

## Lesson 15. Introduction to ProModel

### 1 Overview

- Performing complex simulations via Excel is difficult
- We will transition to **ProModel**, a software package designed specifically for discrete-event simulation
- Let's use ProModel to tackle the following problem

**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.

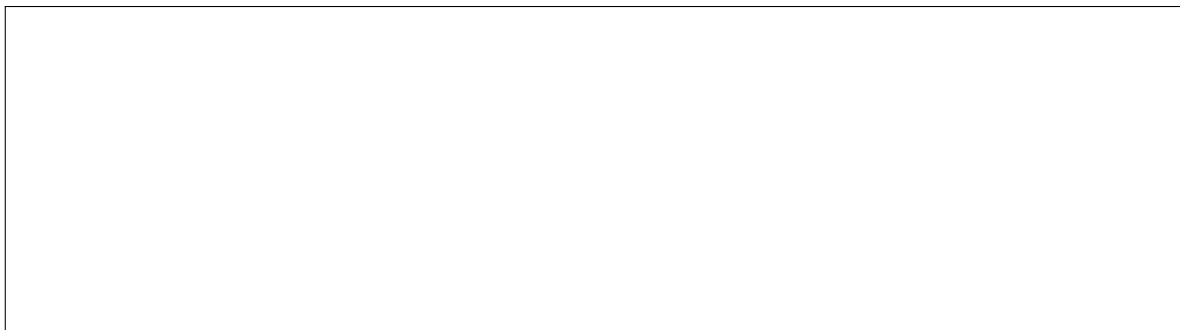
- a. Simulate 1 day of Dan's operations. Assume Dan works continuously for 8 hours a day.
- b. About how many customers does Dan process per day?
- c. What is the average number of customers waiting to get a haircut? What is the maximum?
- d. What is the average time spent by a customer in the shop? What is the maximum?

### 2 Preliminaries

- You can purchase a student version of ProModel for \$30 from <http://promodel.com/academic/>
- ProModel documentation: <http://www.promodel.com/onlinehelp/ProModel/80/>
- Select Tools → Options and change the locations of the default folders to the ProModel folders in your Documents folder, if necessary

### 3 Building our first ProModel model



- Start with a flow diagram of the model



- Basic model elements
  - **Locations:** fixed place in the system where something happens
  - **Entities:** anything that can be processed (e.g. customers)
  - **Arrivals:** how entities enter the system
  - **Processing:** operations that take place at a location, routing of entities between locations

- Select File → New to start a new model
  - Give your model a title (e.g. “Fantastic Dan - Lesson 15”)
  - Change default time units and distance units if desired

### 3.1 Locations

- Select Build → Locations
- Define a location for the queue
  - Again, make sure the New checkbox in the Graphics window is checked
  - Click the  button in the Graphics window
  - Click and drag in the Layout window to form the path of the queue, and double-click when finished
  - Double-click the queue and click the Queue radio button in the Conveyor/Queue dialog
  - Change the name to “Queue” in the Locations window
  - Keep the default capacity  $+\infty$
  - Uncheck the New checkbox in the Graphics window
  - Click the  button in the Graphics window
  - Click the queue in the Layout window and move the resulting label to an appropriate place
- Define a location for Dan
  - Again, make sure the New checkbox in the Graphics window is checked
  - Select an icon to represent Dan
  - Click in the Layout window, move and resize as desired
  - Change the name to “Dan” in the Locations window
  - Keep the default capacity 1
  - Create a label for Dan in the same way we did for the queue



### 3.2 Entities

- Select Build → Entities
- Define an entity for a generic customer
  - Select an icon in the Graphics window to represent a customer
  - Change the name to “Customer” in the Entities window
  - Modify the icon as desired (make sure the New checkbox in the Graphics window is unchecked)

### 3.3 Arrivals

- Select Build → Arrivals
- Define the arrival process for customers
  - Select “Customer” in the Tools window
  - Click on the queue in the Layout window
  - In the Arrivals window, make the first arrival time (First Time) blank
    - ◊ We want the first arrival time to follow the interarrival time distribution
  - Also in the Arrivals window, change the interarrival time (Frequency) to an exponential distribution with mean 9
    - ◊ Right-click in the corresponding cell to open the Logic Builder
    - ◊ Click on Distribution Functions in the Logic Elements list
    - ◊ Click on Exponential in the Distribution Functions list
    - ◊ Enter the mean (9) and the **stream** (1)
- Completely independent model functions should get their own stream numbers

### 3.4 Processing

- Select Build → Processing
- Process customers at the queue: route from the queue to Dan
  - Make sure the New Process button is active in the Tools window
  - Click on the queue, drag to Dan and click again
- Process customers at Dan: get service, then exit the system
  - Again, make sure New Process is active in the Tools window
  - Click on Dan, and then click on the Route to Exit button in the Tools window
  - In the Process window, define the service time by clicking on the Operation... button
    - ◊ In the Operation window, click the  button to open the Logic Builder
    - ◊ Select the WAIT statement, click the Time button, and enter a Uniform distribution function with mean 11, half-range 4, and stream 2
    - ◊ Click Paste to put the expression into the Operation window
    - ◊ It's a good idea to click the  button to make sure the expression works

#### 4 Running the model and obtaining performance measures

- Set the simulation to run for 8 hours
  - Select Simulation → Options
  - Set Run Time to 8
  - Click OK
  - Select Simulation → Save & Run
- You can adjust the speed of the simulation with the slider at the top of the simulation window
- When asked “Do you want to see the results?”, click Yes
- Some points of interest in the Output Viewer
  - Charts → Tables → Entity Summary
    - ◇ How many customers does Dan process per day?
  - Charts → Tables → Location Summary
    - ◇ What is the average/maximum number of customers waiting?
  - Charts → Time Plot
    - ◇ Set Grouping to None