

COMPUTERIZED MODEL OF RENT A CAR SERVICE

System Components and Relations Between Them:

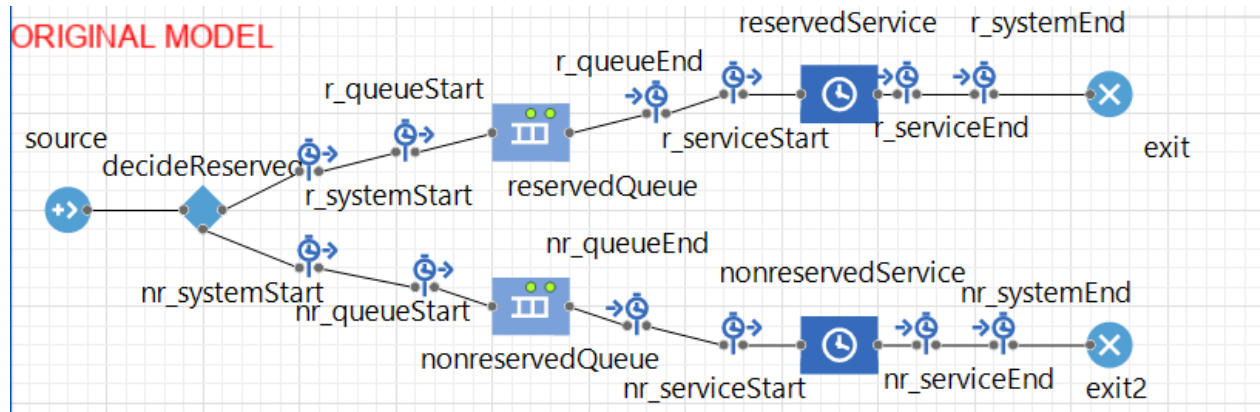


Figure-1: System components of original model

- source (Source): Sends customers to system by using interarrival time distribution.
- decideReserved (Select Output): Chooses customer type between customer who has reservation and customer who has not (Original model: 0.4 reservation, 0.6 no reservation – Alternative model: 0.2 reservation, 0.8 no reservation).
- r_systemStart (TimeMeasureStart) – r_systemEnd (TimeMeasureEnd): Timers that calculates time spent in the system (reserved part).
- r_queueStart (TimeMeasureStart) – r_queueEnd (TimeMeasureEnd): Timers that calculates waiting time in the queue (reserved part).
- reservedQueue (Queue): Queue for customers who have reservation.
- r_serviceStart (TimeMeasureStart) – r_serviceEnd (TimeMeasureEnd): Timers that calculates service time for customers who have reservation.
- reservedService (Delay): Service for customers who have reservation.
- exit (Sink): Disposes incoming customers.
- nr_systemStart (TimeMeasureStart) – nr_systemEnd (TimeMeasureEnd): Timers that calculates time spent in the system (non-reserved part).
- nr_queueStart (TimeMeasureStart) – nr_queueEnd (TimeMeasureEnd): Timers that calculates waiting time in the queue (non-reserved part).
- nonreservedQueue (Queue): Queue for customers who have no reservation.
- nr_serviceStart (TimeMeasureStart) – nr_serviceEnd (TimeMeasureEnd): Timers that calculates service time for customers who have no reservation.
- nonreservedService (Delay): Service for customers who have no reservation.
- exit2 (Sink): Disposes incoming customers.

Generation of Random Variates:

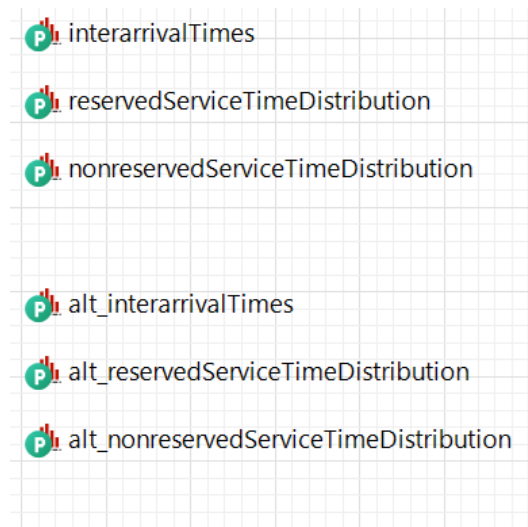


Figure-2: Custom Distributions of the System

The custom distributions which begin with 'alt' are for alternative model of the system.

Interval start	Interval end	Number of obser...
3	3	25.0
4	4	15.0
5	5	10.0
6	6	15.0
7	7	5.0
8	8	5.0
9	9	20.0
10	10	5.0

Figure-3: Custom Distribution - interarrivalTimes

Interval start	Interval end	Number of observ...
3	3	20.0
4	4	30.0
5	5	35.0
6	6	15.0

Figure-4: Custom Distribution – reservedServiceTimeDistribution

Interval start	Interval end	Number of observ...
5	5	20.0
6	6	35.0
7	7	25.0
8	8	20.0

Figure-5: Custom Distribution – nonreservedServiceTimeDistribution

Interval start	Interval end	Number of obser...	^
2	2	20.0	
3	3	15.0	
4	4	15.0	
5	5	10.0	
6	6	15.0	
7	7	10.0	
8	8	10.0	
9	9	5.0	▼

Figure-6: Custom Distribution – alt_interarrivalTimes

Interval start	Interval end	Number of observ...
3	3	20.0
4	4	30.0
5	5	35.0
6	6	15.0

Figure-7: Custom Distribution – alt_reservedServiceTimeDistribution

Interval start	Interval end	Number of observ...
6	6	30.0
7	7	20.0
8	8	25.0
9	9	25.0

Figure-8: Custom Distribution – alt_nonreservedServiceTimeDistribution

2D View of the Model:

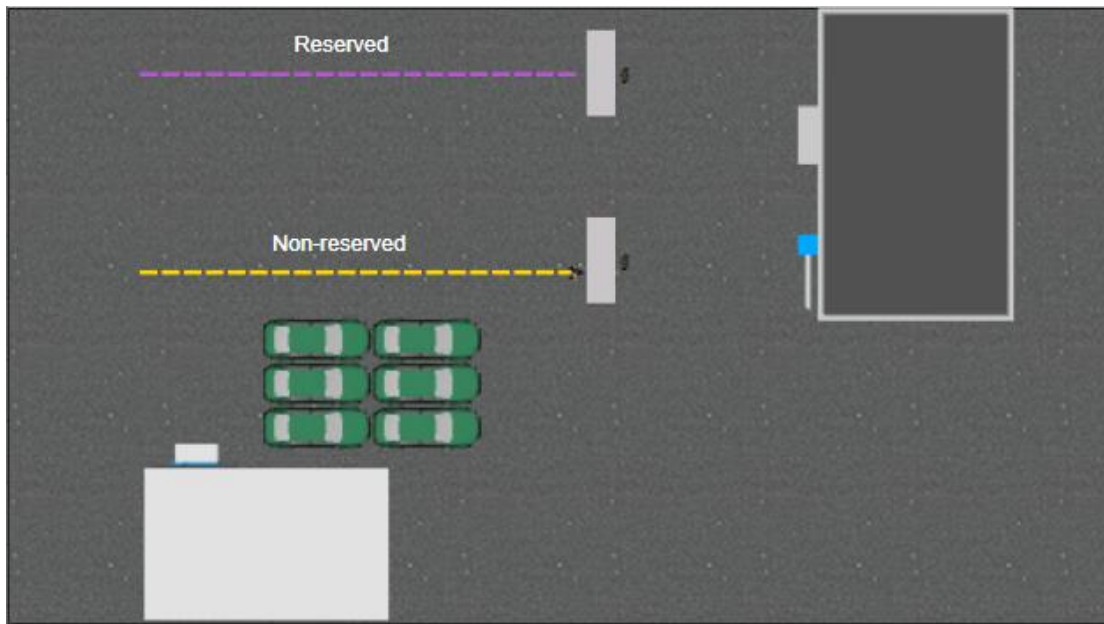


Figure-9: 2D View of the Rent a Car Service Model

3D View of the Model:

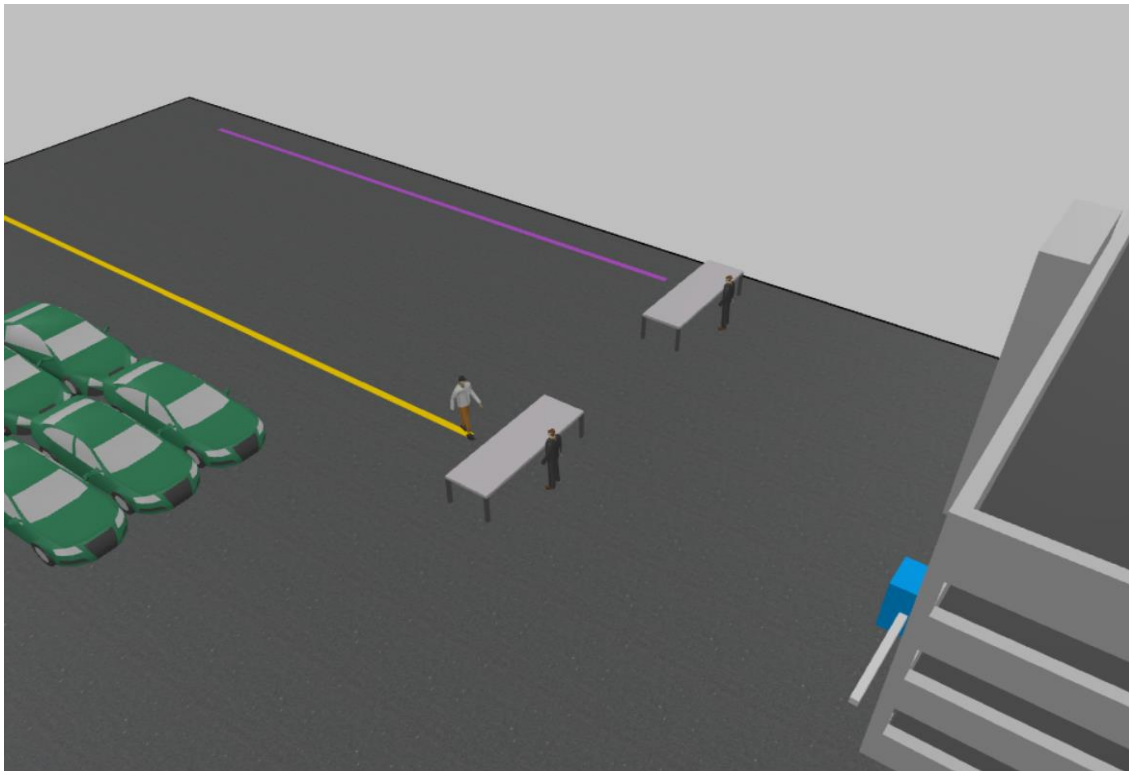


Figure-10: 3D View of the Rent a Car Service Model

Input Variables, the Type and the Values

- Output values in this report is taken with fixed seed which is 1.

☒ Fixed seed (reproducible simulation runs) Seed value:

- Normally system works with random seed values.

☐ Custom generator (subclass of Random):

The Output Parameters:

- The waiting average time in the queue for both customer types in two queues.
- Average service times for both services.
- Average time spent in the system.
- The average time between arrivals.
- Utilization of the both services.
- Rate of Idle time of the both services.

Output Values of Original Model (Seed value is 1):

- 1) The waiting average time in the queue of customers who have reservation:

$$\frac{\text{total time customers wait in queue (minutes)}}{\text{total numbers of customers (reservation)}} = \frac{6.97}{41} = 0.17 \text{ minutes}$$

- 2) The waiting average time in the queue of customers who have no reservation:

$$\frac{\text{total time customers wait in queue (minutes)}}{\text{total numbers of customers (no reservation)}} = \frac{132.75}{59} = 2.25 \text{ minutes}$$

- 3) Average service time of service that is for customers who have reservation:

$$\frac{\text{total service time (minutes)}}{\text{total numbers of customers (reservation)}} = \frac{174}{41} = 4.24 \text{ minutes}$$

- 4) Average service time of service that is for customers who have no reservation:

$$\frac{\text{total service time (minutes)}}{\text{total numbers of customers (no reservation)}} = \frac{391}{59} = 6.63 \text{ minutes}$$

- 5) Average time spent in the system: $\frac{\text{total time customers spend in the system (minutes)}}{\text{total numbers of customers}}$

$$= \frac{162 (\text{reservation}) + 354 (\text{no reservation})}{100} = 5.16 \text{ minutes}$$

- 6) The average time between arrivals: $\frac{\text{sum of all times between arrivals}}{\text{number of arrivals} - 1} = \frac{576}{99}$

$$= 5.82 \text{ minutes}$$

7) Utilization of the service for customers who have reservation: 0.31

8) Utilization of the service for customers who have no reservation: 0.66

9) Rate of Idle time of the service for customers who have reservation: $1 - \text{Utilization Rate}$
 $= 0.69$

10) Rate of Idle time of the service for customers who have no reservation: $1 - \text{Utilization Rate}$
 $= 0.34$

Output Values of Alternative Model (Seed value is 1):

1) The waiting average time in the queue of customers who have reservation:
$$\frac{\text{total time customers wait in queue (minutes)}}{\text{total numbers of customers (reservation)}} = \frac{7.80}{39} = 0.20 \text{ minutes}$$

2) The waiting average time in the queue of customers who have no reservation:
$$\frac{\text{total time customers wait in queue (minutes)}}{\text{total numbers of customers (no reservation)}} = \frac{13150.48}{161} = 81.68 \text{ minutes}$$

3) Average service time of service that is for customers who have reservation:
$$\frac{\text{total service time (minutes)}}{\text{total numbers of customers (reservation)}} = \frac{180}{39} = 4.61 \text{ minutes}$$

4) Average service time of service that is for customers who have no reservation:
$$\frac{\text{total service time (minutes)}}{\text{total numbers of customers (no reservation)}} = \frac{1180}{161} = 7.33 \text{ minutes}$$

5) Average time spent in the system:
$$\frac{\text{total time customers spend in the system (minutes)}}{\text{total numbers of customers}} = \frac{173 (\text{reservation}) + 3045 (\text{no reservation})}{200} = 16.09 \text{ minutes}$$

6) The average time between arrivals:
$$\frac{\text{sum of all times between arrivals}}{\text{number of arrivals} - 1} = \frac{990}{199} = 4.97 \text{ minutes}$$

7) Utilization of the service for customers who have reservation: 0.19

8) Utilization of the service for customers who have no reservation: 1.00

9) Rate of Idle time of the service for customers who have reservation: $1 - \text{Utilization Rate}$
 $= 0.81$

10) Rate of Idle time of the service for customers who have no reservation: $1 - \text{Utilization Rate}$
 $= 0$

Conclusion:

One of the differences between original and alternative model is service time distribution for non-reserved customers. It is slower than service in the original model. In original model, average service time for non-reserved customers is 6.63 minutes but in alternative model, it is 7.33. Another important difference is number of customers who arrives the system. There 100 customers in original model and there are 200 customers in alternative model. Also, in alternative model, probability of arriving non-reserved customer to system is more than original model. It is 0.6 in original model, but in alternative model, it is 0.8.

All important differences above affect average waiting time, time spent in the system, queue line, usage and idle rate of services. So, alternative model is worse than original model in this sense. Customers waits more in the queue, spent more time in the system, queue line is longer especially in non-reserved customer line.

We can see that importance of reservation in the systems when we looked at two systems which are original and alternative models. Reservation is less in the alternative model compared to original model. If the usage of reservation system was less in the systems, everything would be more chaotic. Reservation saves lots of times for both customers and both firms.

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