

Assignment 4 – Tassio Magassy

1. Customers arrive at a service station (with a single server) according to the Poisson process with a mean arrival rate of $\lambda = 0.3$ (customers/min), which indicates that the intra-arrival time follows the exponential distribution with $\lambda = 0.3$. Each customer waits in queue (if present), proceeds to receive service upon his/her turn, and departs the system when the service is completed. The service time is uniformly distributed between 2.5 and 4.5 minutes. On each day, the service station is open for two hours. Any customers in queue at the end of work hours are served before closing the service station for the day. Use simulation in Excel to determine

After applying these values in a excel function, the following answers were

(a) The number of customers served per day

34 customers

(b) Total delay per day

194 minutes was the total delay

(c) Average delay per customer

5 minutes is the average delay

2. Vehicle arrive at entrance to a park with a single gate. The arrival rate = 480veh/hr for the first 30 minutes, and declines to 120 veh/hr thereafter. An entrance it takes each vehicle 12 seconds to purchase tickets.

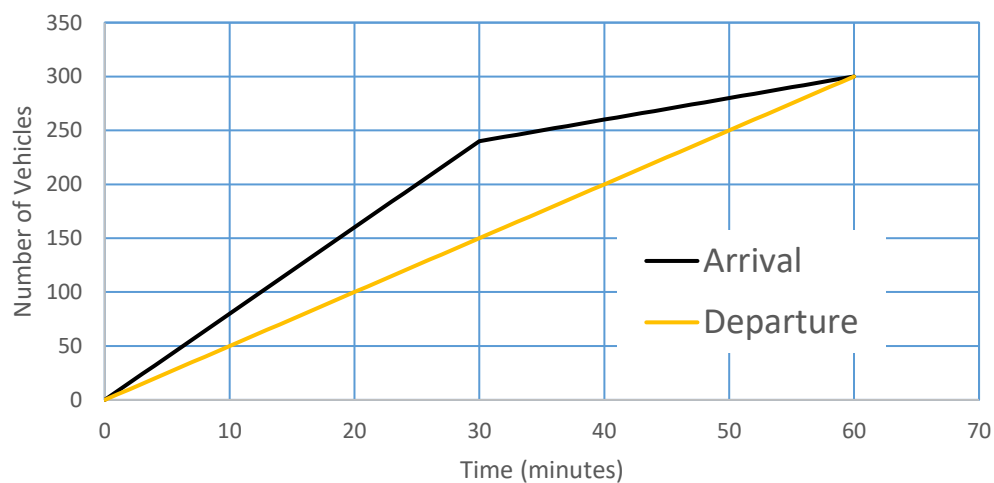
(1) When will the queue disappear? Please draw the cumulative diagram.

Arrival rate in minutes for the first 30 mins = $480/60 = 8$ vehicles/minutes

Arrival rate in minutes thereafter = $(120/60) = 2$ vehicles/minutes

Cumulative Arrival (CA) = $8x$ $0 \leq x \leq 30$
 $2*(x - 30) + 240$ **for $x \geq 30$**

Cumulative Departure (CD) = $5x$ **for $x \geq 0$**
 $2(x - 30) + 240 = 5x$ **$x = 60$**



(2) Please calculate total waiting time, average queue length, and average waiting time.

$$T_{total} = \text{Total Cumulative Arrival Time} - \text{Total Departure Time}$$

$$T_{total} = 11850 - 9150 = 2700 \text{ min}$$

$$\text{Average queue length } L_{ave} = 2700/60 = 45$$

$$\text{Average waiting time } T_{ave} = 2700/300 = 9 \text{ min}$$

3. A three- car platoon is traveling on an arterial, with the lead vehicle at a distance of 300 feet from a traffic signal. The platoon speed is 37.5 mph and vehicles are 80 ft apart, front-to-front. The lead vehicle in the platoon starts decelerating at a comfortable rate of 5 mph/s in order to come to a complete stop at the traffic light. (1) You have been asked to calculate the movement of the individual vehicles in the platoon in a microscopic fashion. The following information is provided regarding driver behavior. GM model 1 is used for the car-following behavior. (2) please visualize the trajectories of 3 vehicles in excel.

GM Model 1: $\ddot{x}_{n+1}(t + \Delta t) = \alpha_0[\dot{x}_n(t) - \dot{x}_{n+1}(t)]$

Driver of Vehicle	Reaction Time (sec.)	Sensitivity Term
1		
2	1.1	0.40
3	0.90	0.40

Reminder: please calculate the trajectory of the lead vehicle (vehicle 1), then calculate vehicles 2 and 3 's trajectories. It is better to use an excel table to finish this problem.

As the first car distance from the signal as 300 feet, the second and the third car distance would be 380 feet and 460 feet respectively.

Initial speed of vehicles: 37.5 mph; Distance between vehicles: 80 ft; Deceleration of vehicle 1: 5 mph/sec

