Distributed Stochastic Simulation
Assignment 6
Descrete Event Simulation

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Abstract

Simulating a probabilistic model involves generating the stochastic mechanisms of the model and then observing the resultant flow of the model over time. Depending on the reasons of the simulation, there will be certain quantities that will want to determine. The present report documents the Discrete Event Simulation for a FIFO queue over an observed time period. We describe the approach and programs used for this simulation and collect the data. We also compute the analytical results of this model and make a comparison.

Introduction
To simulate the events in a FIFO queue, we take the following parameters:
λ : Denotes the customer arrival rate as a descrete Poisson random variable.
μ : Denotes the customer service rate as a descrete Poisson random variable.
We consider Observation time as 100 units of time, modeled here as the iterations. Following section briefly describes the programs that covers the implementation.

Programs Description
Customer.java
This class models the object customer. Associated with each customer is its arrival time, service time and departure time.
Q.java
This class is a FIFO queue implementation. As a new Customer arrives, it is placed in the queue using Q.insert method and as soon as the service is done the Customer is removed from the queue.
DES.java
This is the core functionality of the simulation where we simulate the arrival and service of the customers. We perform 1000 experiments with an observation time of 100 and 1000 units.
Usage: java DES λ μ Observation time.
TheoreticalDES.java
This class is used to compute the analytical value of the results that are compared with the simulated results.

Simulation Results
Following are the simulation results obtained from a practical run of the program DES.class :
λ= 10.0 μ= 11.0 Observation interval O = 10
Average waiting time: 0.0668
Average queue length:0.0675
Average number of Customers in the System:1.0675
Average throughput time:1.0E-4

λ= 10.0 μ= 11.0 Observation interval O = 20
Average waiting time: 0.00245
Average queue length:0.00335
Average number of Customers in the System:1.00335
Average throughput time:2.0E-4

λ= 10.0 μ= 11.0 Observation interval O = 40
Average waiting time: 0.88105
Average queue length:0.882
Average number of Customers in the System:1.882
Average throughput time:2.25E-4

λ= 10.0 μ= 11.0 Observation interval O = 100
Average waiting time: 1.62784
Average queue length:1.6288

Average number of Customers in the System:2.6288
Average throughput time:0.00111

λ= 10.0 μ= 11.0 Observation interval O = 1000
Average waiting time: 0.51017
Average queue length:0.511169
Average number of Customers in the System:1.511169
Average throughput time:0.01428

For λ=10 and μ=20
λ= 10.0 μ= 20.0 Observation interval O = 10
Average waiting time: 0.163
Average queue length:0.163
Average number of Customers in the System:1.163
Average throughput time:0.0

λ= 10.0 μ= 20.0 Observation interval O = 20
Average waiting time: 0.78105
Average queue length:0.782
Average number of Customers in the System:1.782
Average throughput time:6.0E-4

λ= 10.0 μ= 20.0 Observation interval O = 40
Average waiting time: 2.6278
Average queue length:2.628625
Average number of Customers in the System:3.628625
Average throughput time:0.0011

λ= 10.0 μ= 20.0 Observation interval O = 100
Average waiting time: 6.23444
Average queue length:6.23543
Average number of Customers in the System:7.23543
Average throughput time:0.00119

λ= 10.0 μ= 20.0 Observation interval O = 1000
Average waiting time: 0.730157
Average queue length:0.73115
Average number of Customers in the System:1.73115
Average throughput time:0.016618

Analytical Results
λ=10 μ=11
Expected waiting time: 0.9090909090909091
Expected queue length: 9.090909090909092
Expected number of units in the system: 10.0
Expected throughput time of a unit: 1.0

λ=10 μ=20
Expected waiting time: 0.05
Expected queue length: 0.5

Expected number of units in the system: 1.0
Expected throughput time of a unit: 0.1