

## Lesson 16. Global Variables in ProModel

### 1 Overview

- Last time, we used ProModel 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.

- ProModel 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

### 2 Defining global variables

- Let's start with the model we constructed last time
- Select Build → Variables (global)
- In the Variables (global) window, create a variable with ID “Number at shop”
- Click in the Layout window to create an icon for this variable
- Double-click on the icon to change its properties
- When does this variable change?
  - When customers arrive at the queue
    - ◇ Select Build → Arrivals
    - ◇ Change the Logic of the customer arrivals using the INC function
  - When customers exit the system
    - ◇ Select Build → Processing
    - ◇ Change the Operation of the “Customer” entity at the “Dan” location using the DEC function
- Run the simulation
  - Select Charts → Time Plots
  - Note that “Number at shop” is listed as a variable under Items in the left pane

### 3 Play around with ProModel

- 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?<sup>1</sup>
  - Fantastic Dan's shop has 2 hair stylists? 5 hair stylists? Enough hair stylists to handle all customers at any time?
- 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.

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<sup>1</sup>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).