A Gentle Introduction to an Idiot's Guide to SAS Simulation Studio 14.1 for Dummies

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JACK B NIMBLE SIMULATES JUMPING OVER A CANDLESTICK.
CARTOONSTOCK .com
Search ID: jcon4655

What is SAS Simulation Studio?

From the SAS documentation, Simulation Studio is:

- A graphical user interface that requires no programming and provides all the tools for building, executing, and analyzing discrete-event simulation
- A programmatic interface enables you to run models in batch mode

Interacts seamlessly with both SAS and JMP

Enables you to investigate the effects of different parameters on your model output, and gives you a place to record results

Why would I want to use Simulation Studio?

Have you ever wondered about scenarios similar to:

- The effect of hiring an additional cashier on customer wait times?
- Which floor layout for your factory / warehouse would be most efficient?
- Test the effects of moving to a different scheduling model for nurses on your inpatient unit?

If the answer is yes, then Simulation Studio is for you!

What is Discrete-event simulation?

Discrete-event simulation refers to the modeling of a system as it changes over time, where the state of the model only changes at countable points in time, called **events**

- Objects that move within a simulation model are called entities, and they can have properties or **attributes**
- Fundamental modeling objects include Entities, Data Values, Blocks, Ports and Links
- Resources are an essential part of most models since they control / restrict the flow of entities
  - May be unlimited or limited; governed by a schedule or random failure
  - Modeled as special types of hierarchical entities that can be seized and released by other entities to fulfill resource demands
- Experiments are used to control the initialization and running of a model

More on modelling

- A computer model of a system is used to numerically generate data that can be used to better understand the system
- Two types of Modelling techniques:
  - Physical
  - Logical / Mathematical (our focus)
- Logical Modelling Techniques:
  - **Analytical Models:** For some systems, traditional mathematical techniques such as queuing theory, differential equations, and linear programming can be used to get “exact” answers.
  - **Simulation Models:** Appropriate for systems that have randomness and a general level of complexity that makes it difficult to derive an analytical model.

E Lada, Personal Communication, 12/2015

Modelling cont'd

- Static versus dynamic – Does time play a role?
- Deterministic versus stochastic – Is there uncertainty or randomness?
- Continuous versus discrete – Can the state of the system change continuously or only at discrete points in time?

Discrete-event simulation refers to the modelling of a system as it changes over time, where the state of the model only changes at countable points in time, called **events**.

- Since stochastic inputs cause stochastic outputs, the following are important parts of the DES modelling process:
  - Selecting appropriate input probability distributions
  - Replicating the experiment
  - Selecting an appropriate output analysis method

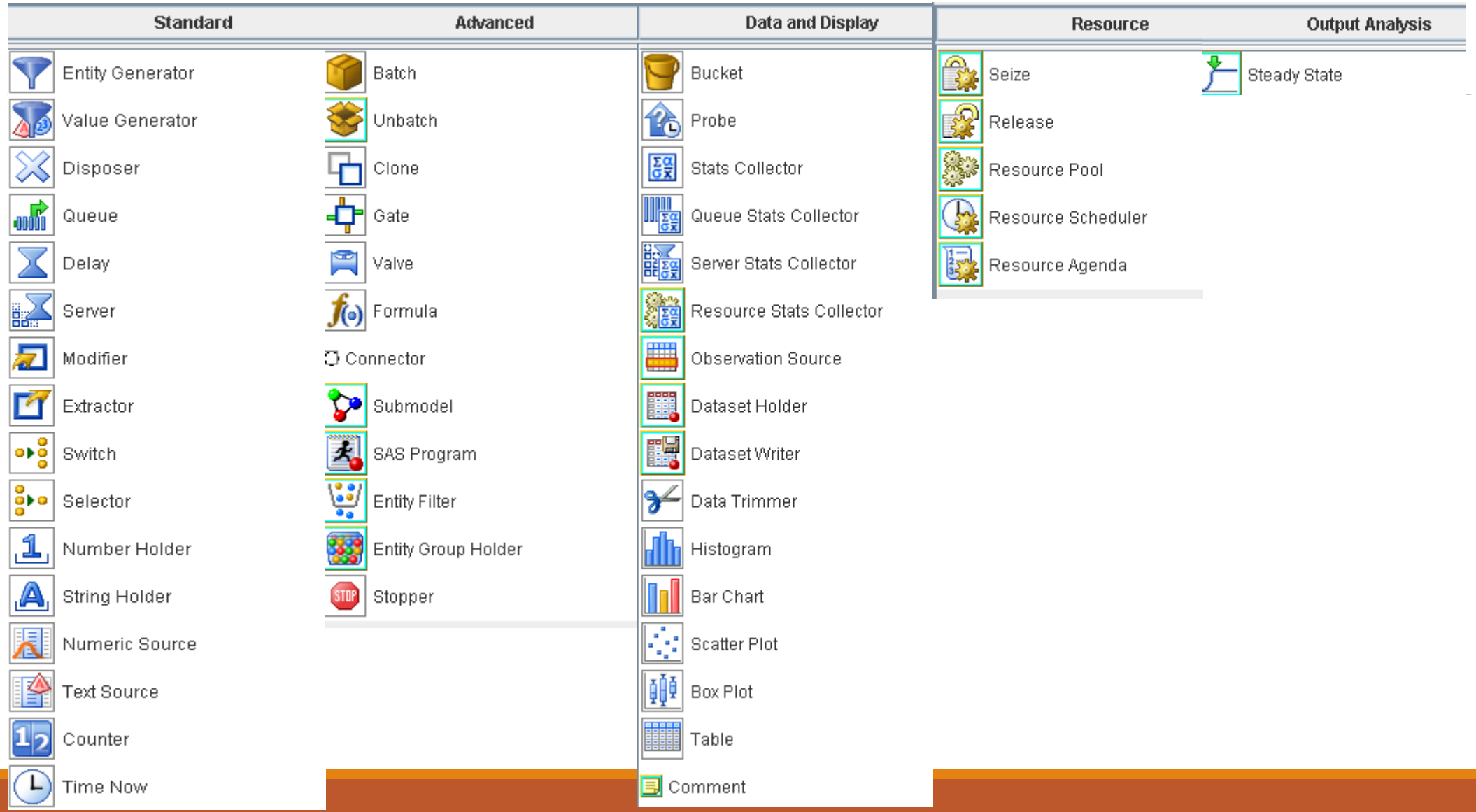
Different types of Models

Model Name	# of "Servers"	Arrivals Determined by	Service Times
M/M/1	1	Poisson process	Exponential distribution
D/M/1	1	Fixed Intervals	Random with Exponential distribtuion
M/D/1	1	Poisson process	Fixed
M/D/c	*c*	Poisson process	Fixed
M/M/c	*c*	Poisson process, single queue	

Other models include M/G/1, M/M/∞, M/G/k, G/M/1, G/G/1

Information compiled from Wikipedia, accessed December 4th 2015

SAS Simulation Studio - Terms used



Some definitions

Entity Generator – Can control when the entities are created, total number of entities, and how many are created simultaneously.

Disposer Block – Disposes of entities after they are no longer needed in the model. Routing entities no longer needed should be routed through a Disposer to reduce memory usage.

Modifier Block – Assigns attributes to an entity as it passes through. Attributes include Name, Type and Default Value.

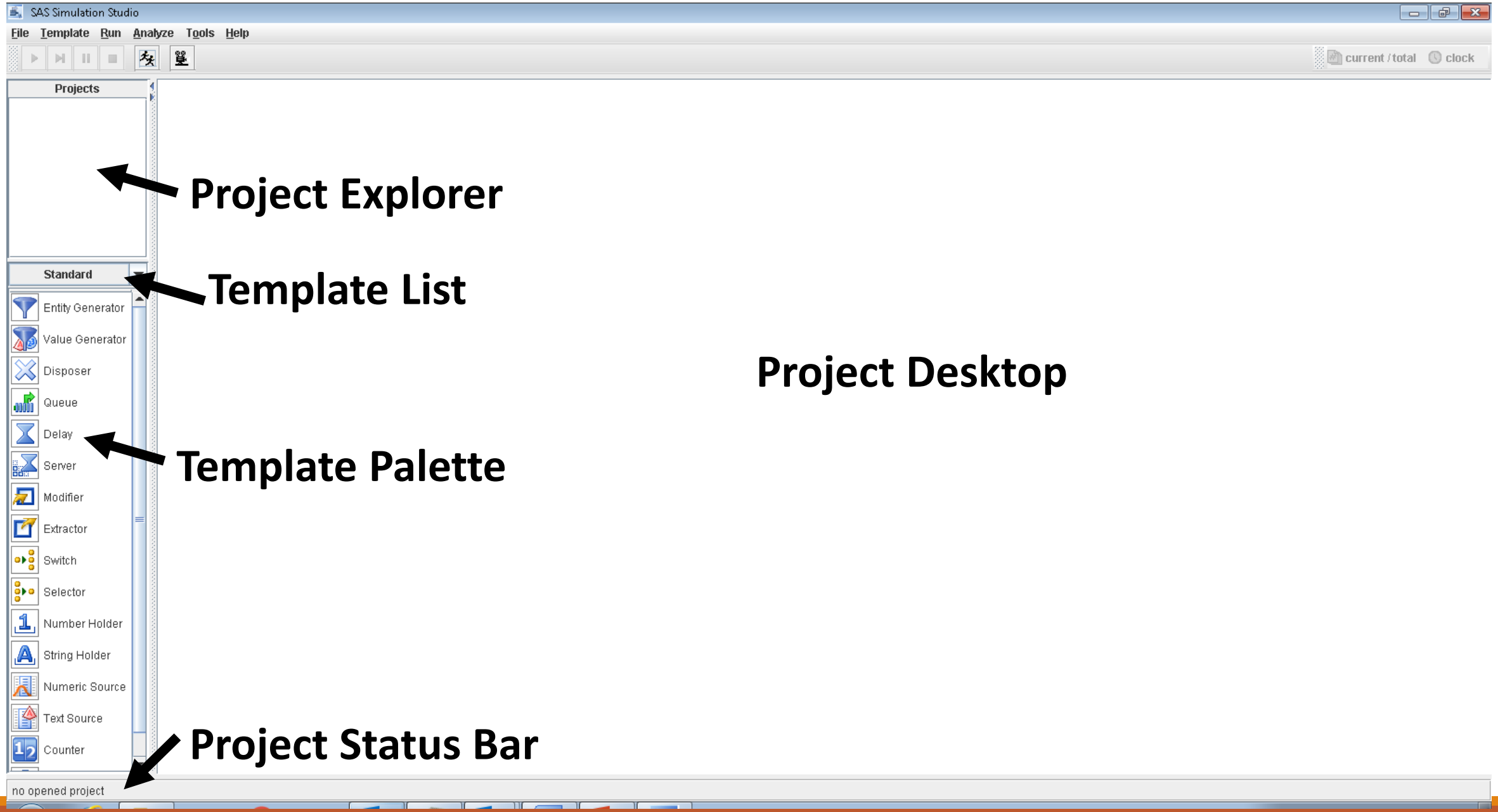
Queue Block – Used for the transient storage of entities. Three different types of queue policies are available: First in First Out, Last in First Out, and Priority.

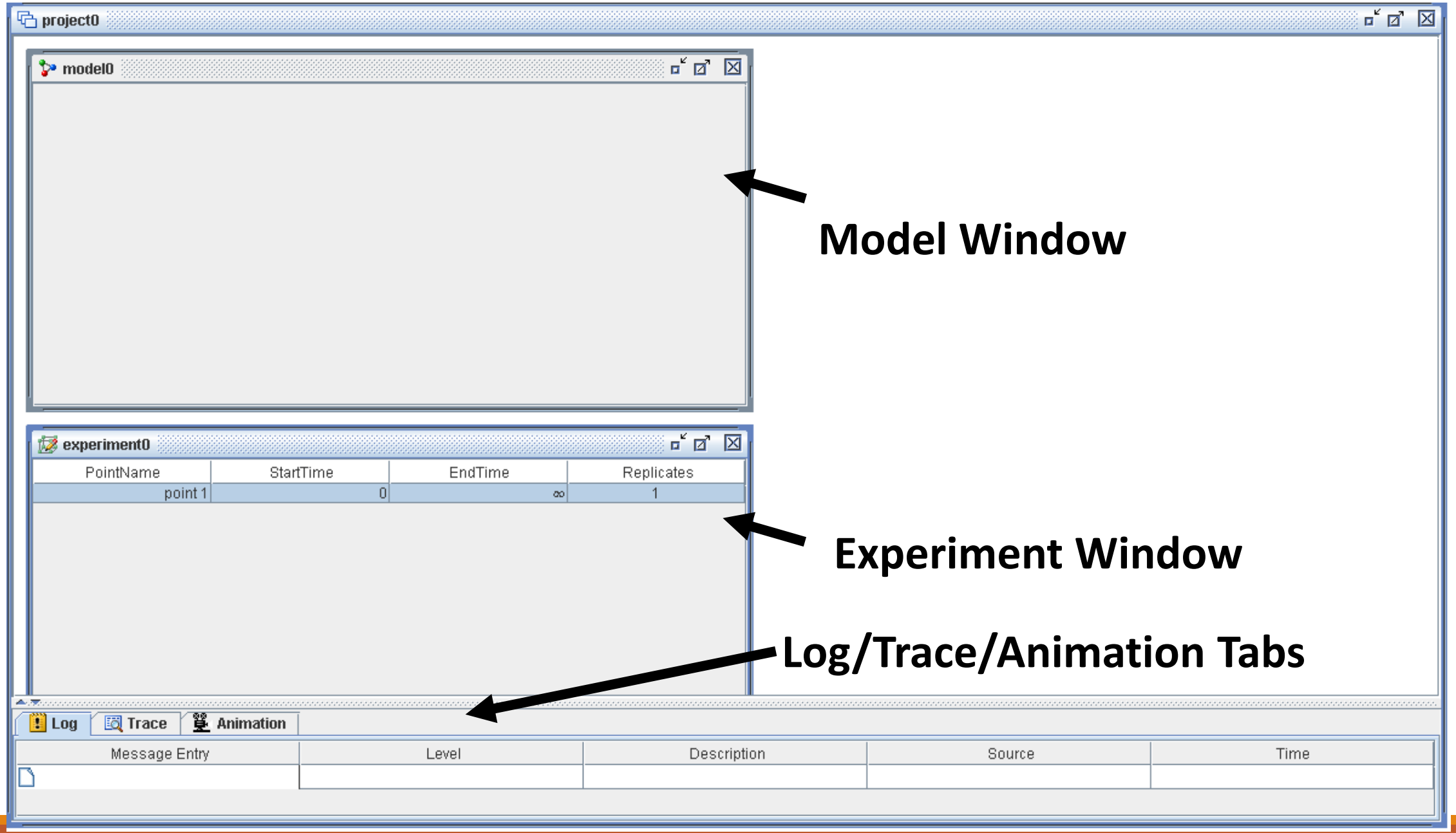
Switch Block – Directs the flow of an entity through the model, directing or re-directing as indicated in the model.

Batch Block – Groups entities so they flow together through a simulation model. Entities arrive individually until it reaches the pre-specified number of entities, and then all entities are released into the model simultaneously.

Formula Block – Evaluates an expression based on state or model information. Variables can be created to be used in the expression, and formulated into an expression that is evaluated every time a value is pulled from the Formula block's OutValue Port.

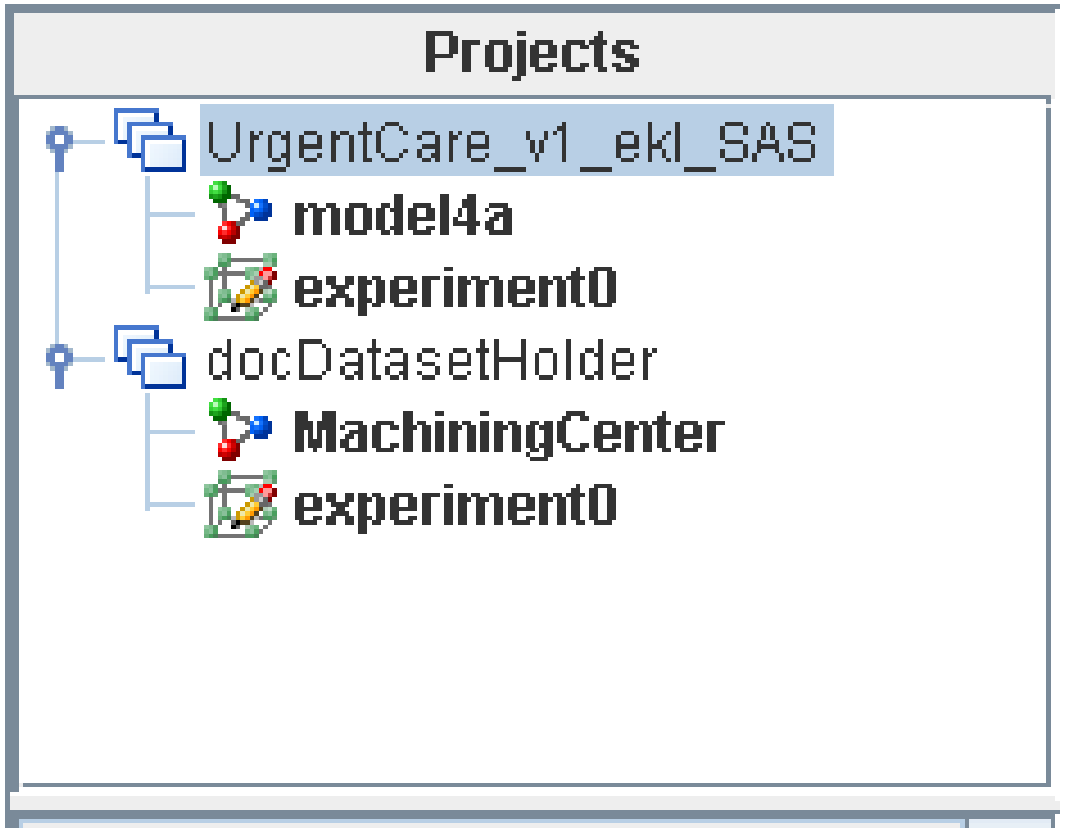
In / Out Value Port – How the entities flow through the various blocks in the model.


SAS Simulation Studio
File Template Run Analyze Tools Help
current / total clock
Projects
Standard
Entity Generator
Value Generator
Disposer
Queue
Delay
Server
Modifier
Extractor
Switch
Selector
Number Holder
String Holder
Numeric Source
Text Source
Counter
no opened project
Project Explorer
Template List
Template Palette
Project Status Bar
Project Desktop


project0
model0
experiment0
PointName
StartTime
EndTime
Replicates
point 1
0
∞
1
Log
Trace
Animation
Message Entry
Level
Description
Source
Time
Model Window
Experiment Window
Log/Trace/Animation Tabs

Project Window

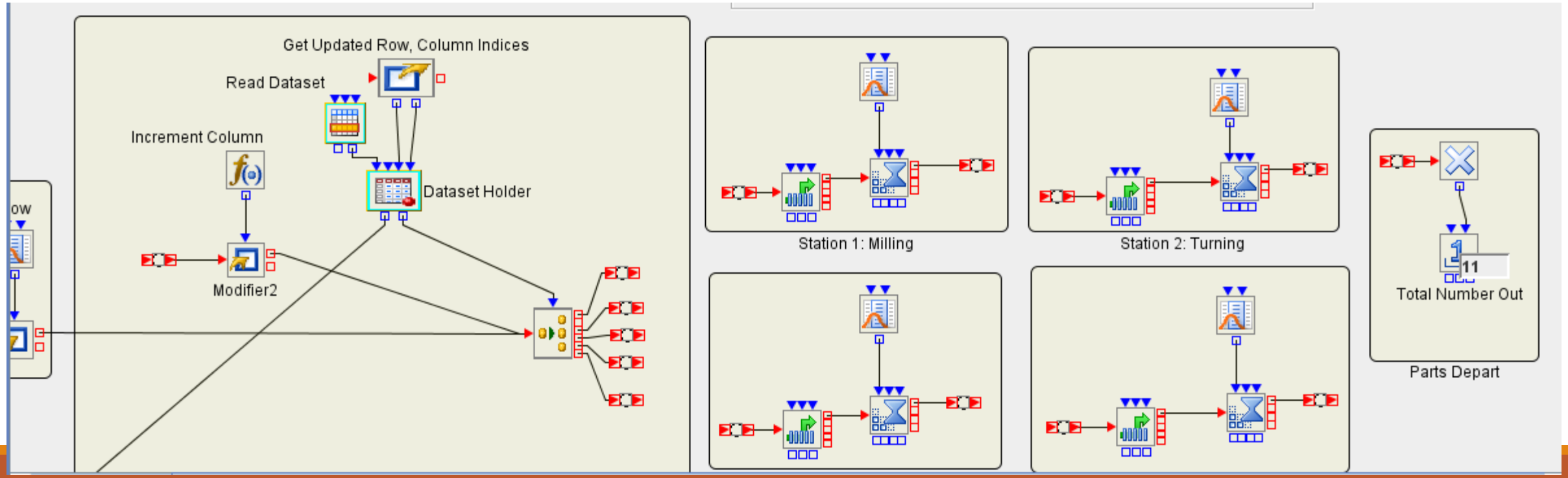
Each project loaded into Simulation Studio has a Project Window associated with it



Model Window

This window is used to graphically construct and display a simulation model.

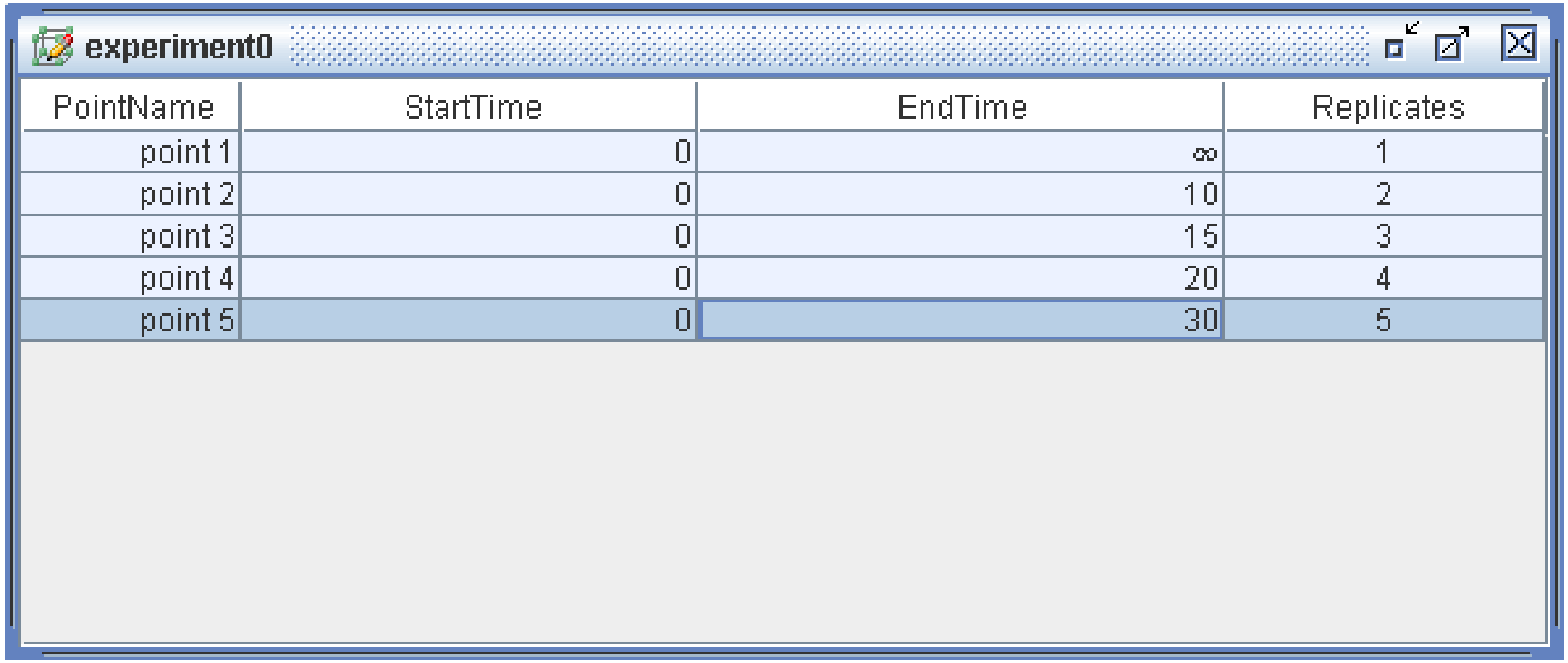
Like Enterprise Guide, blocks are dragged from the Template screen and connected by creating links between ports on the various blocks.



Experiment Window

The Experiment Window is used to control the set-up and running of the model.

Contains columns for controlling the Start and End times, along with number of times to Repeat the run.



PointName	StartTime	EndTime	Replicates
point 1	0	∞	1
point 2	0	10	2
point 3	0	15	3
point 4	0	20	4
point 5	0	30	5

Log, Trace and Animation Tabs

Log Tab – Displays messages from currently running or the most recently run model. Messages include Severity, Source, and the Simulation Time of the message.

Trace Tab – After the Trace Tab is enabled, trace messages are generated by individual blocks during the execution of a model and are intended to provide details about events and execution flow within the blocks.

Animation Tab – Provides options for controlling the simulation animation as a model runs. You can enable animation for different regions of the model, as well as adjust the animation speed, start time, and end time for each selected region.

Example – Urgent Care Center at a Hospital (A lot of Simulation Studio, no math)

Assumptions of the Simulation

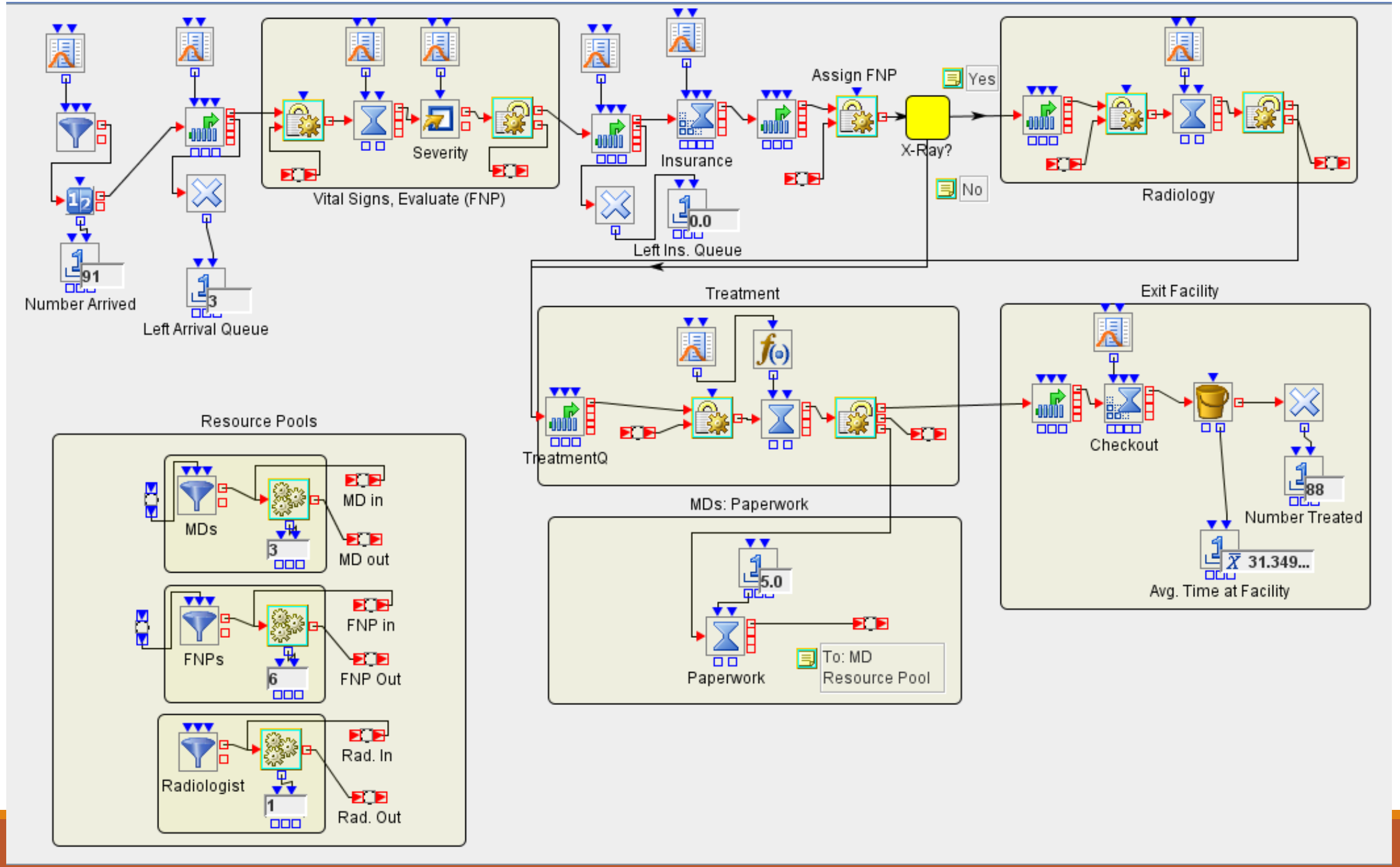
One radiologist, 4 clerical staff (one for checkout, three for insurance checks)

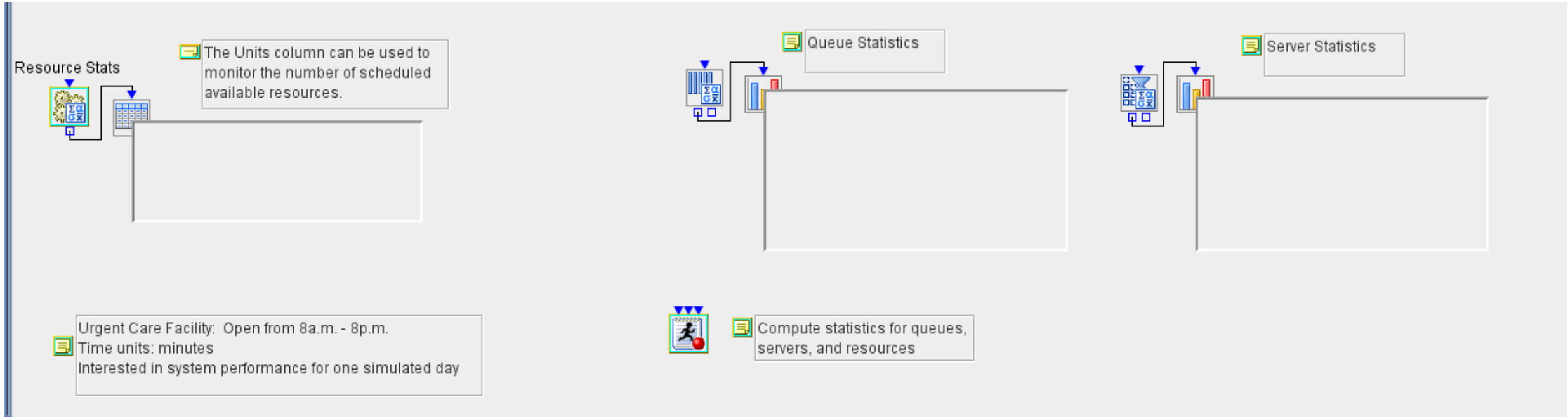
Radiologist gets 2 15-minute breaks and a 30-minute break based on a fixed schedule

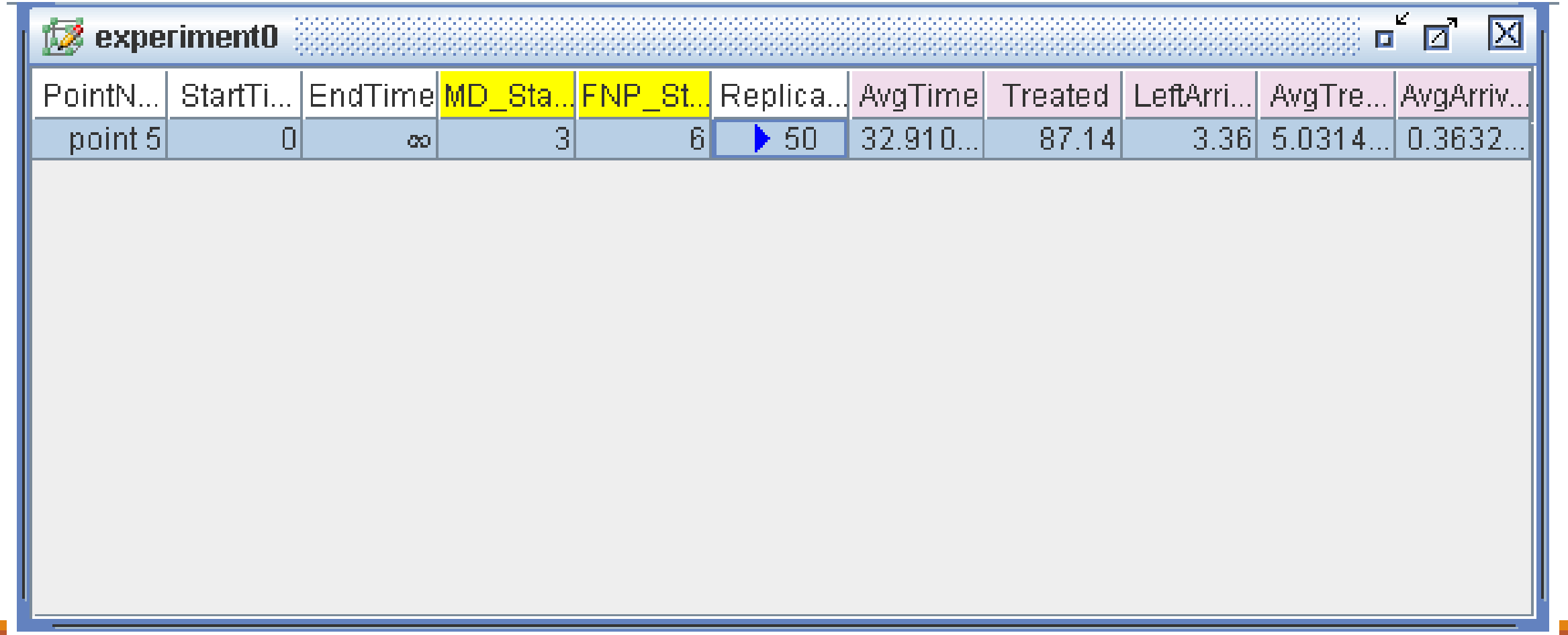
The nurses are on the same break schedule but 1/3 of them are on break at a time, and they rotate in succession

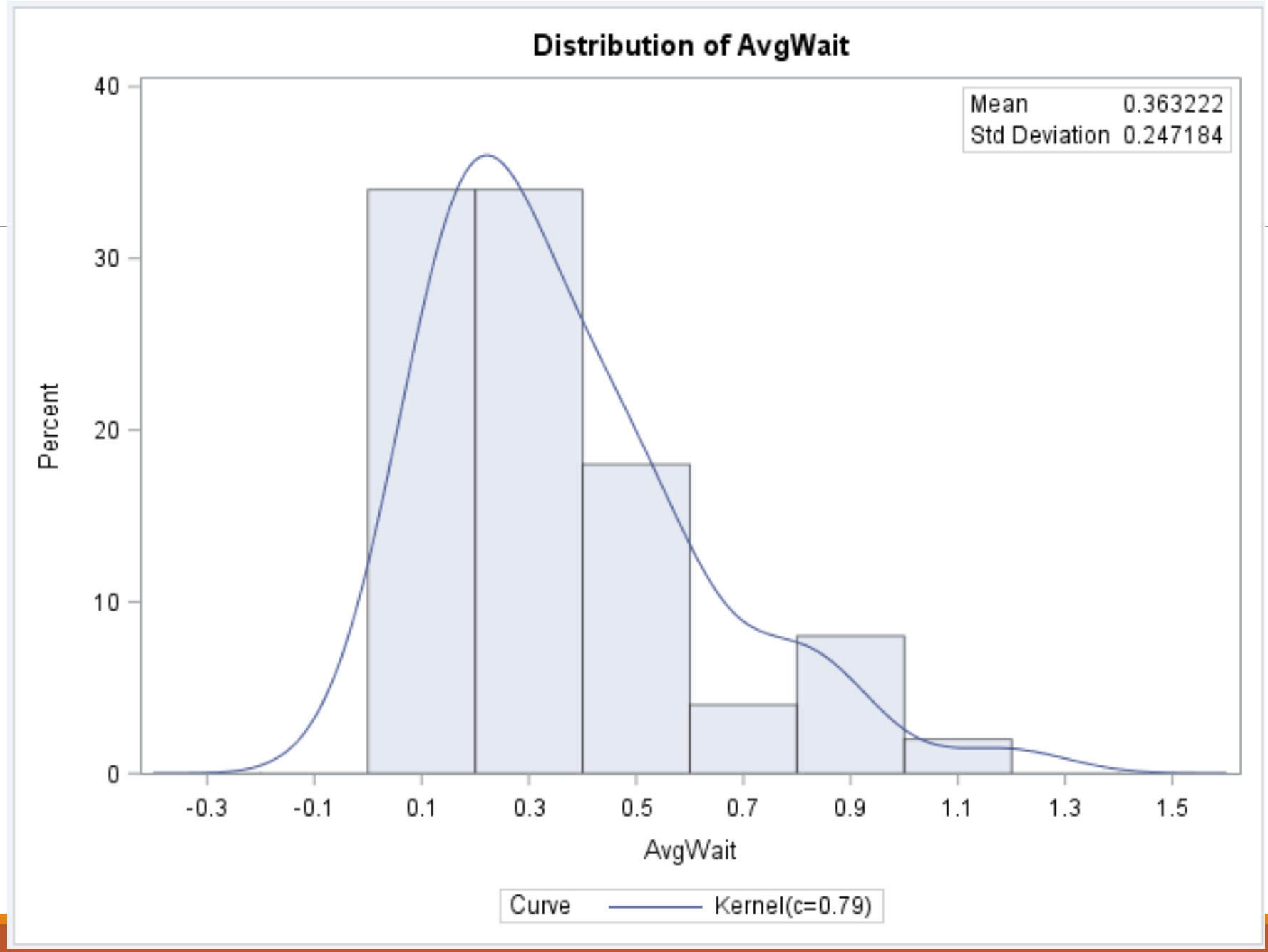
MDs get the same breaks but get a 60-minute lunch, with the same rotation as the nurses

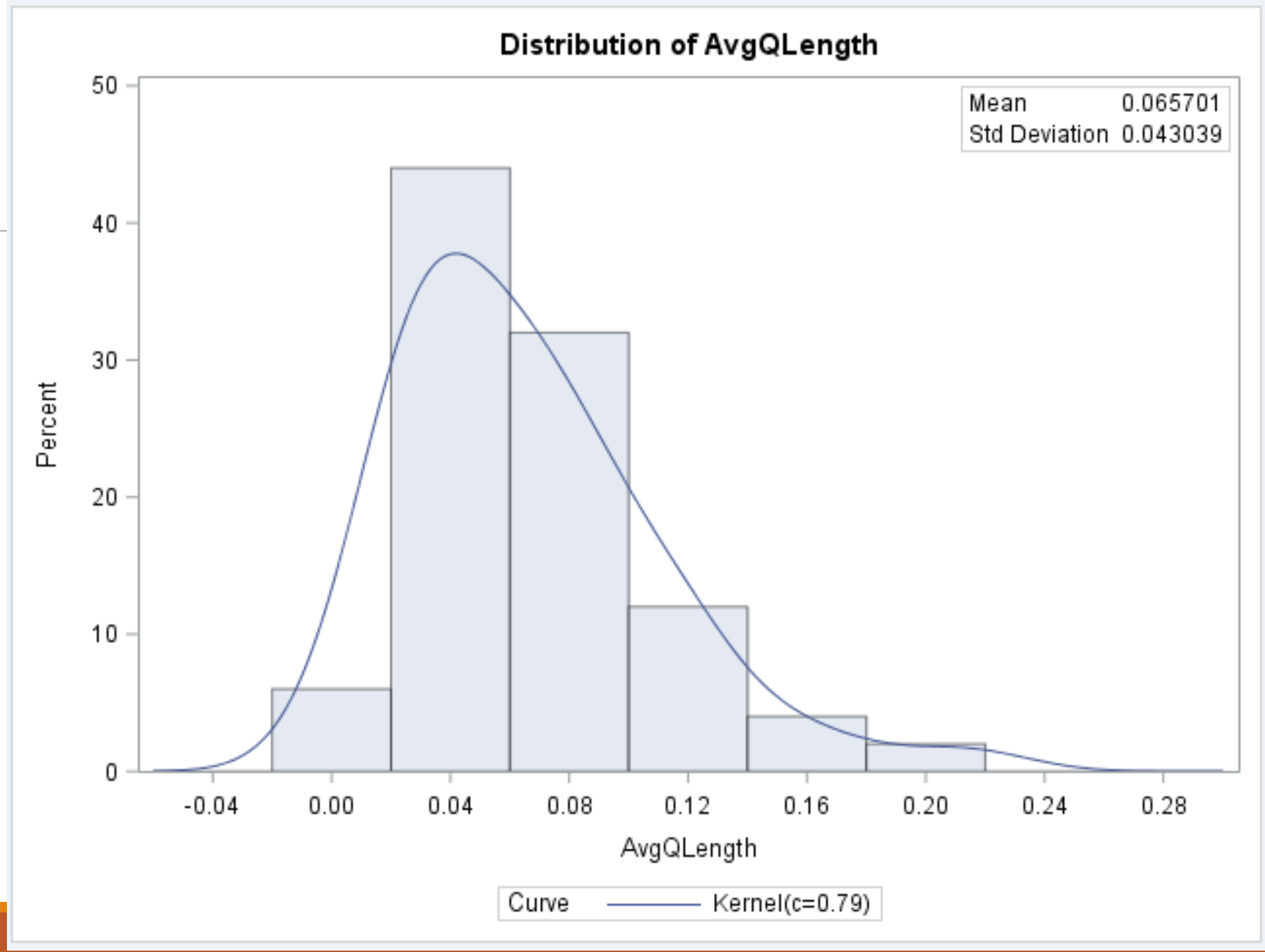
The facility is open 8am – 8pm, totaling 720 minutes plus whatever time it takes to checkout /transfer the patients at closing time

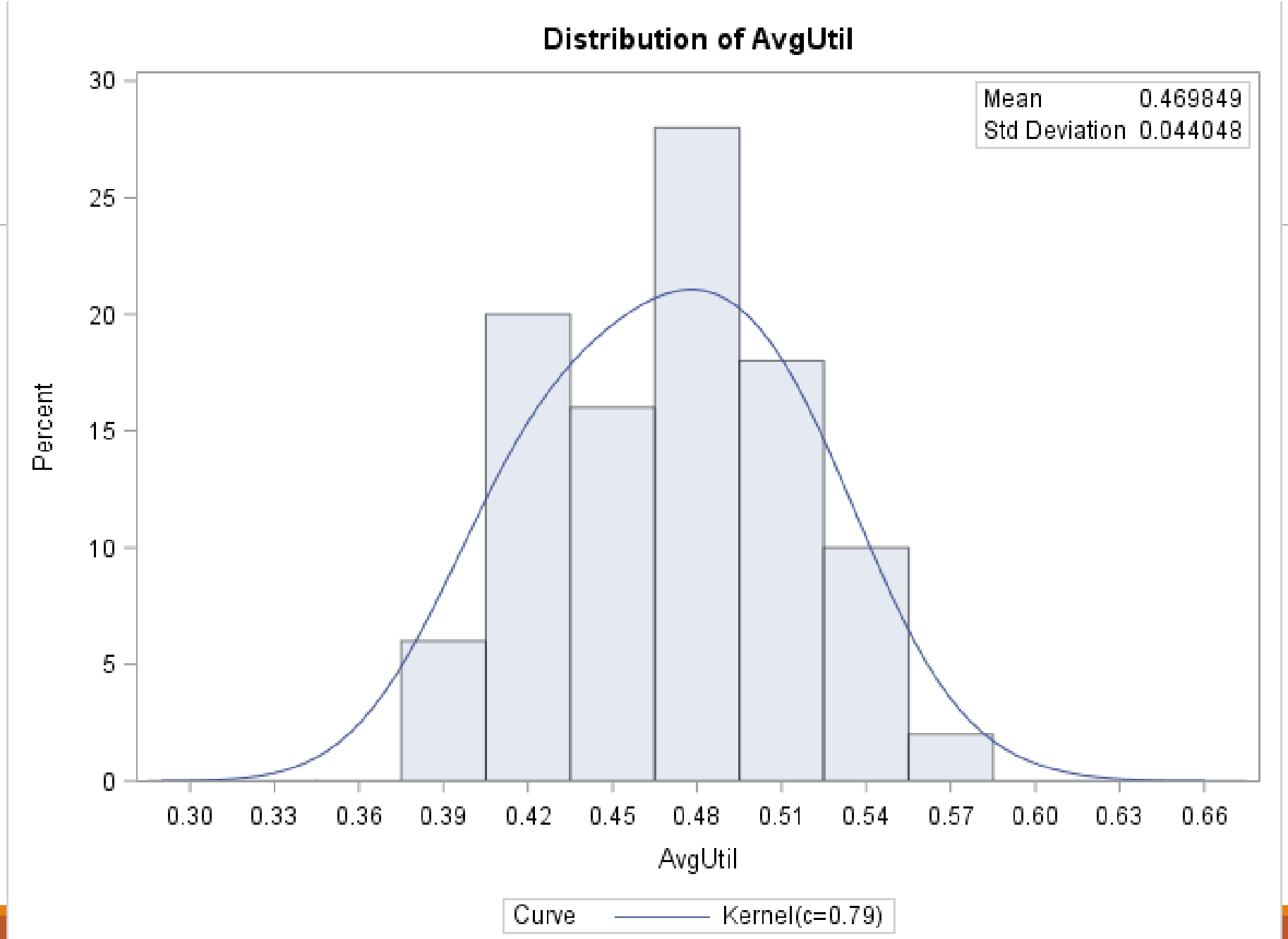

Number Arrived
91
Left Arrival Queue
3
Vital Signs, Evaluate (FNP)
Severity
Insurance
Left Ins. Queue
0.0
Assign FNP
X-Ray?
Yes
No
Radiology
Treatment
TreatmentQ
MDs: Paperwork
5.0
Paperwork
To: MD Resource Pool
Exit Facility
Checkout
88
Number Treated
31.349...
Avg. Time at Facility
Resource Pools
MDs
3
MD in
MD out
FNPs
6
FNP in
FNP Out
Radiologist
1
Rad. In
Rad. Out

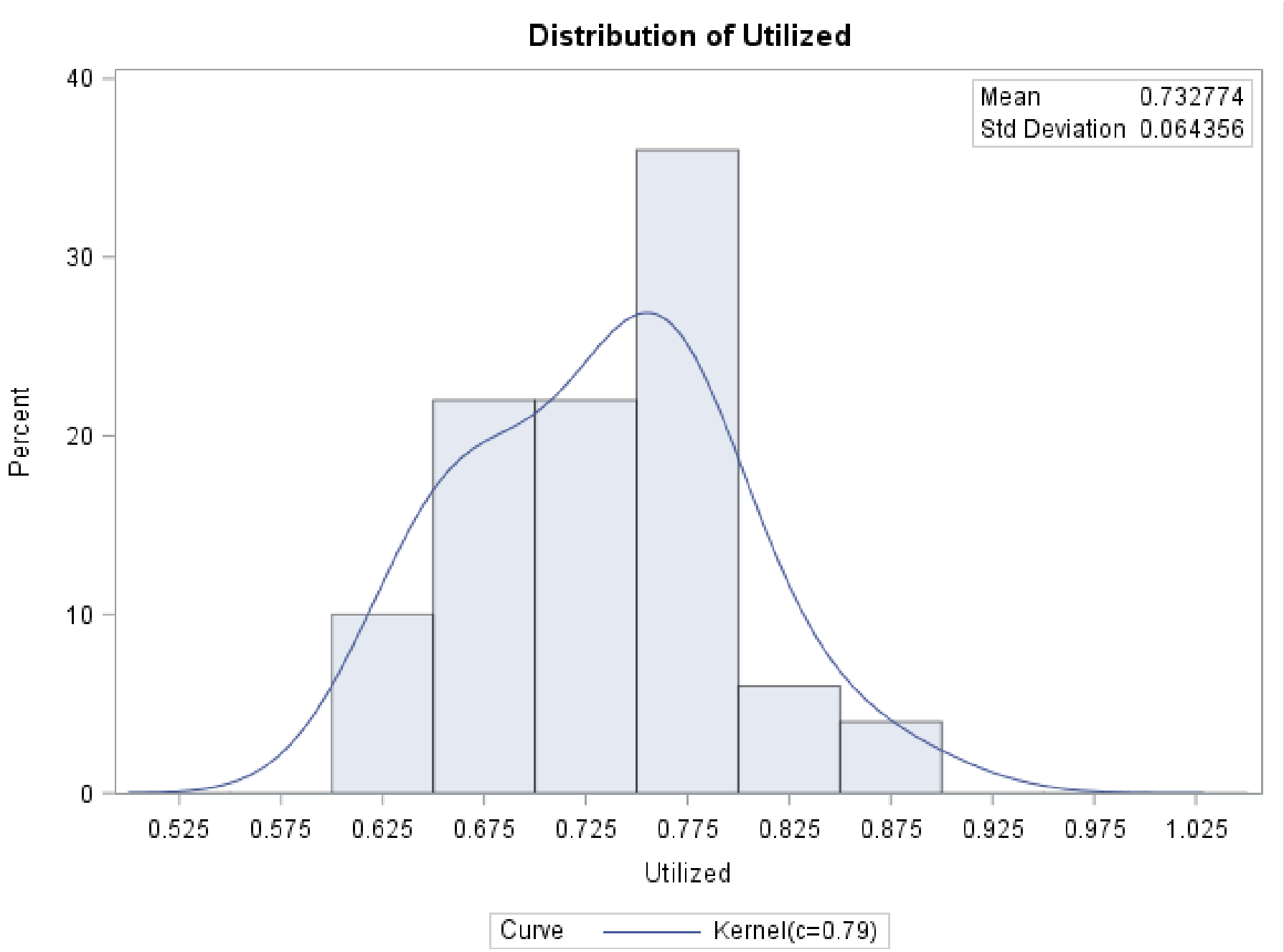

Resource Stats
The Units column can be used to monitor the number of scheduled available resources.
Queue Statistics
Server Statistics
Urgent Care Facility: Open from 8a.m. - 8p.m.
Time units: minutes
Interested in system performance for one simulated day
Compute statistics for queues, servers, and resources


experiment0
PointN...
StartTi...
EndTime
MD_Sta...
FNP_St...
Replica...
AvgTime
Treated
LeftArri...
AvgTre...
AvgArriv...
point 5
0
∞
3
6
50
32.910...
87.14
3.36
5.0314...
0.3632...


Distribution of AvgWait
Mean 0.363222
Std Deviation 0.247184
Percent
40
30
20
10
0
-0.3
-0.1
0.1
0.3
0.5
0.7
0.9
1.1
1.3
1.5
AvgWait
Curve
Kernel(c=0.79)


Distribution of AvgQLength
Mean 0.065701
Std Deviation 0.043039
Percent
50
40
30
20
10
0
-0.04
0.00
0.04
0.08
0.12
0.16
0.20
0.24
0.28
AvgQLength
Curve
Kernel(c=0.79)


Distribution of AvgUtil
Mean 0.469849
Std Deviation 0.044048
Percent
30
25
20
15
10
5
0
0.30
0.33
0.36
0.39
0.42
0.45
0.48
0.51
0.54
0.57
0.60
0.63
0.66
AvgUtil
Curve
Kernel(c=0.79)


Distribution of Utilized
Mean 0.732774
Std Deviation 0.064356
Percent
40
30
20
10
0
0.525
0.575
0.625
0.675
0.725
0.775
0.825
0.875
0.925
0.975
1.025
Utilized
Curve
Kernel(c=0.79)

Recommended Reading

- SAS Simulation Studio 14.1 User's Guide (Chapter 3, Introduction to Simulation, has been updated with a separate link) http://support.sas.com/documentation/onlinedoc/simstudio
- System Modeling in SAS Simulation Studio http://youtube.com/watch?v=soYE-9NRPLA
- Introduction to SAS Simulation Studio http://support.sas.com/rnd/app/or/papers/SimStudioIntroWSC13.pdf

Contact Info and Thanks

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SAS Canada: Chris Battiston (I'm the one with the Darth Vader picture)

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