

Lesson 28. Model Testing and Output Data Analysis

1 Testing your model

- **Model verification:** ensure the model behaves as you intended
 - Use the trace of the model to make sure events occur as intended
 - Make sure at the statistical output of the model matches with what you expect
 - ◊ e.g. if the average service time has a known value, the simulated service times should have approximately the same average
 - Make sure throughput values make sense (e.g. number of entities entering and exiting the system)
- **Model validation:** ensure the model behaves similarly to the actual system
 - Not a clear-cut, well-defined procedure
 - The degree of fidelity must be sufficient for your study
 - Usually requires comparison of model output with data from the system
 - ◊ e.g. Are the simulated costs of operating the shop for 1 day according your model close to the actual cost of operating the shop for 1 day?
- **Model stability testing:** ensure the long-term behavior of the model reaches steady-state, if the actual system is stable
 - Run model for increasing lengths of time and observe performance measures
- **Value ranging:** sensitivity analysis on the input parameters of your model
 - Run model for different values of an input parameter and observe performance measures
 - ◊ e.g. run the model for different numbers of servers, means of service time distribution, etc.
 - If your model is not that sensitive to a particular input parameter, you can worry less about the accuracy of that input

Example 1. Customers visit Fantastic Dan's barber shop for haircuts. Dan works with another barber, Bob. The customer interarrival time is exponentially distributed with mean 9 minutes. Each haircut takes Dan and Bob 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. The barber shop is open for 8 hours.

- The ProModel file for today's lesson contains a model for Fantastic Dan's problem
- Don't look at how the simulation is built, just run 50 replications of the simulation
- Does the output of the model look OK to you?

2 Comparing alternate systems

- How do you know if the performance measure of two alternate systems is actually different?

Example 2. Dan is concerned with the average time a customer spends in the shop, and is considering adding another barber, Mike, who can cut with the same speed as Dan and Bob. Should he do it?

- Run 50 replications of the simulation with 2 barbers
- Copy the average time a customer spends in the shop for these replications in Excel
- Repeat this for 3 barbers
- Compute mean and standard deviation
- Is the performance gain with 3 barbers significant?
- Before moving on, some Excel setup: make sure the Data Analysis add-in is activated
- We can statistically determine this with an independent two-sample t -test
 - First, perform an F -test for the equality of two variances to determine whether the samples have equal variance
 - ◊ H_0 : sample populations have equal variances
 - Perform the appropriate two-sample t -test (assuming equal/unequal variances)
 - ◊ H_0 : average time in shop with 2 barbers = average time in shop with 3 barbers
 - ◊ For this null hypothesis, use two-tailed test
- What do you conclude?