

Simulation Software

Chapter 3

3.1 Introduction

- Many features common to most simulation programs
- Special-purpose simulation packages incorporate these common features
- Packages discussed in this chapter
 - Arena
 - ExtendSim
 - Simio

3.2 Comparing Simulation Packages with Programming Languages

- Advantages of using a simulation package
 - Many of the needed features have been incorporated, reducing programming time
 - Easier to modify and maintain system models
 - Better, automatic error detection
- Advantages of using a general purpose programming language
 - Most modelers already know a programming language

Comparing Simulation Packages with Programming Languages

- Advantages of using a general purpose programming language (cont'd.)
 - Generally faster execution time
 - Greater programming flexibility
 - Object-oriented languages considered better by many analysts and programmers
 - Simulation packages not truly object-oriented
 - Software cost generally lower

3.3 Classification of Simulation Software

- General-purpose simulation package
 - Can be used for any application
- Application-oriented simulation package
 - Designed for a certain class of applications
 - Examples: manufacturing, health care, telecommunications

Classification of Simulation Software

- Process
 - Time-ordered sequence of interrelated events, separated by intervals of time
- Most packages use process approach to simulation modeling
 - Process routine explicitly contains the passage of simulated time
 - Multiple entry points

Process Approach Example

- Entry points
 - 1: Arrival event
 - 5,9: Departure event

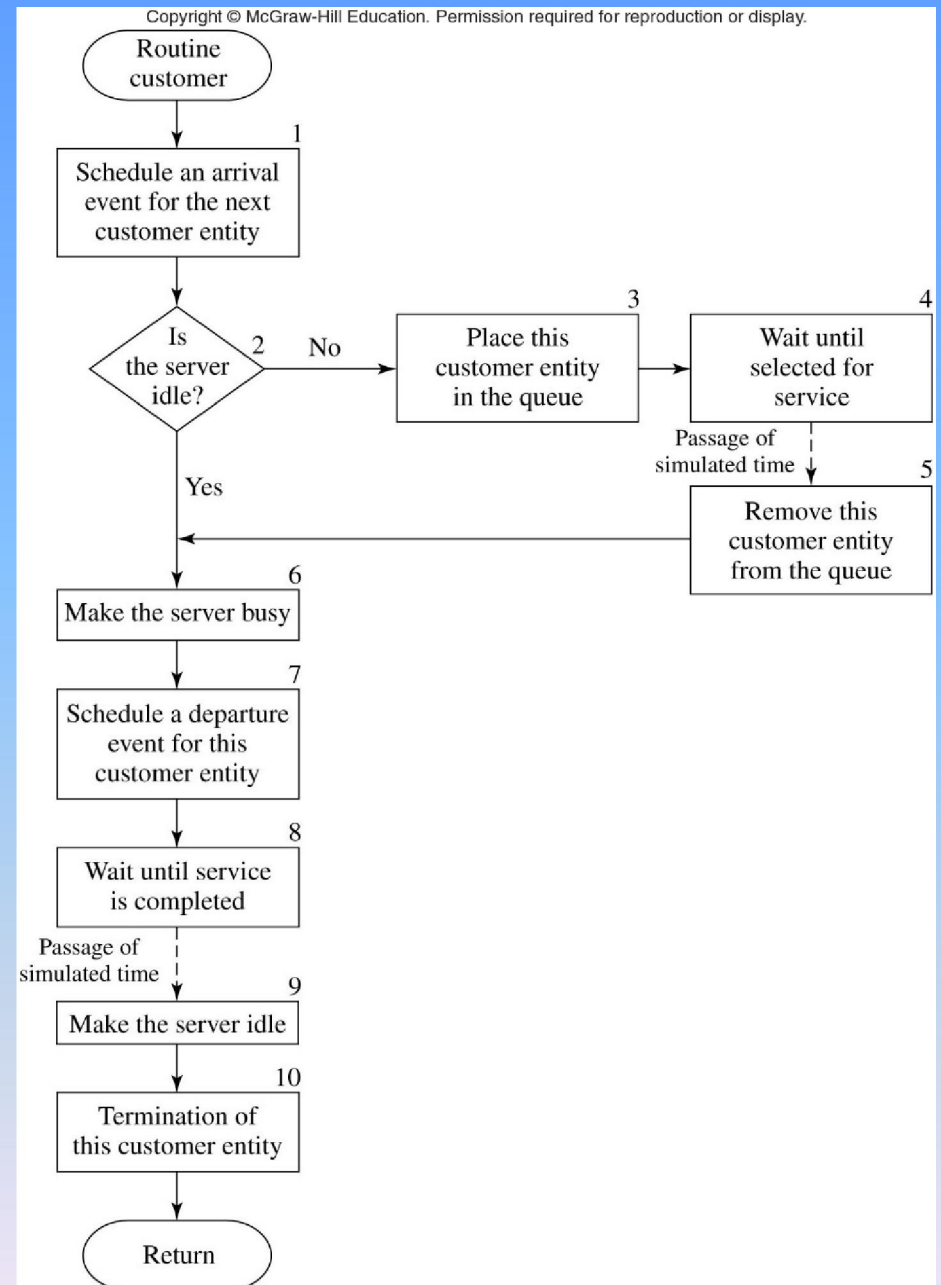


Figure 3.2 Prototype customer-process routine for a single-server queuing system

Classification of Simulation Software

- Common modeling elements
 - Entity
 - Created, moves through the system, and then usually destroyed
 - Attributes
 - Pieces of information stored within the entity
 - Resources
 - Entity requests their use while moving through the system
 - Queues

3.4 Desirable Software Features

- Feature groups
 - General capabilities
 - Hardware and software considerations
 - Animation
 - Statistical features
 - Customer support and documentation
 - Output reports and plots

Desirable Software Features

- General capabilities
 - Modeling flexibility, including the ability to:
 - Define and change attributes for entities and global variables, and use both in decision logic
 - Use mathematical expressions and functions
 - Create new modeling constructs and modify existing ones
 - Ease of use
 - Hierarchy
 - Good debugging aids

Desirable Software Features

- General capabilities (cont'd.)
 - Ability to import/export data
 - Fast execution speeds
 - Cost module
 - Ability to initialize to nonempty and idle state
 - Ability to save simulation states after run
 - Cost of software package

Desirable Software Features

- Animation and dynamic graphics
 - Icons change position, color, and/or shape
 - Helps communicate details to nontechnical people
 - Useful in debugging and training
 - Ability to create high resolution icons and save for later use

Desirable Software Features

- Statistical capabilities
 - Random number generator should have at least 100 different streams
 - Each source of randomness should be represented by a probability distribution
 - Statistically sound method for constructing a confidence interval for the mean
 - Statistical experimental designs
 - Optimization capability

Desirable Software Features

- Customer support and documentation
 - Documented well enough to allow use without taking a training class
- Output reports and graphics
 - Standard and customized reports
 - Histograms
 - Time plots
 - Correlation plots

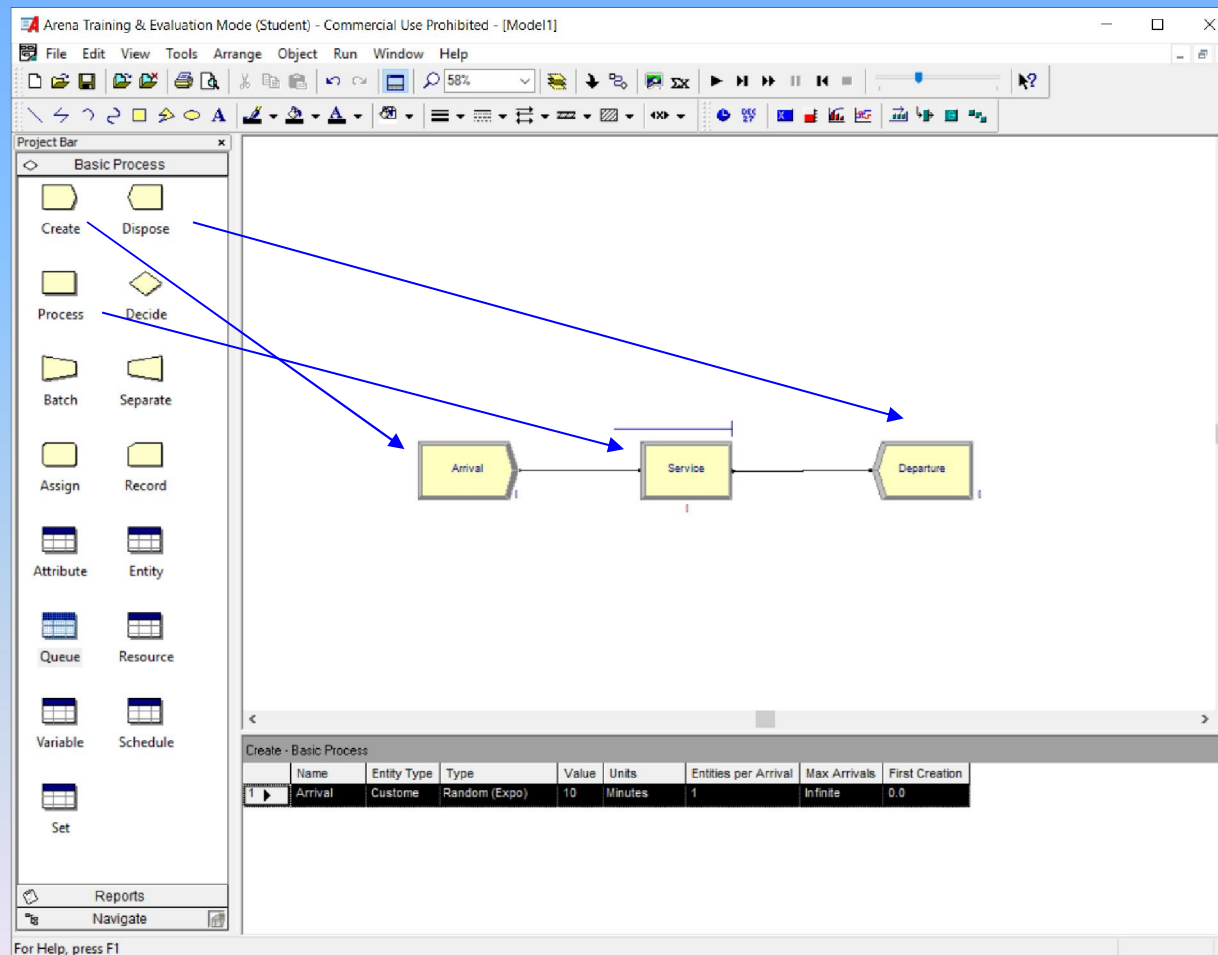
3.5 General-Purpose Simulation Packages

- Arena by Rockwell Automation
 - Standard and Professional Editions available
 - Modules arranged into a number of templates
 - Examples of templates: basic process, advanced process, advanced transfer, and flow process
 - Virtual designer used to create concurrent 3-D animations

General-Purpose Simulation Packages

- Arena features
 - Unlimited number of random number streams
 - Twelve standard theoretical probability distributions and empirical distributions
 - Includes activity-based costing
 - Microsoft VBA and complete ActiveX object model are available

Arena Example – Project View



Arena Example - Arrival

Create

Name: Arrival Entity Type: Customer

Time Between Arrivals

Type: Random (Expo) Value: 10 Units: Minutes

Entities per Arrival: 1 Max Arrivals: Infinite First Creation: 0.0

OK Cancel Help

Arena Example - Service

Process

Name: Service Type: Standard

Logic

Action: Seize Delay Release Priority: Medium(2)

Resources:

Resource, Server, 1
<End of list>

Add... Edit... Delete

Delay Type: Expression Units: Minutes Allocation: Wait

Expression: EXP0(6)

☒ Report Statistics

OK Cancel Help

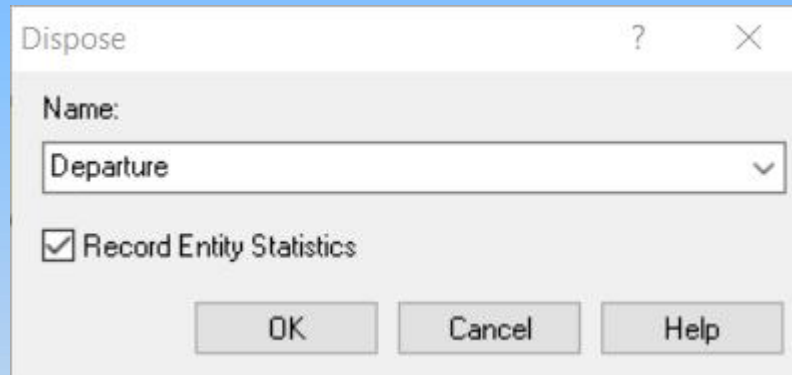
Resources

Type: Resource

Resource Name: Server Quantity: 1

OK Cancel Help

Arena Example - Departure



The image shows a screenshot of a 'Dispose' dialog box from the Arena simulation software. The dialog box has a title bar with the text 'Dispose' and standard window controls (minimize, maximize, close). Inside the dialog, there is a label 'Name:' followed by a dropdown menu that currently displays 'Departure'. Below the dropdown, there is a checked checkbox labeled 'Record Entity Statistics'. At the bottom of the dialog, there are three buttons: 'OK', 'Cancel', and 'Help'.

Arena Example

- Run Setup

Run Setup

Run Speed Run Control Reports Project Parameters

Replication Parameters Array Sizes Arena Visual Designer

Number of Replications:
1

Initialize Between Replications
☒ Statistics ☒ System

Start Date and Time:
☐ Thursday , September 15, 2016 11:29:23 AM

Warm-up Period:
0.0

Time Units:
Hours

Replication Length:
200

Time Units:
Minutes

Hours Per Day:
24

Base Time Units:
Minutes

Terminating Condition:

OK Cancel Apply Help

Arena Example - Report

Arena Training & Evaluation Mode (Student) - Commercial Use Prohibited - [Model1 - Category Overview]

File Edit View Tools Arrange Object Run Window Help

58%

Project Bar

Basic Process

Create Dispose

Process Decide

Batch Separate

Assign Record

Attribute Entity

Queue Resource

Variable Schedule

Set

Reports

Navigate

Preview

Unnamed Project

Entity

Time

VA Time

NVA Time

Wait Time

Customer

Transfer Time

Other Time

Total Time

Other

Queue

Resource

Time

VA Time

	Average	Half Width	Minimum Value	Maximum Value
Customer	0.00	(Insufficient)	0.00	0.00

NVA Time

	Average	Half Width	Minimum Value	Maximum Value
Customer	0.00	(Insufficient)	0.00	0.00

Wait Time

	Average	Half Width	Minimum Value	Maximum Value
Customer	9.6973	(Insufficient)	0.3610	33.0670

Transfer Time

	Average	Half Width	Minimum Value	Maximum Value
Customer	0.00	(Insufficient)	0.00	0.00

Other Time

	Average	Half Width	Minimum Value	Maximum Value
Customer	0.00	(Insufficient)	0.00	0.00

Total Time

	Average	Half Width	Minimum Value	Maximum Value
Customer	9.6973	(Insufficient)	0.3610	33.0670

Other

Number In

	Value
Customer	17.0000

Number Out

	Value
Customer	14.0000