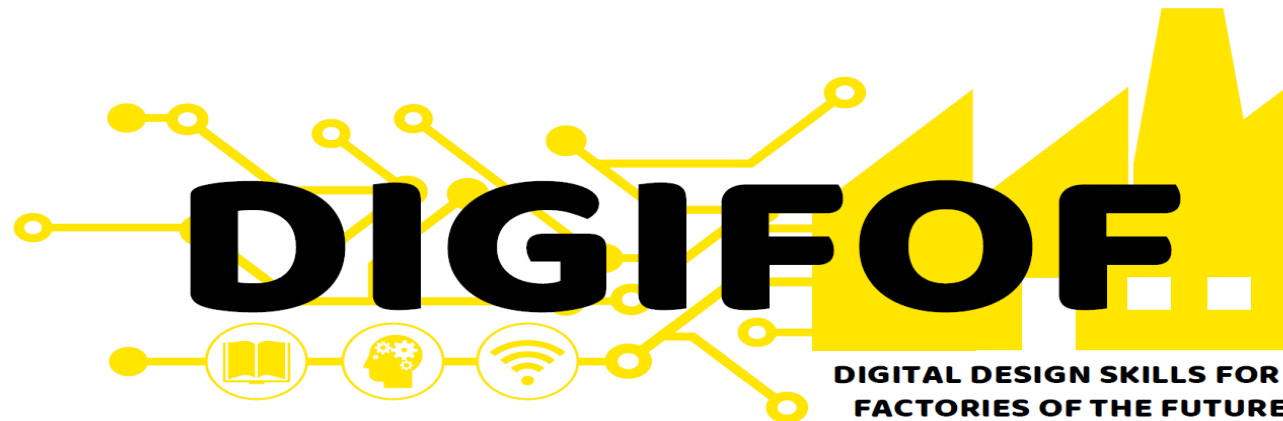


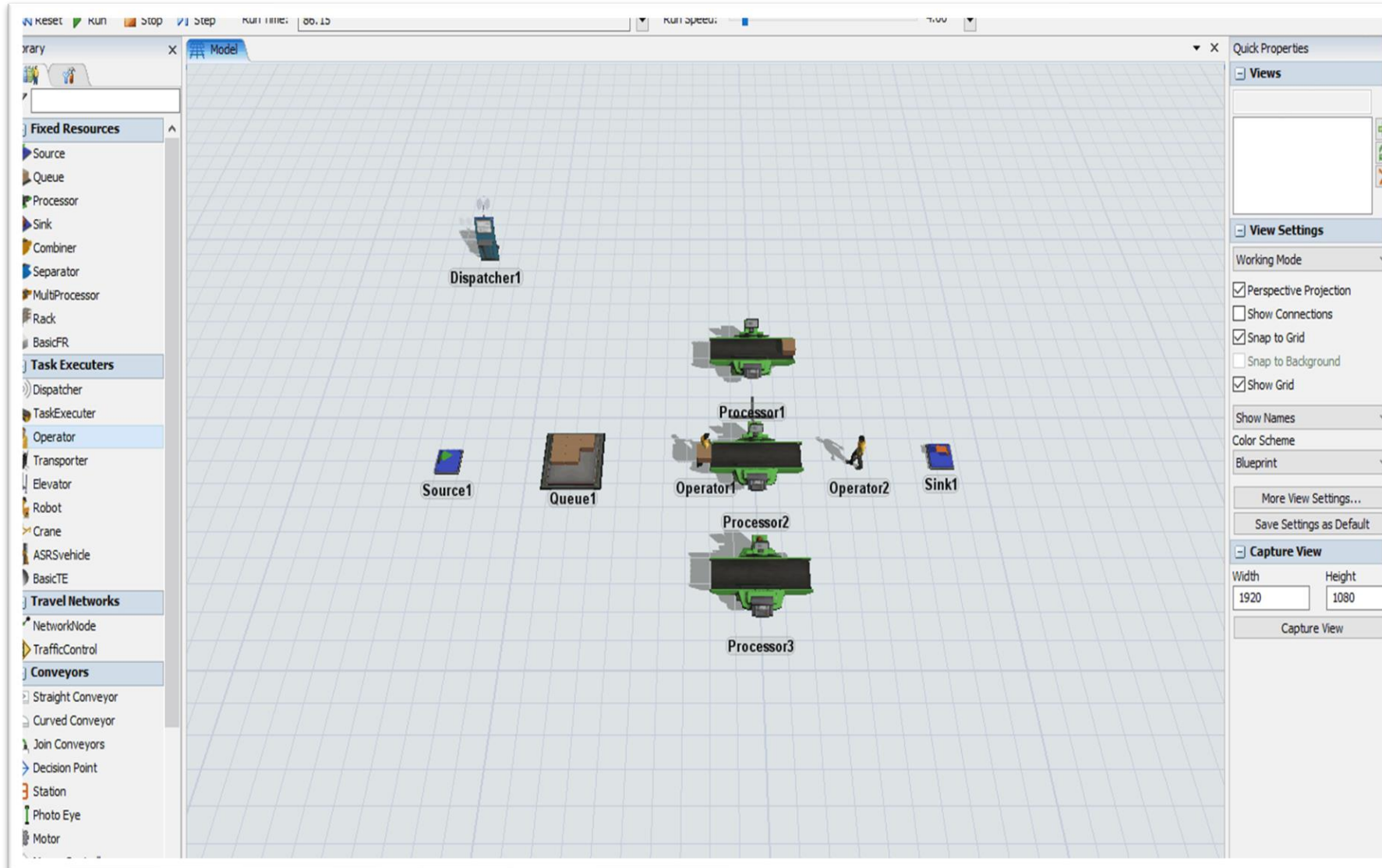
Process Simulation in manufacturing

Advanced topics in Flexsim

Prof. Fabiana Pirola



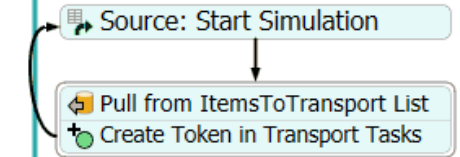
Creation of the Model



Shared Assets

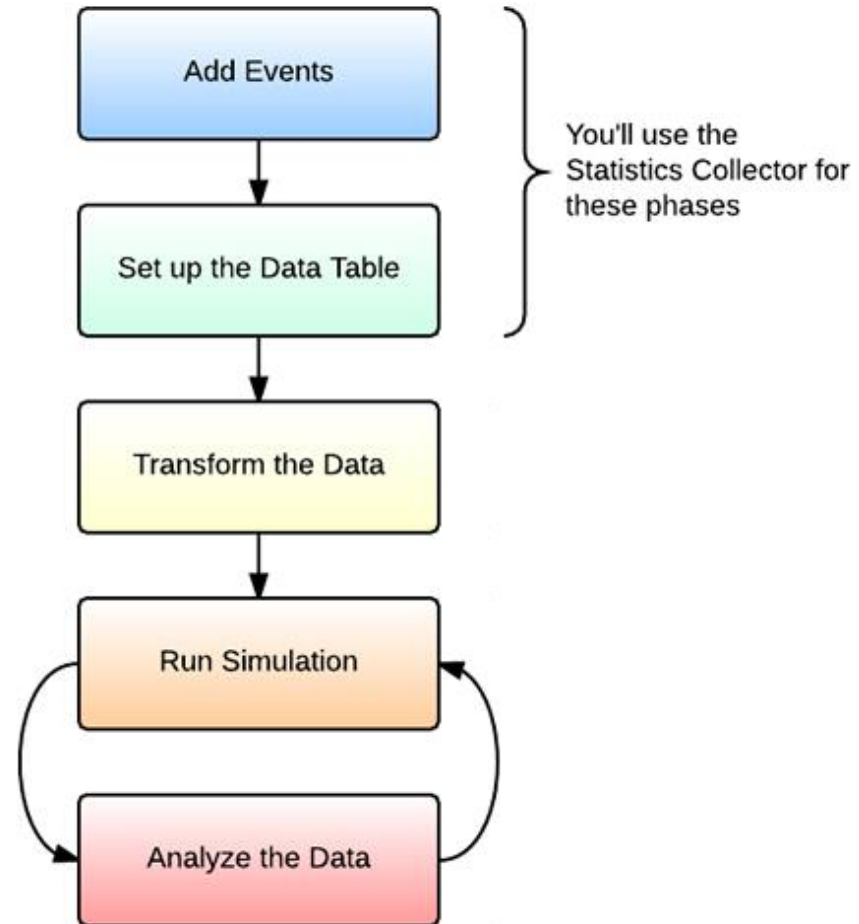
- List: ItemsToTransport
- Resources: Operators

Task Creation



Transport Tasks

- Assign Labels: Destination
- Acquire Operator
- Load Item at Queue
- Unload Item at Destination
- Travel back to Queue
- Release Operator
- Sink: Finish Task



Add Events and Setup Data Table



Statistics Collector Properties

ProcessingTimes Enabled

Event Listening | Data Recording | General

Rows

Row Creation Mode: Add Per Event Row Value*: None

Enumerated Rows

*Row values that are arrays will create multiple rows

Columns

Name	Update	Value	Storage Type	Display Format
Staytime				
Object				
Time	N/A			

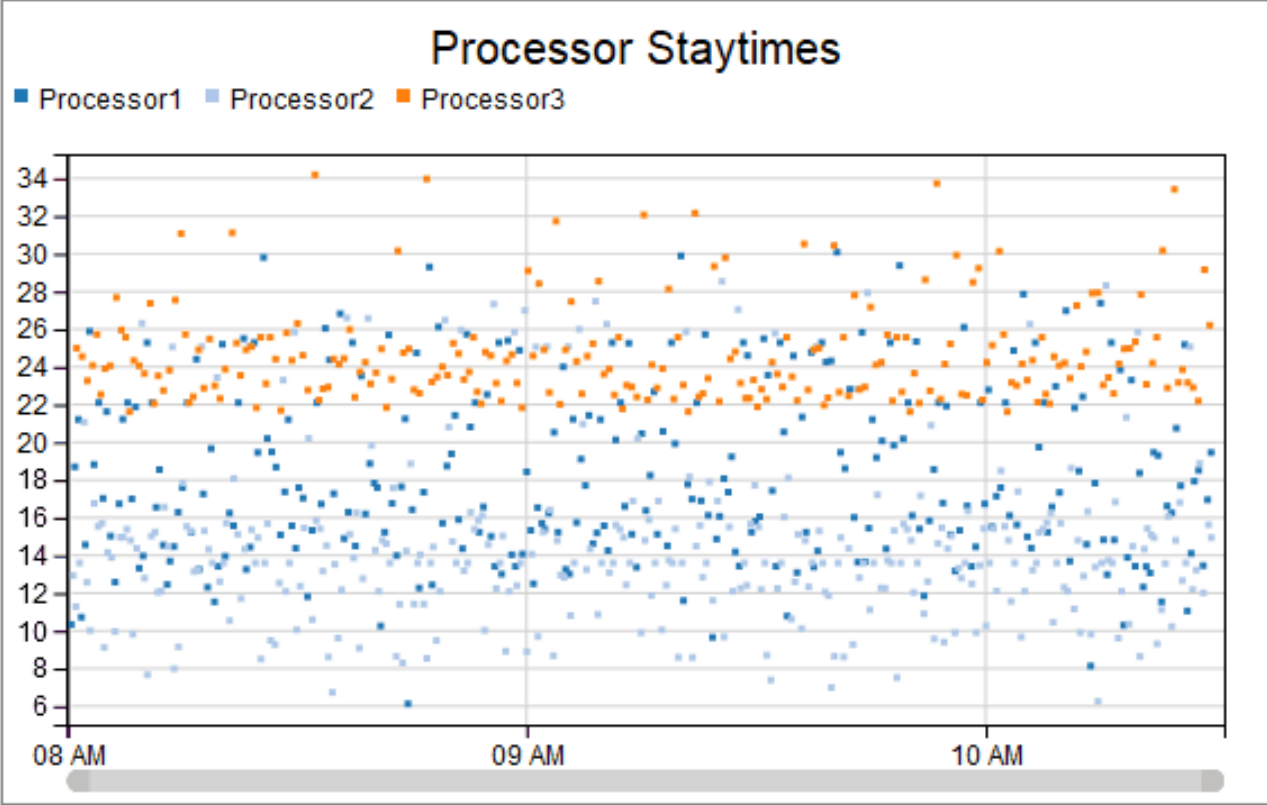
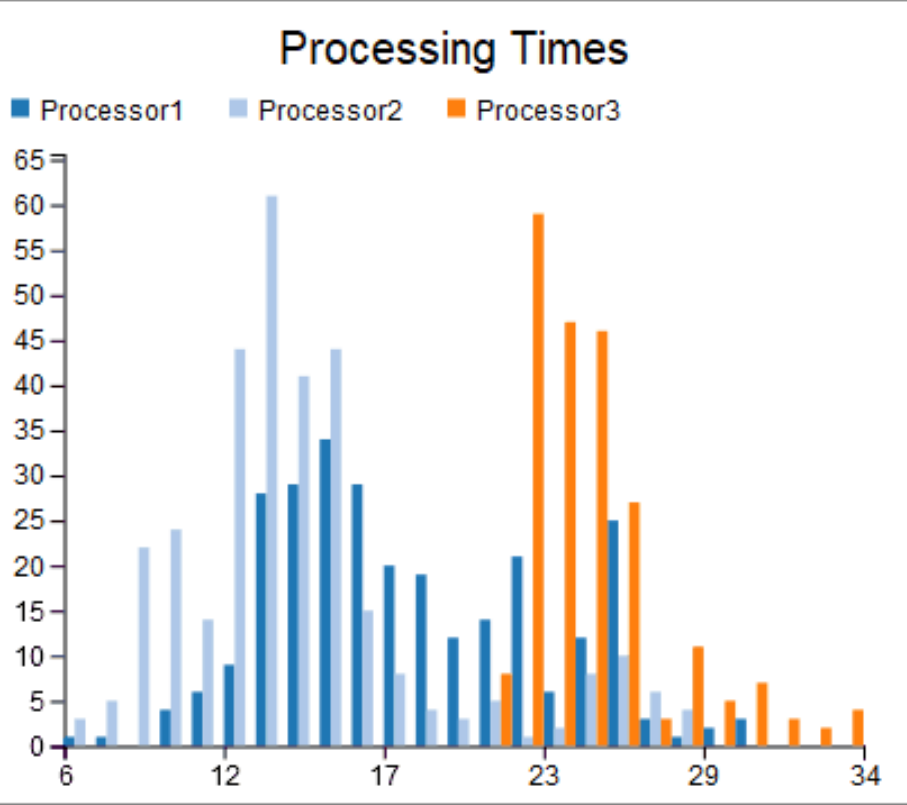
ent/Column Dependence

Apply OK Cancel

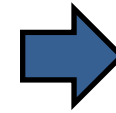
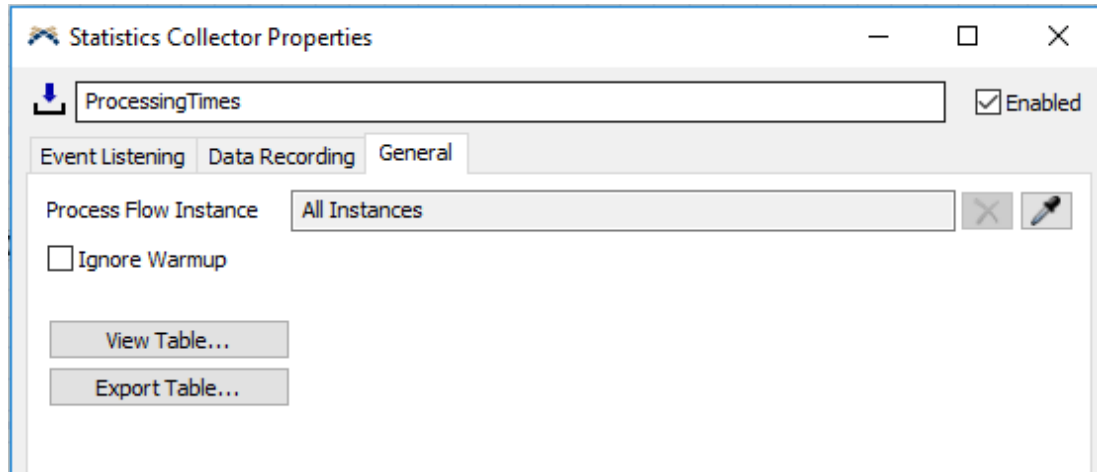
ProcessingTimes

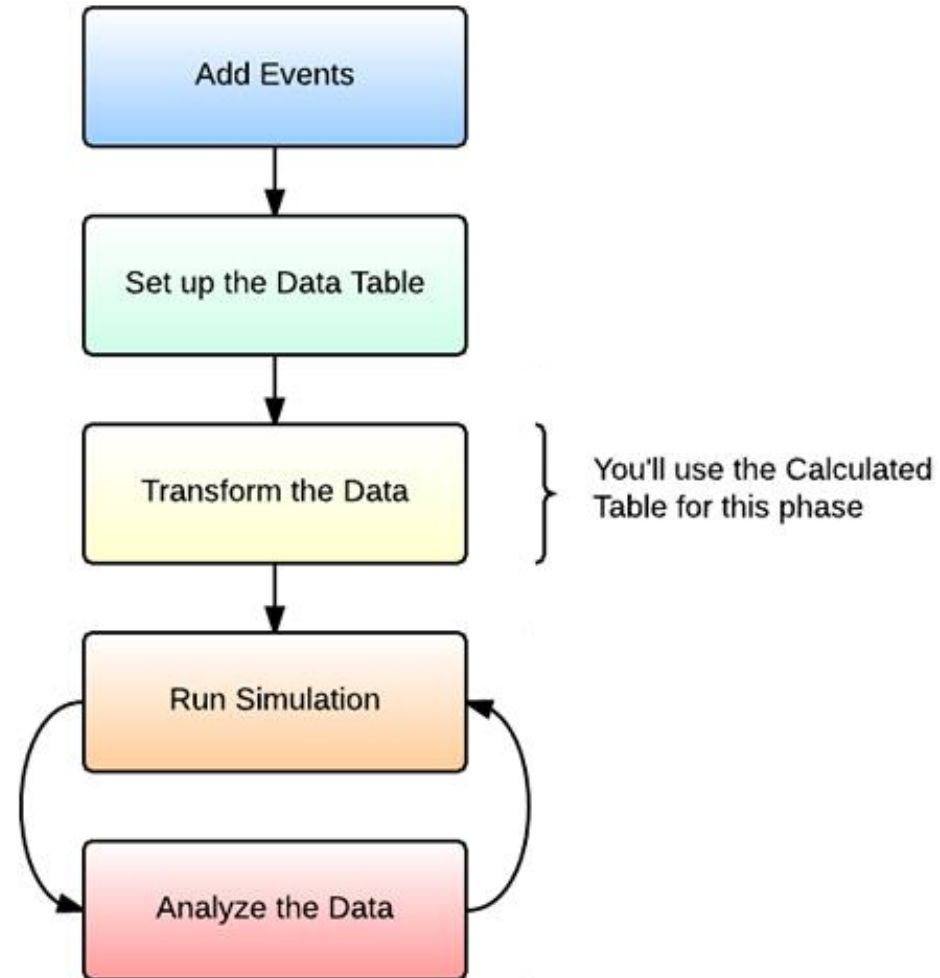
Staytime	Object	Time
10.34	Processor 1	10/04/2018 08:00:23 a. m.
12.93	Processor 2	10/04/2018 08:00:37 a. m.
18.70	Processor 1	10/04/2018 08:00:51 a. m.
11.28	Processor 2	10/04/2018 08:00:59 a. m.
25.00	Processor 3	10/04/2018 08:01:05 a. m.

Add Events and Setup Data Table

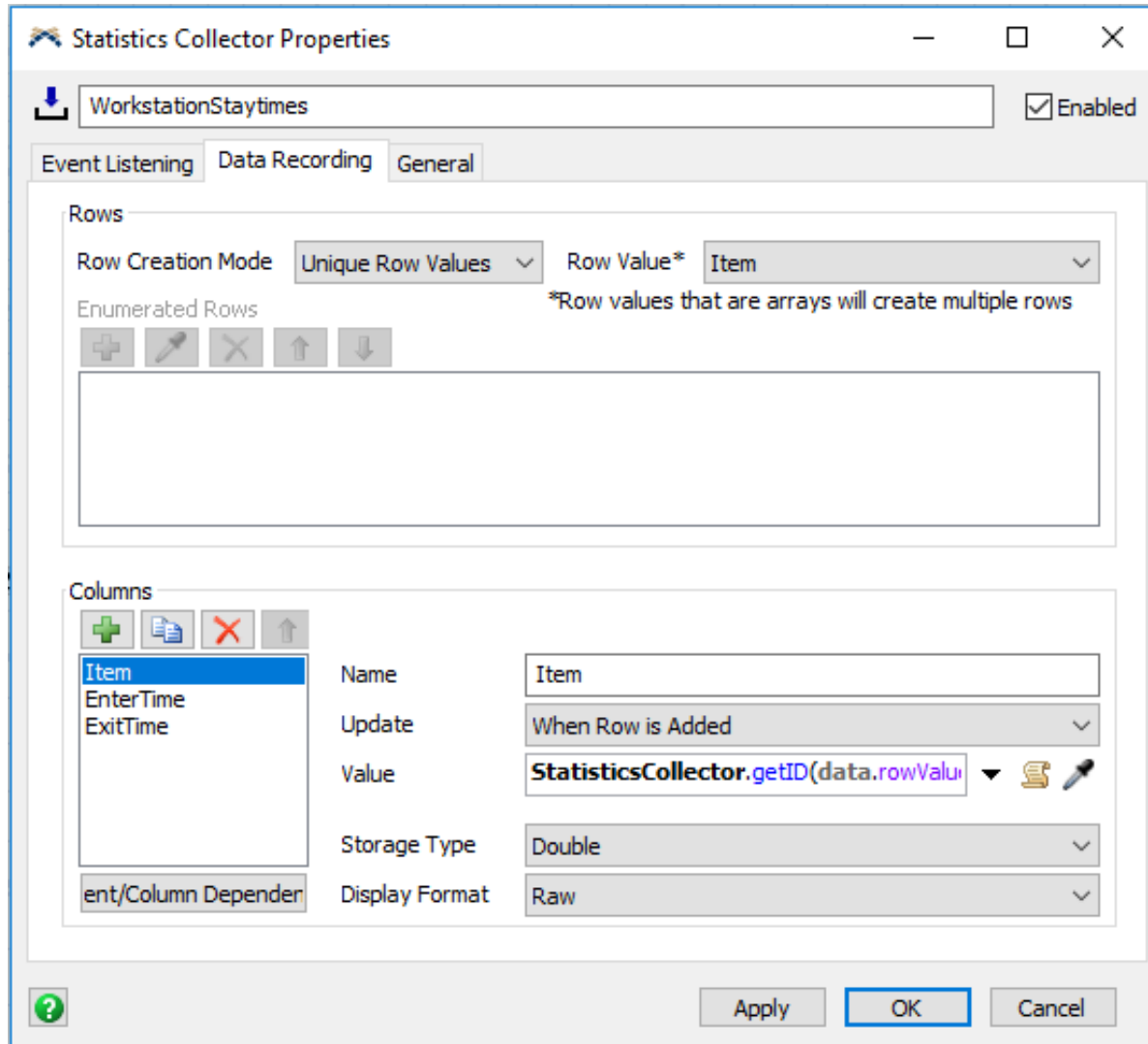


Add Events and Setup Data Table





Calculated Data Table



Statistics Collector Properties

WorkstationStaytimes Enabled

Event Listening | Data Recording | General

Rows

Row Creation Mode: Unique Row Values Row Value*: Item

Enumerated Rows

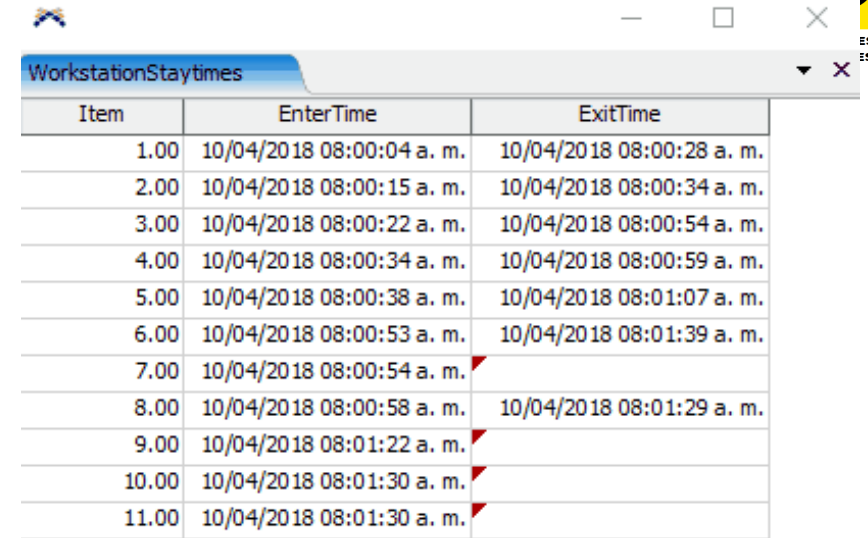
*Row values that are arrays will create multiple rows

Columns

Column Name	Name	Update	Value	Storage Type	Display Format
Item	Item	When Row is Added	StatisticsCollector.getID(data.rowValue)	Double	Raw
EnterTime					
ExitTime					

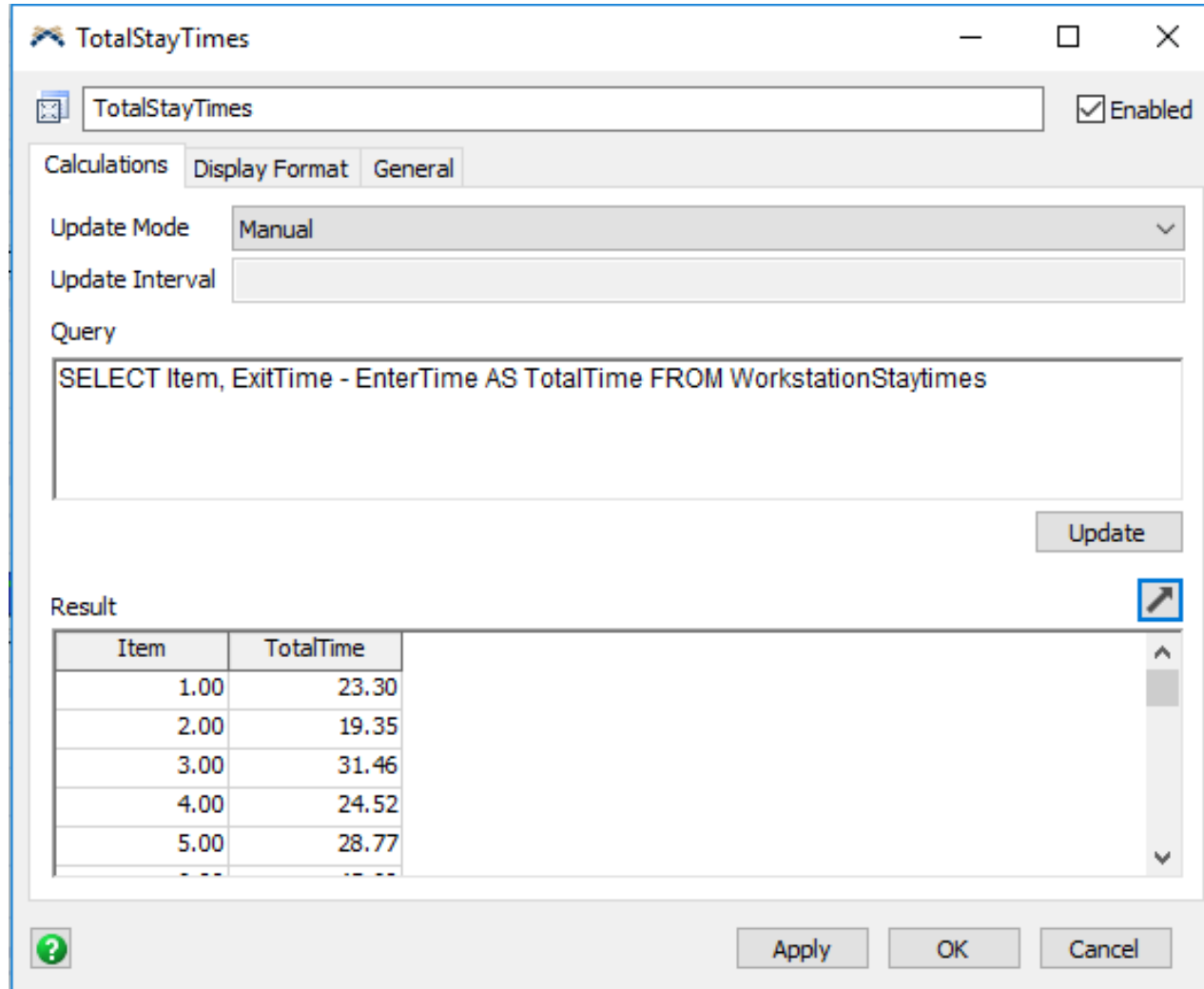
ent/Column Depender

Apply OK Cancel



Item	EnterTime	ExitTime
1.00	10/04/2018 08:00:04 a. m.	10/04/2018 08:00:28 a. m.
2.00	10/04/2018 08:00:15 a. m.	10/04/2018 08:00:34 a. m.
3.00	10/04/2018 08:00:22 a. m.	10/04/2018 08:00:54 a. m.
4.00	10/04/2018 08:00:34 a. m.	10/04/2018 08:00:59 a. m.
5.00	10/04/2018 08:00:38 a. m.	10/04/2018 08:01:07 a. m.
6.00	10/04/2018 08:00:53 a. m.	10/04/2018 08:01:39 a. m.
7.00	10/04/2018 08:00:54 a. m.	
8.00	10/04/2018 08:00:58 a. m.	10/04/2018 08:01:29 a. m.
9.00	10/04/2018 08:01:22 a. m.	
10.00	10/04/2018 08:01:30 a. m.	
11.00	10/04/2018 08:01:30 a. m.	

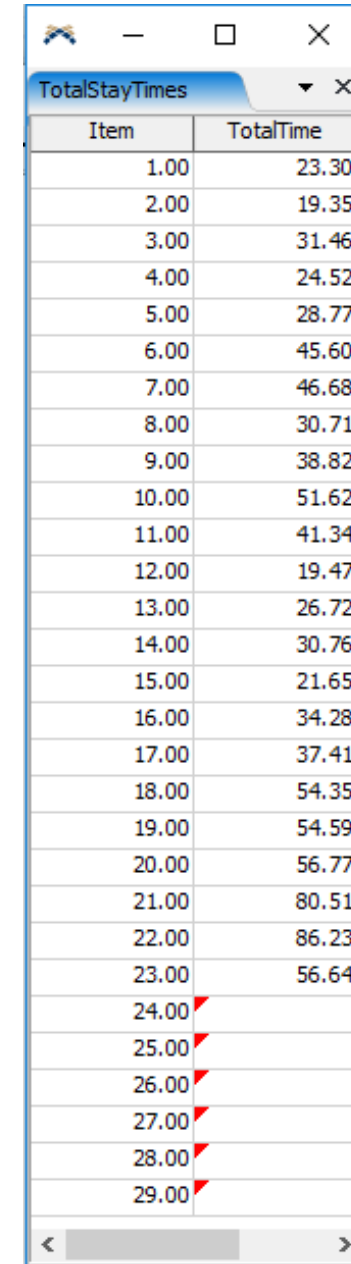
Calculated Data Table



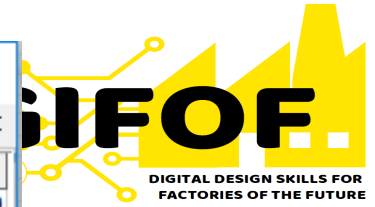
The screenshot shows the 'TotalStayTimes' dialog box with the following configuration:

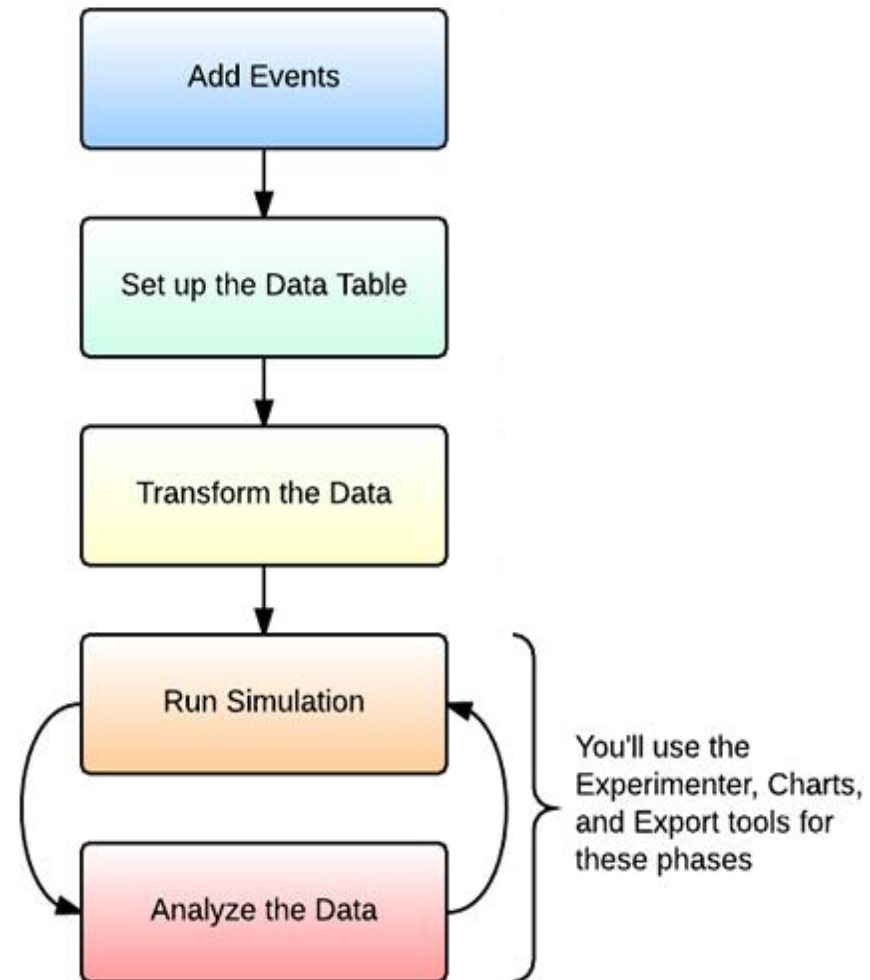
- Tab: Calculations
- Update Mode: Manual
- Update Interval: (empty)
- Query: `SELECT Item, ExitTime - EnterTime AS TotalTime FROM WorkstationStaytimes`
- Result table (partial):

Item	TotalTime
1.00	23.30
2.00	19.35
3.00	31.46
4.00	24.52
5.00	28.77



Item	TotalTime
1.00	23.30
2.00	19.35
3.00	31.46
4.00	24.52
5.00	28.77
6.00	45.60
7.00	46.68
8.00	30.71
9.00	38.82
10.00	51.62
11.00	41.34
12.00	19.47
13.00	26.72
14.00	30.76
15.00	21.65
16.00	34.28
17.00	37.41
18.00	54.35
19.00	54.59
20.00	56.77
21.00	80.51
22.00	86.23
23.00	56.64
24.00	
25.00	
26.00	
27.00	
28.00	
29.00	





Design of Experiments

Simulation Experiment Control

Scenarios Performance Measures Experiment Run Optimizer Design Optimizer Run Optimizer Results Advanced

Variables + | - | ↑ | ↓ Scenarios + | - | ← | → Choose default reset scenario: None

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Scenario 10	
Num.Operators	Nr TEs in Team /Dispatcher1	1	2	3	4	5	6	7	8	9	10

Simulation Experiment Control

Scenarios Performance Measures Experiment Run Optimizer Design Optimizer Run Optimizer Results Advanced

+ | - | ↑ | ↓

Name: Throughput

Label for Y-axis: Value

Performance Measure: Statistic by individual object

- Throughput
- Max.Queue.Content

Design of Experiments



Simulation Experiment Control

Scenarios Performance Measures Experiment Run Optimizer Design Optimizer Run Optimizer Results Advanced

Run Experiment

Replications per Scenario

End Time Save dashboard data for each replication

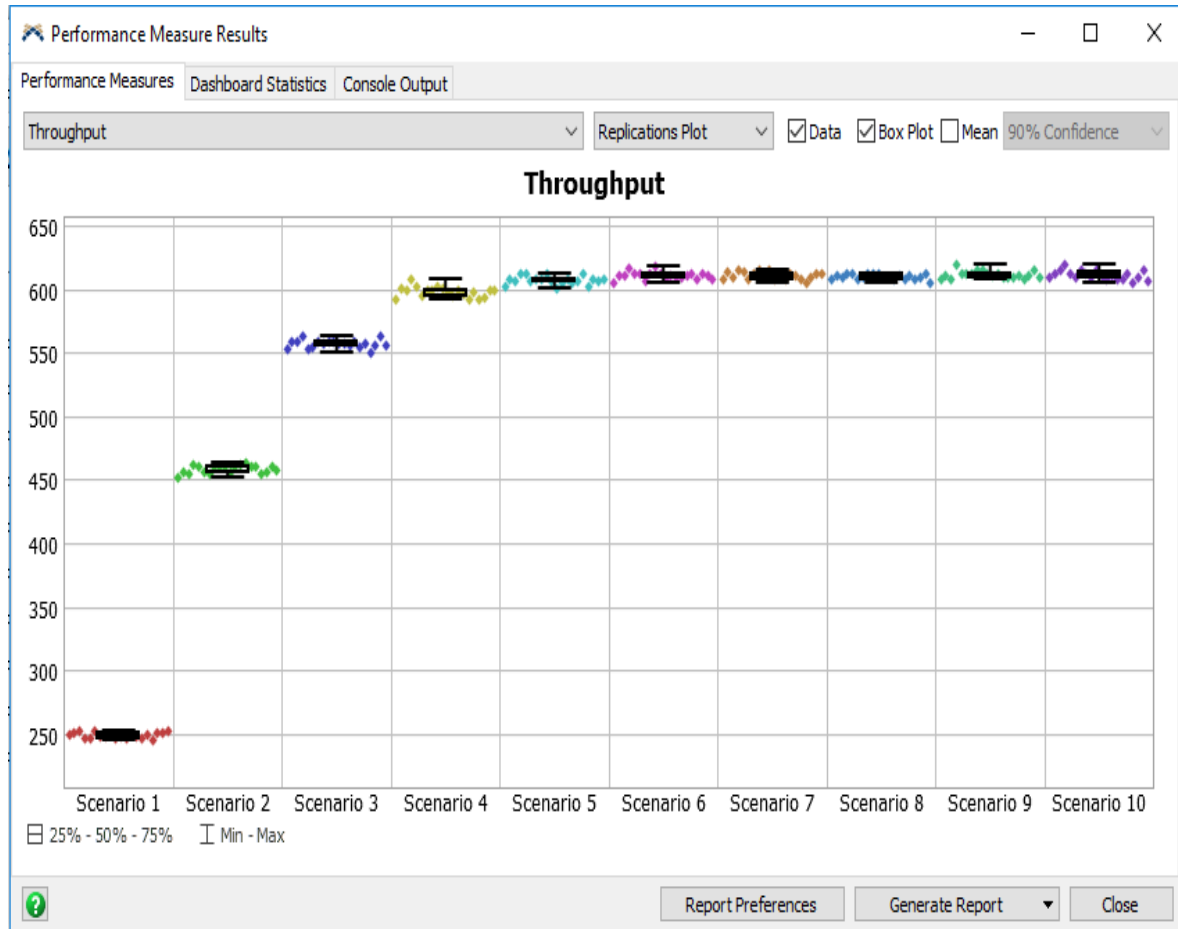
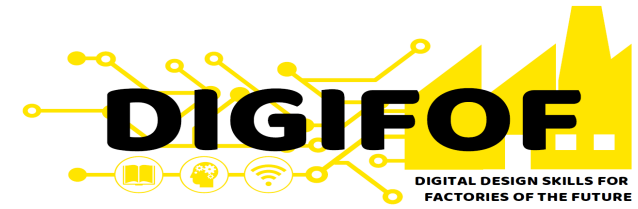
Run Time Save state after each replication

Warmup Restore original state after each replication

Experiment Status

Export results after each replication

Design of Experiments



Performance Measure Results

Performance Measures: Throughput | Dashboard Statistics | Console Output

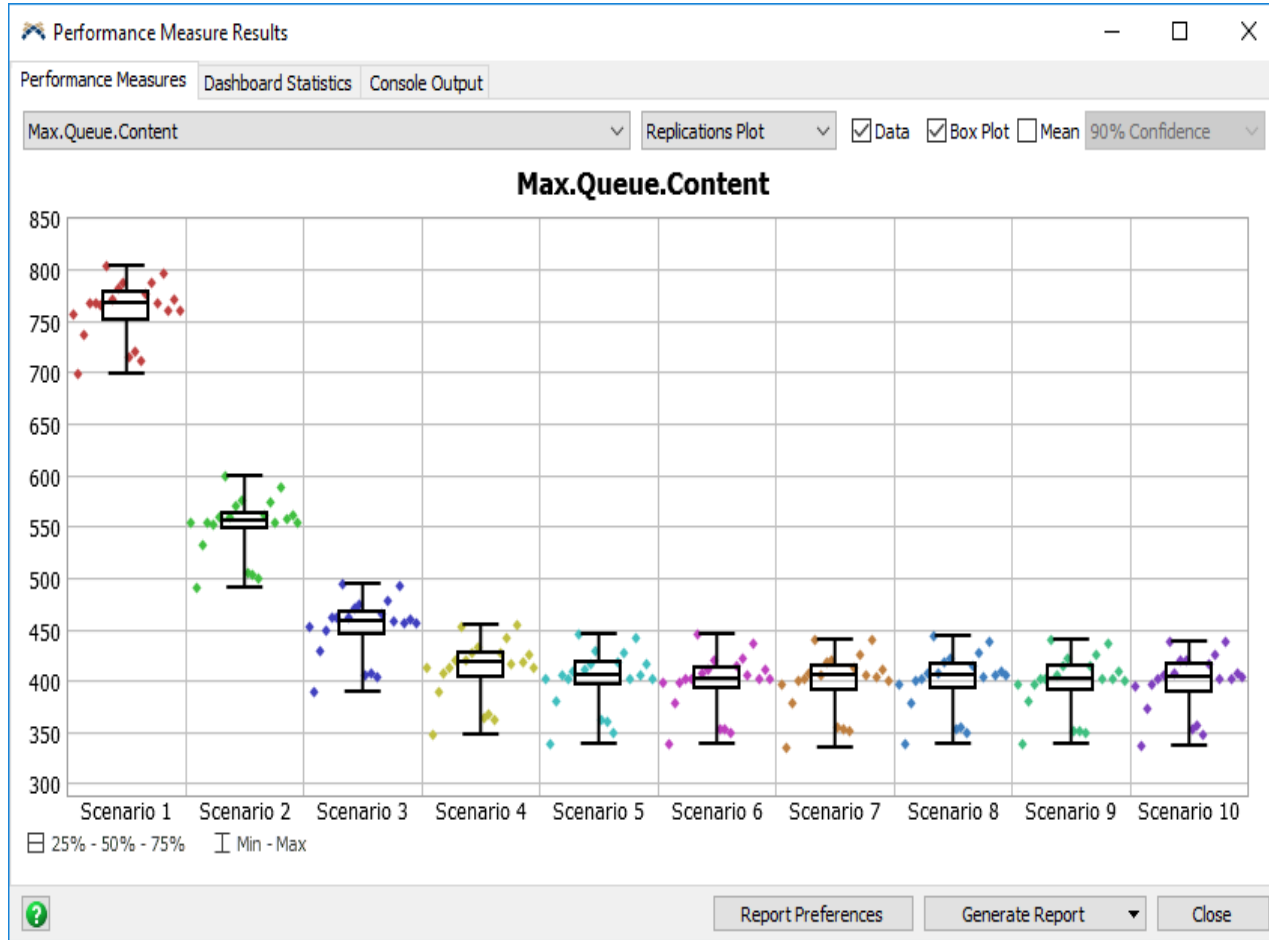
Data Summary | Mean Based on: 90% Confidence

Throughput

	Mean (90% Confidence)	Sample Std Dev	Min	Max
Scenario 1	247.81 < 248.75 < 249.69	2.43	245.00	253.00
Scenario 2	457.35 < 458.50 < 459.65	2.96	452.00	463.00
Scenario 3	556.16 < 557.35 < 558.54	3.08	551.00	564.00
Scenario 4	597.01 < 598.50 < 599.99	3.86	592.00	608.00
Scenario 5	606.51 < 607.80 < 609.09	3.33	601.00	613.00
Scenario 6	610.10 < 611.25 < 612.40	2.97	606.00	619.00
Scenario 7	610.17 < 611.20 < 612.23	2.67	605.00	615.00
Scenario 8	609.58 < 610.35 < 611.12	1.98	606.00	613.00
Scenario 9	610.87 < 611.95 < 613.03	2.80	608.00	620.00
Scenario 10	610.31 < 611.60 < 612.89	3.33	606.00	620.00

Report Preferences | Generate Report | Close

Design of Experiments



Performance Measure Results

Performance Measures: Dashboard Statistics Console Output

Max.Queue.Content

Data Summary

Mean Based on: 90% Confidence

Max.Queue.Content

	Mean (90% Confidence)	Sample Std Dev	Min	Max
Scenario 1	749 < 760 < 772	29	698	804
Scenario 2	539 < 550 < 562	29	491	599
Scenario 3	440 < 452 < 463	30	389	495
Scenario 4	399 < 411 < 422	30	348	454
Scenario 5	390 < 401 < 413	29	339	446
Scenario 6	387 < 398 < 409	29	338	446
Scenario 7	387 < 398 < 410	29	335	441
Scenario 8	388 < 399 < 410	29	338	444
Scenario 9	386 < 397 < 408	29	339	441
Scenario 10	386 < 398 < 409	29	337	439

Report Preferences Generate Report Close

