SEN9110 Simulation Package: Assignment 1

Assignment to be carried out in your simulation package

A ferry takes care of the connection between mainland Canada and Broken Island. The island is a popular destination for tourists, most of which come by car. Some stay one day; some tourists stay multiple days. The ferry is extremely busy during the summer – on peak days more than 1000 cars are transported per day. Delays and long waiting times have become the norm rather than the exception. The management of 'Canadian Ferries' has therefore asked to carry out a simulation study to gain more insight into the problems.

The first step was to analyze the customer categories and their arrival patterns. One can distinguish between tourists, who spend one or more days on the island, employees who live on the mainland but work on the island, and employees who live on the island but have to go to the mainland for business. On peak days, the average number of cars per hour that arrive for the ferry, looks as follows:

Hour	*Average number of tourist cars / hour*		*Average number of employee cars / hr*	
	From mainland	*From island*	*From mainland*	*From island*
06:00-09:00	8	2	35	22
09:00-12:00	60	10	2	4
12:00-15:00	20	8	7	3
15:00-17:00	12	80	2	5
17:00-19:00	10	20	20	40
19:00-23:00	2	14	2	2

The ferry sails on the hour (xx:00) from the mainland to the island, and on the half hour (xx:30) back from the island to the mainland. The first departure is 07:00 from the mainland, and the last departure is 23:30 back to the mainland. It is possible that the ferry cannot make this schedule, because of long loading or unloading times during busy hours. As a result, it will start to run behind schedule. When it gets less busy, it will try to recuperate the lost time, until it runs on schedule again. Ferries never leave before the scheduled departure time. Sailing time is depending on wind, current, and other ships, and is usually 13 minutes; but always more than 10 and not more than 18 minutes.

Depending on the size of the cars, between 70 and 80 cars fit on the ferry. Usually, the ferry carries 75 cars.

On the mainland and the island, **3 lanes** (queues) are present for the waiting cars. The first lane is reserved for the employees, who all have a season ticket. They pass an automated booth, show their ticket, and the gate will open, after which they wait in their own lane. The second lane is for tourists who pre-paid. About 20% of the tourists pre-pay by phone and credit card, the other 80% still have to pay on the spot. The pre-pay customers have a separate (staffed) booth where their payment is checked, which takes 30 seconds on average, after which they can wait in their own lane (lane 2). The final 80% have to pay on the ferry terminal. Two staffed booths are available for payment, which usually takes 2 minutes, minimally 1, and maximally 4. Both booths are only staffed during peak hours (09:00-12:00 on the mainland and 15:00-17:00 on the island); at other times, only one booth is available. Those who have paid, wait in lane 3 for the ferry. The process is the same on the mainland and the island.

When the ferry arrives, all cars on the ferry have to leave first, before new cars can enter. Driving off the ferry takes about 5 seconds for each car; entering the ferry is a bit slower and takes on average 10 seconds for each car. Cars have to enter and leave the ferry one at a time. There are no differences between the processes on the island and on the mainland. The employees in lane 1 always have priority, no matter how long tourists already had to wait. When lane 1 is empty, the pre-paid customers in lane 2 can enter the ferry. Only when that lane is empty (and if there is still space left on the boat), the tourists in lane 3 can enter the boat. If the ferry is full, but it is still before the scheduled departure time, the ferry waits till the departure time. When tourists in lane 2 are entering the ferry, and an employee arrives in lane 1, the employee has to wait and is not allowed to enter the ferry, at least not until all other lanes have been handled. The same holds for pre-paid customers arriving in lane 2, while handling tourists from lane 3.

For the base model, it is not necessary to load customers who arrive late, e.g. between finishing the loading of the ferry from all three lanes and the scheduled departure time (this would be a repetition of the process scanning lane 1, 2 and then 3 for cars, until the scheduled departure time). If you are able to incorporate this into the first version of the model, indicate this clearly with a comment in your slides. it will be part of a later assignment, though.

Of course, pedestrians and cyclists can also use the ferry. As there is always room for these customers, and as they do not delay the sailing of the ship, they have been left out of the model.

Model the basic working of this system for a full day, without warmup time. Run 10 replications, and gather the average and maximum waiting times for different types of customers, as well as the queue length for these customers (average and 95% confidence interval), based on the 10 replications.

Animation is not yet necessary. Just create the basic model. When something is too difficult, simplify and implement what can be done. Make assumptions for missing information. Take note of what is easy and what is hard in the simulation language, and which parts you were able to model, and which parts not.

Deadline and requirements

Hand in a small slide pack (5-10 slides) describing how you built the model, and how you created the experiment. Provide the results of the simulation experiment as well. Describe what was easy and what was difficult, compared to simulation package(s) that you know. Hand in the model as well.

The slides and model have to be uploaded Friday at the end of week 3, latest Friday 18 September at 17:00 to "Simulation tool Assignment 1" in Brightspace. We will cover your results in week 4 in class.

Note

The goal is not to make the 'perfect' simulation model, but to learn about the plusses and minuses of the different simulation packages. So if something seems to be impossible in your tool, give it your best shot, but don't keep trying to implement it, but document in your slides that it is super hard or impossible, and explain the limitation clearly.