Tutorial

1BK20 – Business Process Simulation

A travel agency gives its customers the opportunity to book holidays by phone. Calls are received according to an exponential distribution of 4 calls per hour. Currently, there is one employee who handles the phone calls. Calls have a duration which is uniformly distributed between 10 and 15 minutes.

1. Make a SimPN model for the described process using basic Petri net concepts. Do not use prototypes. Simulate 1 hour. Use a SimpleReporter to check if the model behaves as you would expect.
2. Make a SimPN model for the described process using task, start\_event, and end\_event protoypes. Simulate 40 hours. Use an EventLogReporter to store the event log to disc. Use the process mining tool ‘Disco by Fluxicon’ to check if the model behaves as expected. Especially check if the average processing time and the number of cases that are produced are in line with what you would expect.
3. Generally, January is a busy month at the travel agency. During this period, phone calls arrive according to an exponential distribution of 7 calls per hour. To make sure the travel agency can handle all these calls, an extra employee will be appointed to answer the phone. Adapt your SimPN model to account for the new arrival rate and the extra employee using task, start\_event, and end\_event prototypes. Use a Visualization to check if the model behaves as you would expect.
4. Use the model from the previous exercise, but remove the Visualization.
   1. Use a WarmupTimeReporter to report on the warmup time of the model.
   2. Reset the simulator (using a checkpoint). Use two ProcessReporters, one with a warmup time of 20 hours and one without warmup time. Check the differences between the results from the ProcessReporters.
   3. Reset the simulator (using a checkpoint). Use 20 replications and a 20 hours warmup time to create a boxplot of the average waiting time of customers.
5. The travel agency divides its customers into two categories: customers that want to book a holiday within Europe and customers that want to book a holiday outside Europe. On average 70% of the customers wants to book a holiday within Europe. On average, it takes less time to book a holiday within Europe. Therefore, calls of customers that want to book a holiday within Europe have a duration which is uniformly distributed between 8 and 12 minutes. The duration of phone calls from customer that want to book a holiday outside Europe is still uniformly distributed between 10 and 15 minutes. Extend your model such that it divides the customers into these two categories. Use an EventLogReporter to export the results of the simulation to Disco. Use Disco to check the throughput times of the different types of customers. To detect the different types of customers in Disco, you need to distinguish the paths that the customers take. These paths are called variants in Disco. For example, you can distinguish the customers by completing them with different end-events.
6. Since there are two employees handling the phone calls, the manager decides that it would be logical to appoint all the phone calls for the holidays within Europe to one employee and the ones for holidays outside Europe to the other. Extend your model such that this division of customers per employee is included. Use Disco again to check the throughput time of both types of customers and compare the results with those from the previous exercise.
7. Consider the model from exercise 3. In case both employees are in a phone call, customers will be set in line and will have to wait until an employee is available. However, some customers do not have the patience to wait that long. When customers have waited for 5 minutes, there is a chance of 70% that they will hang up. Extend your model such that the patience of customers is included in your model. Use Disco to check your model.
8. A new phone system does not enable the travel agency to create a waiting queue when all employees are busy. Therefore, when new customers arrive and there are no employees available, they leave immediately. Extend your model to represent this. Use a Visualization to check your model.
9. Consider the model from exercise 3. The agency wants to test what the impact is on the average throughput time if they give customers the option to call them back after making them a booking offer. In this way, each time a customer’s call is received, the customers can be either “new”, if they have no pending offers (which happens 70% of the times) or “in handling”, i.e., they are associated to a pending offer and are calling to either reject it or accept it. At the end of call, a *new* customer either communicates the decision to accept or reject the offer immediately (probability of 40%) or decides to call back after some time to communicate the decision. Customers communicating their decision immediately accept the offer in 30% of the cases. If the customer has to call back, it becomes an "in handling" customer. On average 25% of the customers *in handling* accept the offer. The delay with which a customer calls back is uniformly distributed between 30 and 60 minutes. Extend the model from exercise 3 to represent this. **Hint:** model this by associating each customer with a dictionary that has a key ‘is\_new’ to indicate whether a customer is new or not. Initially the customer ‘is\_new: 1’. After its call has been answered, it can end the process with an ‘accept’ end event, a ‘reject’ end event, or back to waiting for a call to be answered but then with ‘is\_new: 0’.