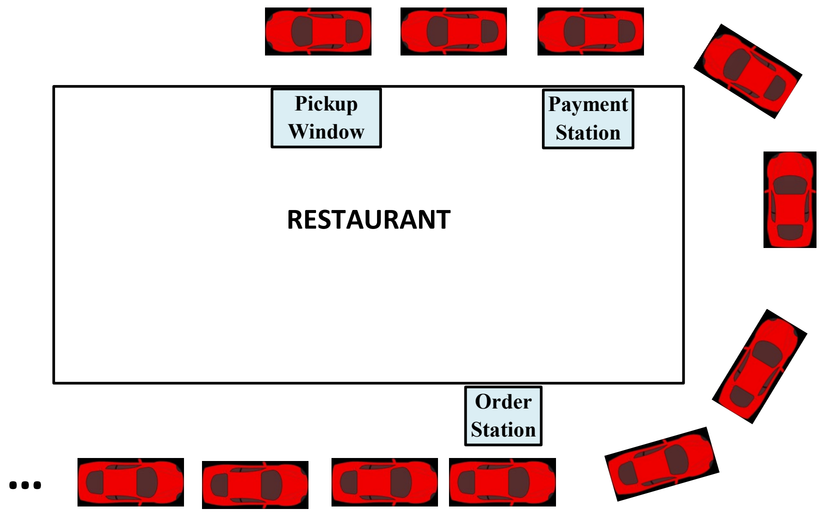
CS 4830/6830
Programming Project 1

For your first simulation project, you will design a simulation of a restaurant drive-thru facility using SimPy. The drive-thru consists of an order station payment window and a pickup window. There is a limited amount of space for cars in the overall drive-thru facility so the owner of the restaurant would like to optimize the throughput of cars to maximize profit during the lunch rush that occurs from 11 AM – 1 PM. The diagram shown above illustrates the



layout of the facility. There is space for one car at each station (order, payment, and pickup windows). There is space for 4 cars between the order and payment window, and there is space for one car between the payment and pickup window. There is also space for 7 cars (not shown in the diagram) waiting to reach the order window. Due to space limitations, if the number of cars waiting to reach the order station exceeds 7, no additional cars will join the line.

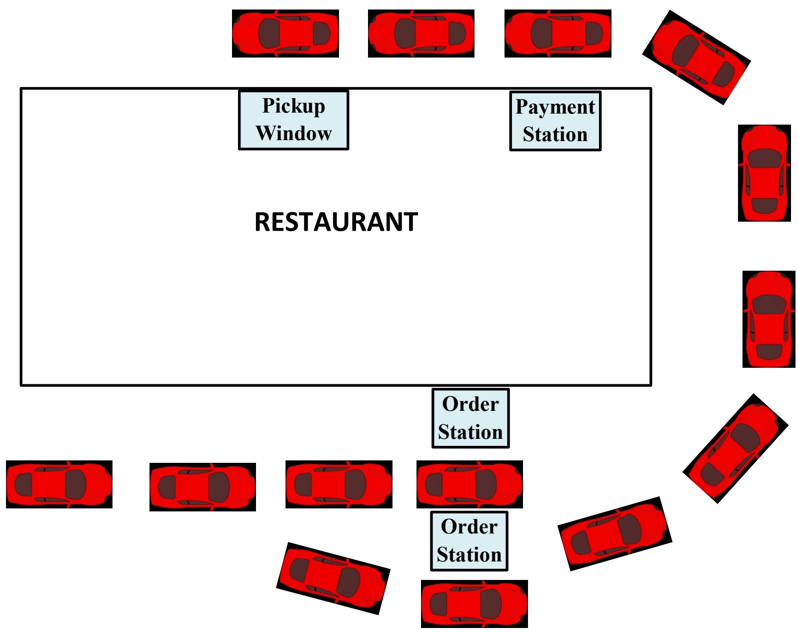
You may assume that a customer's arrival at the restaurant is described by an exponentially distributed random variable with a mean interarrival time of approximately AR minutes. The time to place an order is defined by a Weibull distributed random variable with a shape parameter of 1.5 and a mean (scale parameter) order time of 3 minutes per order. The time to pay for an order is determined by Weibull distribution with a mean of 2 minutes and a shape parameter of 1.5. The time to prepare a food order is also described by a Weibull distributed random variable with a mean preparation time of 6 minutes and a shape parameter of 2.0. The time to pick up an order is also determined by a Weibull distributed random variable with a mean of 2 minutes per order and a shape parameter of 1.5.

When a car arrives at the restaurant, the customer will decide if they want to enter the waiting line or leave immediately. If the order line has less than 7 cars waiting, the car will always join the line. Once a car enters an order line, they will wait to reach the order station, place their order, wait to reach the payment window, pay for their order, and finally wait to reach the pick-up window, pick up their food and exit the system. No customer ever leaves the line once they begin waiting.

Once a customer reaches the order station, they place their order. The time to place the order is determined by sampling a Weibull distributed random variable with a mean of 3 minutes. Once the customer completes his or her order, if there is space available, the car moves forward and the next car moves up and begins placing an order. Inside the restaurant as soon as an order is taken, food preparation begins. The time to complete the food preparation is determined by sampling a Weibull distributed random variable with a mean of 6 minutes. When a car reaches the payment window, the server processes the payment in a time determined by a Weibull distributed random variable with a mean of 2 minutes. At the end of this time, the customer waits to move forward to the pickup window. Once they reach the pickup window, it takes an amount of time determined by sampling a Weibull distributed random variable with a mean of 2 minutes to collect their order and leave the restaurant.

For this project, you will investigate two different service scenarios. The first scenario is described above. In the second scenario, an additional order station is added to the restaurant. We are still restricted to 7 cars waiting to order, but cars may select either order station. The time to process as order at either station is modeled by a Weibull distributed random variable with a mean of 3 minutes. Once a car places an order all processes described above remain the same.

Scenario 2



Once you develop your simulation you will need to conduct a simulation study to determine (1) what is the upper limit on mean interarrival time (AR) of customers that can be maintained in a steady-state without a significant number of customers exiting the system without service using scenario #1, and (2) what is the upper limit on mean interarrival time (AR) of customers that can be maintained in steady-state without a significant number of customers exiting the system without service under scenario #2.

When you have completed your simulation experiments, write a brief report (~3 pages) describing your experimental design, simulation results with your recommendations. Make sure to provide statistically significant results and suitable tables and/or plots to support your recommendations.

You have the option to work as a team of two on this project