

PART 1 Service Simulation

Why Simulation?

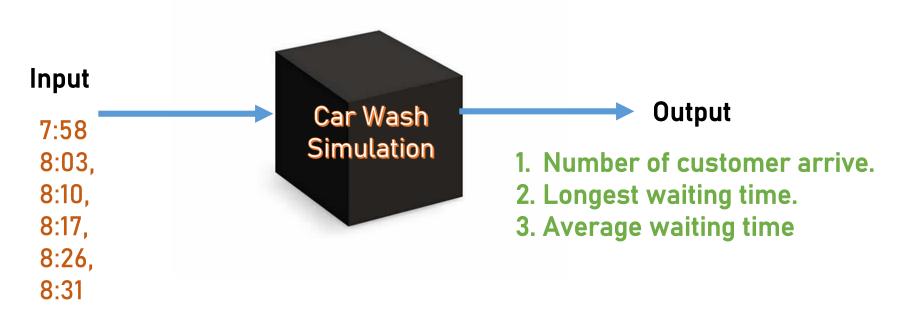
- Simulation is used to imitate the real operation and gather **statistic** of certain information.
 - Example: Game simulation, Activity/program simulation, Simulation at a bank counter, etc.
- Queue simulation is the replication of the real queue. It will retain the queue concept: first item in queue 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 <u>fixed</u> 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

fixed service time (1 service type) = 10 minutes startTime = 8.00am endTime = 8.30am



- 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

CAR WASH - CLAMME F-O

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



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.

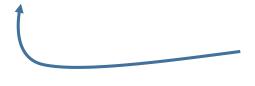




RANDOM SERVICE TIME

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.





RANDOM SERVICE TIME

Many servers with one service.

One queue with many customers.

Case 3



Example:

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





FIX SERVICE TIME

Many servers with Many services.

One queue with many customers.

Case 4

RANDOM ARRIVAL

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?

















