



CIVE 7380

Problem Set #1

Due: January 22, 2025

1. An approach to an intersection is controlled by a traffic light with cycle 60 sec. and effective green time of 40 sec. Vehicles approach at a uniform (deterministic) rate of 600 veh/hr (vehicles per hour). Vehicles are being served during the green period (when a queue is present) at a (deterministic) rate of 1800 veh/hr. The system is deterministic.
 - a. Plot a diagram showing cumulative arrivals and departures
 - b. Find the following quantities:
 - i. Duration of queue
 - ii. Number of vehicles in queue
 - iii. Maximum queue length
 - iv. Maximum delay
 - v. Total delay
 - vi. Average delay per vehicle in queue
2. A three-lane directional freeway has a capacity of 6,000 veh/hr. The flow of vehicles in the freeway is 4,800 veh/hr. An accident occurs that lasts for 0.75 hrs. The operating authority is interested in finding out the impact of accidents on the operations of the freeway. Perform a sensitivity analysis for different reduction capacity scenarios because of the incident, assuming that the capacity is reduced from 6,000 veh/hr to 2,000 veh/hr in steps of 1,000 veh/hr. For each case find the following quantities of interest assuming deterministic queuing:
 - a. Duration of queue
 - b. Number of vehicles in queue
 - c. Maximum queue length
 - d. Maximum delay
 - e. Total delay
 - f. Average delay per vehicle in queue
3. Passengers arrive to board a plane at steady (deterministic) rates given by:

$$\lambda = \begin{cases} 2 \text{ pax/min} & 0 \leq t < 30 \\ 3 \text{ pax/min} & 30 \leq t < 40 \\ 2 \text{ pax/min} & 40 \leq t < 55 \end{cases}$$

Passengers start boarding during the interval between 32 and 55 minutes at a maximum rate of 6 pax/min. Find:

- a. The total delay before boarding
- b. The maximum queue length
- c. The longest delay of any customer using a FIFO policy
- d. Assume that the boarding area has a capacity of 50 pax. What time should the boarding start to ensure that the capacity is not exceeded?