

PART 1

Service Simulation



Why Simulation?

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- Simulation is used **to imitate the real operation** and **gather statistic** of certain information.
 - Example: Game simulation, Activity/program simulation, Simulation at a bank counter, etc.
- **Queue simulation** is the replication of the real queue. It will retain the queue concept: *first item in queue will be served prior to the next item.*
- Simulation process is used to produce **statistical reports**:
 - *arrival rates and patterns,*
 - *waiting and service times*
 - *percentage of time* the automated equipment is utilized.

Case 1-Drive through car wash

- Each car wash takes a fixed amount of time. (let say 10 minutes)
- The next customer is likely to arrive within 1-9 minutes after the current customer. (*not realistic, but ok*)
- Observe time of arrival and gaps between arrival.
- Output:
 - number of customer arrive.
 - Longest waiting time.
 - Average waiting time

*One server with one fixed service time.
One queue with random arrival.*

fixed service time (1 service type) = 10 minutes

startTime = 8.00am endTime = 8.30am

Input

7:58
8:03,
8:10,
8:17,
8:26,
8:31



Output

1. Number of customer arrive.
2. Longest waiting time.
3. Average waiting time

- arrival of car is as follows: 8.01, 8.05, 8:10, 8:19, 8:28, 8:28, 830
- 1 type of service (fix service time)= 10 minutes
- Info: *startTime* = 8.00am *endTime* = 8.30pm

#car	Arriving time	Start wash	End wash	Waiting Time	Max waiting Time
1	8.01	8.01	8.11	0	0
2	8.05	8.11	8.21	6	6
3	8.10	8.21	8.31	11	11
4	8.19	8.31	8.41	12	12
5	8.28	8.41	8.51	13	13
6	8.28	??	??	??	
7	8.30	??	??	??	

Output:

- (1) number of customer arrive,
- (2) Longest waiting time,
- (3) Average waiting time

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6	8.28	8.51	9.01	23	23
7	8.30	9.01	9.11	31	31

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Output:

- (1)number of customer arrive,
- (2)Longest waiting time,
- (3)Average waiting time

End wash = 10 minit after every start wash

Waiting time = Start Wash – arrival time

Average waiting time = total waiting time / no of cars

Longest waiting time = Max waiting time

Simulation Complexity



Requirement:

- Information that need to identify about service simulation is its complexity.
- The complexity of simulation determined by :
 - (1) number of **servers**
 - (2) number of **services provided**.

Example	#SERVER	#SERVICES
cinema ticket counter	Many counter	1 service (buying ticket)
auto teller machine	One machine	2 services: (1)withdraw money (2)Transfer money

Case 1

FIXED SERVICE TIME

One server with one service.

One queue with many customers.

RANDOM ARRIVAL

Example:

Case: Queue at Car wash machine
1 machine with **1** type of wash,
Many cars arrives each day.



Case 2

RANDOM SERVICE TIME

One server with many services.

One queue with many customers.

RANDOM ARRIVAL

Example:

Case: Queue at **ATM Machine**

1 machine with **3 type of services**

Services: 1.withdraw, 2.transfer money, 3.top-up TouchNGo

Many customers arrives each day.



Simulation Complexity

RANDOM
SERVER

RANDOM SERVICE TIME

Many servers with one service.
One queue with many customers.

RANDOM ARRIVAL

Case 3

Example:

Case: Checkout counter at Supermarket
Many counter, for many customer to
make payment



Simulation Complexity

RANDOM
SERVER

FIX SERVICE TIME

Many servers with Many services.
One queue with many customers.

RANDOM ARRIVAL

Case 4

Example:

Case: **Bank Counter**

Many counter, many services

Services: saving acct, withdraw money, loan
payment, credit card

One queue (queue number) with **many customers**



How complex is this case?



