Lesson 16. Global Variables in Arena

1 Overview

- Last time, we used Arena to simulate the following situation

Problem 1. Customers visit the neighborhood hair stylist Fantastic Dan for haircuts. The customer interarrival time is exponentially distributed with mean 9 minutes. Each haircut takes Fantastic Dan anywhere from 7 to 15 minutes, uniformly distributed. This time also includes the initial greetings and the transaction of money at the end of the haircut.

- Arena gave us information about the time average number of customers in each location (e.g. the queue)
- How about the time average number of customers in the shop?
- Today, we will use global variables to compute our own performance measures
- In Figure 1, we have a screenshot which displays the Basic Process palette, the Flowchart area, and the Spreadsheet area.

Figure 1: The Arena Windows
2 Defining global variables

- Let’s start with the model we constructed last time
- On the Basic Process palette, click the Variable icon.
- In the spreadsheet window, double-click to add a new row.
- Click on the “Variable 1” and change the variable name to “Number at shop”
- Click on the Initial Values cell and in the resulting spreadsheet click on the row with “0.0”. Change to “0” and hit return. Click the red X to make the change. The Initial Values cell should read “1 rows”.
- When does this variable change?
  - When customers arrive at the queue
    - Add in a Assign process.
    - Change the Name to “Increment Number at shop”.
    - Add an assignment that sets the “Number at shop” variable to “Number at shop + 1”.
    - Add another Assign process called “Decrement Number at shop” that reduces “Number at shop” by 1.
  - Delete and add appropriate connections so that the increment occurs after an arrival and a decrement occurs right before a departure.
- Run the simulation
  - Note what the average and maximum “Number at shop” is.
  - Remember you have to click on the “stop” button to get out of Run mode (which prevents editing of your model).

3 Play around with Arena

- How would you change your model so that:
  - Haircut times are exactly 10 minutes? Exponentially distributed with mean 12 minutes?
  - Customers interarrival times are uniformly distributed between 10 and 20 minutes? Triangularly distributed with minimum 6, maximum 12, and mode 10?\(^1\)
  - Fantastic Dan’s shop has 2 hair stylists? 5 hair stylists? Enough hair stylists to handle all customers at any time?

\(^1\)The pdf of a triangular random variable with minimum \(a\), maximum \(b\), and mode \(c\) is given by

\[
f(x) = \begin{cases} 
0 & \text{if } x < a \\
\frac{2(x-a)}{(b-a)(c-a)} & \text{if } a \leq x \leq c \\
\frac{2(b-x)}{(b-a)(b-c)} & \text{if } c < x \leq b \\
0 & \text{if } x > b 
\end{cases}
\]

The graph of the pdf \(f\) has a triangular shape, hence the name. The triangular distribution is often used when the minimum and maximum values of an outcome are known, as well as the most likely outcome (the mode).
• Run the simulation with an infinite number of hair stylists. Is the average number in the queue what you expect? Play around with the speed of the customers and the physical length of the queue.