from counters 1 and a pair of, respectively.

Resources:

The simulation model includes two ticket issuers: **Ticket Issuer 1 and Ticket Issuer 2.** These resources are assigned to serve the passengers at the respective counters.

Stations & Route Logic:

Several stations and routes are described in the version to represent the one-of-a-kind ranges of the passenger journey. These stations encompass:

1. Enter Station: The station wherein passengers' input and examine the queue.

2. Exit Station to Platform: The station wherein passengers depart to the platform after buying their tickets. There are two exits to the platform.

3. Ticket Counter Station: The station where passengers can buy tickets. There are counters available to launch tickets.

4. Queue Line Station: The preliminary factor on the station where passengers pick the queue with the least crowded and stand in line to purchase tickets.

5. Queue Station: The station where passengers wait within the queue line to shop for their tickets.

Schedules:

Several schedules are utilized to simulate variations in worker capability and passenger arrivals over 16-hour shifts from 6 AM to 10 PM. The schedules encompass:

1. Arrival Schedule: This schedule simulates the frequency of passenger arrivals in minutes, differentiating among busy hours (office hours morning and night) and sluggish hours (non-workplace hours). The arrivals are based totally on triangular distribution expressions for busy and slow hours.

2. Ticket Issuer Schedules: These schedules change between gradual and busy hours, adjusting the ability of to be had price ticket issuers accordingly. During slow hours, one price tag company is going on a destroy at the same time as the other counter remains open. During busy hours, both counters are open for service.

Expressions:

The version contains diverse expressions to decide manner instances, consisting of:

1. Slow Arrival: A triangular distribution representing the time between passenger arrivals throughout non-office hours.

2. Busy Arrival: A triangular distribution representing the time between passenger arrivals in busy hours.

3. Order Time: A triangular distribution simulating the time taken to finish an order.

4. Pay Time: A regular 1-minute expression representing the time spent by way of passengers paying for their tickets.

Sets, Attributes, and Variables:

The simulation model makes use of units, attributes, and variables as follows:

1. Sets:

1.1counter: A set containing the two entities, Ticket Issuer 1 and Ticket Issuer 2, used for assigning entity types in the model.

1.2Passenger: A set containing photographs for the entities stated above and passengers, used for assigning entity pix for animation functions.

2. Attributes:

Process time: An open characteristic used as an expression for every procedure inside the ticket issuing routes.

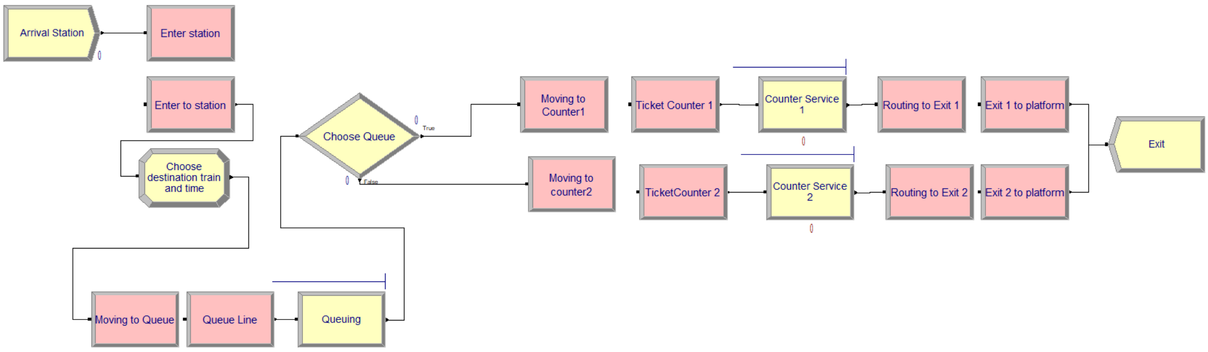
3. Variables:

Walk time: A variable representing the time taken to walk among stations for a price tag counter. It is assigned a steady price of 1 minute and mixed with random distributions to simulate passenger travel times within the railway station.

The detailed model setup described above forms the foundation for simulating the railway metro ticketing queue system at Subway.

Overview of Model:

Subway Ticket Query System



Model Results

The model runs for 16 hours a day to represent the hours working 06AM - 10PM and is replicated time 500hrs to represent one month of business operations. Entities per arrival are dictated by a triangular distribution, TRIA (2,4,6), with the maximum likely arrival value being a set of four entities. These are the consequences:

Entity

Time

VA Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.08604910	0.000619075	0.04309284	0.1556

NVA Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.00	0.000000000	0.00	0.00

Wait Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.1392	0.019813619	0.00	1.1690

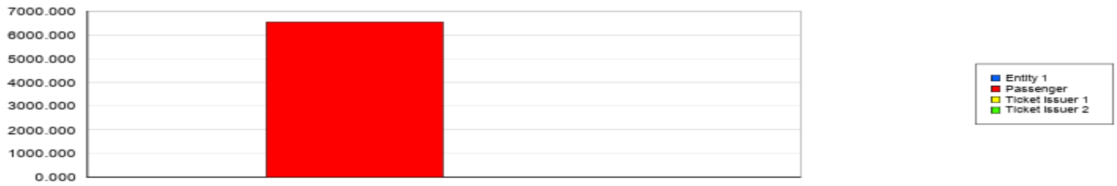
Transfer Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.06837709	0.000803420	0.00182738	0.1707

Other Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.00	0.000000000	0.00	0.00

Total Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.2936	0.020049865	0.06177577	1.4030

Other

Number In	Value
Entity 1	0.00
Passenger	6533.00
Ticket Issuer 1	0.00
Ticket Issuer 2	0.00



Entity

Other

Number Out

	Value
Entity 1	0.00
Passenger	6533.00
Ticket Issuer 1	0.00
Ticket Issuer 2	0.00

WIP

	Average	Half Width	Minimum Value	Maximum Value
Entity 1	0.00	(Insufficient)	0.00	0.00
Passenger	3.8365	0.381697246	0.00	37.0000
Ticket Issuer 1	0.00	(Insufficient)	0.00	0.00
Ticket Issuer 2	0.00	(Insufficient)	0.00	0.00

Queue

Time

Waiting Time

	Average	Half Width	Minimum Value	Maximum Value
Counter Service 1.Queue	0.00739760	0.001846266	0.00	0.1826
Counter Service 2.Queue	0.00889669	(Correlated)	0.00	0.1640
Queuing.Queue	0.1311	0.019229681	0.00	1.1690

Other

Number Waiting

	Average	Half Width	Minimum Value	Maximum Value
Counter Service 1.Queue	0.04846908	0.012826600	0.00	4.0000
Counter Service 2.Queue	0.05795301	0.010306739	0.00	4.0000
Queuing.Queue	1.7123	0.300916104	0.00	31.0000

Resource

Usage

Instantaneous Utilization

	Average	Half Width	Minimum Value	Maximum Value
passenger Queue	0.4690	(Correlated)	0.00	1.0000
Ticket Issuer1	0.2219	(Correlated)	0.00	1.0000
Ticket Issuer2	0.2188	0.011342095	0.00	1.0000

Number Busy

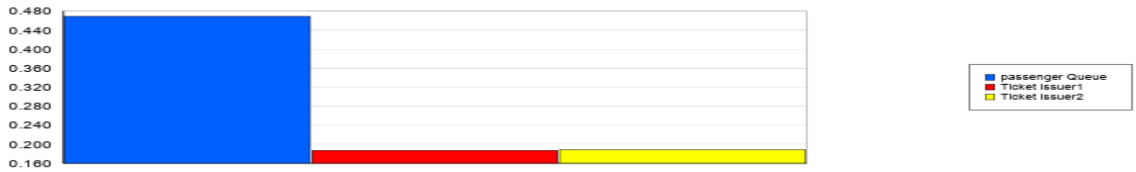
	Average	Half Width	Minimum Value	Maximum Value
passenger Queue	0.4690	(Correlated)	0.00	1.0000
Ticket Issuer1	0.3265	(Correlated)	0.00	2.0000
Ticket Issuer2	0.3288	0.014993223	0.00	2.0000

Number Scheduled

	Average	Half Width	Minimum Value	Maximum Value
passenger Queue	1.0000	(Insufficient)	1.0000	1.0000
Ticket Issuer1	1.7480	(Insufficient)	1.0000	2.0000
Ticket Issuer2	1.7480	(Insufficient)	1.0000	2.0000

Scheduled Utilization

	Value
passenger Queue	0.4690
Ticket Issuer1	0.1868
Ticket Issuer2	0.1881

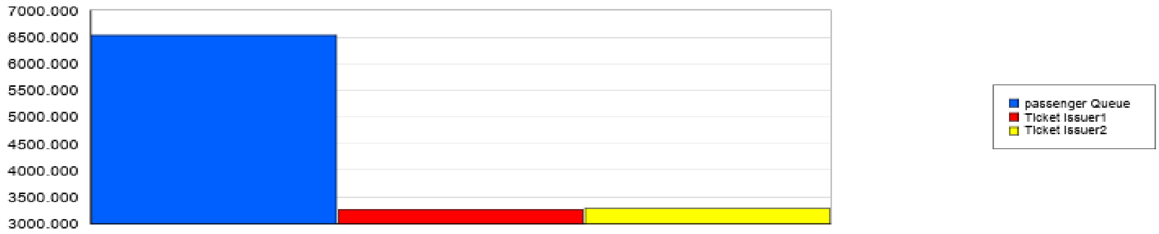


Resource

Usage

Total Number Seized

	Value
passenger Queue	6533.00
Ticket Issuer1	3257.00
Ticket Issuer2	3276.00



Based on the results, it is obtained that the average queue time of simulation is 0.131 minutes with an average number of 1.71 people per minute. Service time at counter 1 is 0.07 minutes with an average number of 0.048 per minute. The service time at counter 2 is 0.08 minutes with an average amount of 0.057 per minute.

Alternate Model:

In addition to the initial model, an alternative queuing system solution is proposed to reduce queue lengths for passengers at the Subway. The alternate model setup is as follows:

Entities:

The entities involved in the alternate model remain the same**: passengers, Ticket Issuer 1, and Ticket Issuer 2.**

Resources:

Like the initial model, the alternate model includes **Ticket Issuer 1 and Ticket Issuer 2** as resources responsible for issuing tickets at their respective counters.

Stations & Route Logic:

The alternate model maintains the same stations as the initial model, including **Enter Station, Exit Station to Platform, Ticket Counter Station, Queue Line Station, and Queue Station.**

Schedules:

The schedules used in the alternate model are the same as those in the initial model, simulating variations in employee capacity and customer arrivals over the 16-hour work shift.

Expressions:

The expressions utilized in the alternate model are also the same as those in the initial model, determining process times and travel times between stations.

Sets, Attributes, and Variables:

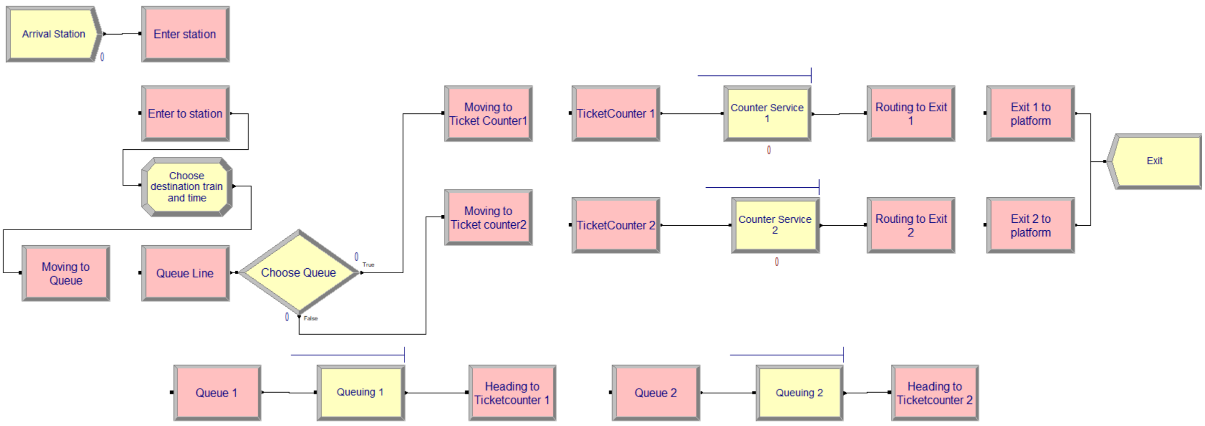
The sets, attributes, and variables used in the alternate model are identical to those in the initial model.

Explanation of Alternate Model:

The proposed alternate model offers a method to cope with the existing queue length challenges at the Subway. In this model, passengers are allowed to pick out their queue upon getting into the metro station, which gives them the opportunity to enroll in the queue with the least crowd. After completing the queueing technique, passengers are directed to the counter like their selected queue, and upon finishing touch of the ticketing process, they proceed to the platform.

By simulating the alternate model, the usage of the identical parameters and eventualities because the initial version, the examine aims to assess the effectiveness of imposing a a couple of-queue system in reducing queue lengths and enhancing normal performance. The outcomes acquired from the alternate model might be as compared to the ones of the initial version to assess the impact of the proposed solution on key performance signs and passenger enjoy. The alternate version gives a possibility to discover capacity upgrades to the present queuing machine, providing precious insights for decision-making and implementation on the Subway.

Overview of Model:



Model Results

The model runs for 16 hours a day to represent the hours working 06AM - 10PM and is replicated time 500hrs to represent one month of business operations. Entities per arrival is dictated by a triangular distribution, TRIA (2,4,4), with the maximum likely arrival value being a set of four entities. These are the consequences:

Entity

Time

VA Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.07786558	0.000448628	0.05025868	0.1252

NVA Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.00	0.000000000	0.00	0.00

Wait Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.03335378	0.003484561	0.00	0.3518

Transfer Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.1128	0.000683746	0.03738490	0.2103

Other Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.00	0.000000000	0.00	0.00

Total Time	Average	Half Width	Minimum Value	Maximum Value
Passenger	0.2240	(Correlated)	0.1103	0.5400

Other

Number In	Value
Entity 1	0.00
Passenger	5006.00
Ticket Issuer 1	0.00
Ticket Issuer 2	0.00

Entity

Other

Number Out	Value
Entity 1	0.00
Passenger	5006.00
Ticket Issuer 1	0.00
Ticket Issuer 2	0.00

WIP	Average	Half Width	Minimum Value	Maximum Value
Entity 1	0.00	(Insufficient)	0.00	0.00
Passenger	2.2429	0.117348364	0.00	17.0000
Ticket Issuer 1	0.00	(Insufficient)	0.00	0.00
Ticket Issuer 2	0.00	(Insufficient)	0.00	0.00

Queue

Time

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
Counter Service 1.Queue	0.00647709	0.001497526	0.00	0.1635
Counter Service 2.Queue	0.00933562	0.002747064	0.00	0.2082
Queuing 1.Queue	0.02529612	0.002519836	0.00	0.2890
Queuing 2.Queue	0.02553802	0.002822033	0.00	0.2804

Other

Number Waiting	Average	Half Width	Minimum Value	Maximum Value
Counter Service 1.Queue	0.03178956	0.006247168	0.00	3.0000
Counter Service 2.Queue	0.04764903	0.012730607	0.00	5.0000
Queuing 1.Queue	0.1242	0.015020413	0.00	6.0000
Queuing 2.Queue	0.1303	0.017138073	0.00	6.0000

Resource

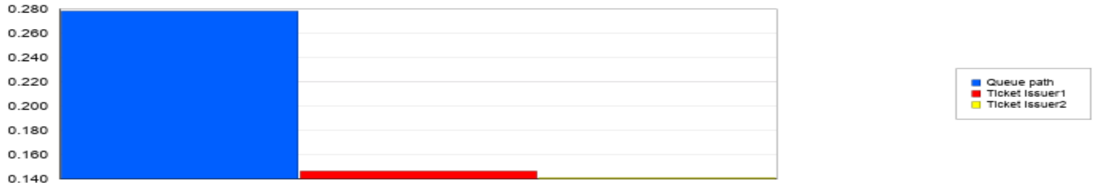
Usage

Instantaneous Utilization	Average	Half Width	Minimum Value	Maximum Value
Queue path	0.2783	0.013734525	0.00	1.0000
Ticket Issuer1	0.1724	0.009692672	0.00	1.0000
Ticket Issuer2	0.1659	0.008022710	0.00	1.0000

Number Busy	Average	Half Width	Minimum Value	Maximum Value
Queue path	0.2783	0.013734525	0.00	1.0000
Ticket Issuer1	0.2554	0.014895859	0.00	2.0000
Ticket Issuer2	0.2459	0.012370155	0.00	2.0000

Number Scheduled	Average	Half Width	Minimum Value	Maximum Value
Queue path	1.0000	(Insufficient)	1.0000	1.0000
Ticket Issuer1	1.7480	(Insufficient)	1.0000	2.0000
Ticket Issuer2	1.7480	(Insufficient)	1.0000	2.0000

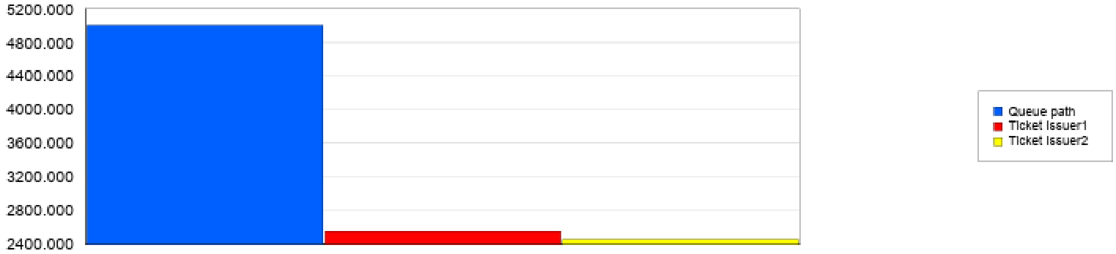
Scheduled Utilization	Value
Queue path	0.2783
Ticket Issuer1	0.1461
Ticket Issuer2	0.1407



Resource

Usage

Total Number Seized	Value
Queue path	5006.00
Ticket Issuer1	2552.00
Ticket Issuer2	2454.00



Based on the results, it is obtained that the average queue time of simulation in Queues 1 and 2 are 0.025 and 0.025 minutes with an average number of 0.12 and 0.13 people per minute. Service time at counter 1 is 0.006 minutes with an average number of 0.031 per minute. The service time at counter 2 is 0.009 minutes with an average amount of 0.047 per minute.

Insights and Conclusion:

The simulation results of the railway metro ticket queuing system of Subway provide valuable insights for optimizing the queuing system for ticketing. Comparing the original model with the newly proposed model, using a multi-queuing scheme significantly reduces the queue length and improves the overall performance.

The original prototype identified existing challenges, such as long waiting times due to queue queues, which resulted in dissatisfied passengers and possible ticket cancellations, but the new prototype showed a marked improvement by way of it is used to select passengers to be selected over the queue. Simulation results showed that increasing the number of queuing methods from one to two significantly reduced the queuing time and the number of people sitting in line per minute This increase is expected to make passenger experience greater, reduced wait times, and ultimately increased customer satisfaction.

Based on the findings, we can say that our proposed system is good for improving the quality of the ticketing process. Simulation results provide strong evidence that the inclusion of queuing routes effectively reduces queue length and improves scheduling efficiency by adopting this solution, stations can better manage passenger flows, for improve service, and reduce customer dissatisfaction caused by long queues Queue systems.

References:

1) https://ieeexplore.ieee.org/document/5768318
2) https://www.youtube.com/watch?v=M5XKBRdIKCE