Central Library

Our Team

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Problem Statement

Simulating the Library as a Discrete Event Systems

Objectives

Suggest improvements in subsystems through simulation

Experimentation

Running models with different configurations

Methodology

Data Collection, Analysis

Suggestions

Possible Improvements in System

Problem Statement

Analyse different subsystems in library, figuring out the current problems, and suggesting system improvements through DES simulation



Library

Central Library Subsystems

- Entry and exit counter
- Book issue counter
- Digital knowledge access center
- OPAC system

Situation & problems to solve

First Problem

Queue management at entry and exit counter

Second Problem

Book issue counter and Queue Management

Third Problem

Inadequate capacity of Cycle Stand

Situation & problems to solve

Fourth problem

Inadequate no of seats at Digital Knowledge Access Centre

Fifth problem

Optimal number of Online Public Access Catalogue

Methodology

Our methodology

Data Collection

Modelling

Experimentation

Inference

In-person monitoring of the system and input analysis

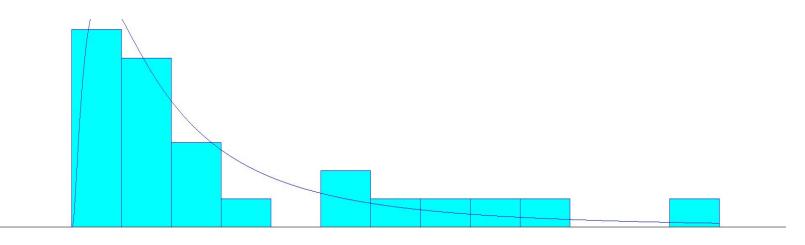
DES models simulation on **Arena**

Model run with different configurations

Best configuration results are reported

Data Analysis

Laptop and Book Entry (Weekday)



Distribution: Lognormal

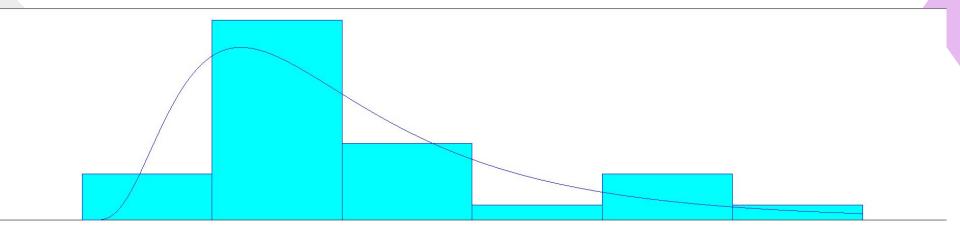
Expression: -0.5 + LOGN(3.42, 5)

Laptop and Book Entry (Weekend)

Distribution: Lognormal

Expression: -0.5 + LOGN(1.65, 1.92)

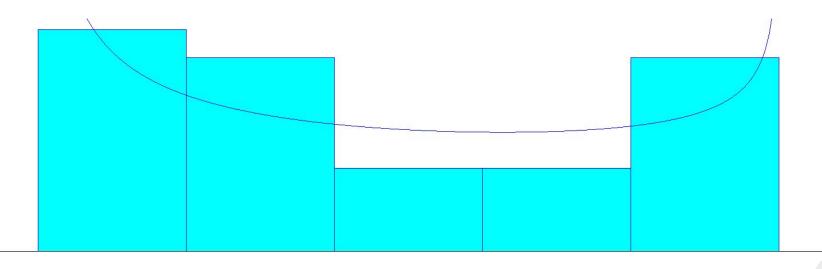
Input Analyzer of each problem specimen Cycle Stand (Weekday)



Distribution: Lognormal

Expression: -0.5 + LOGN(2.18, 1.5)

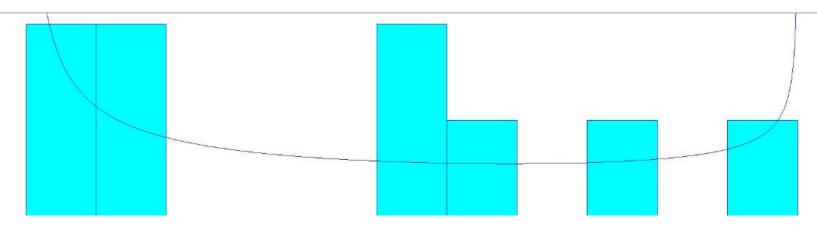
Cycle Stand (Weekend)



Distribution: Erlang

Expression: -0.5 + ERLA(0.436, 3)

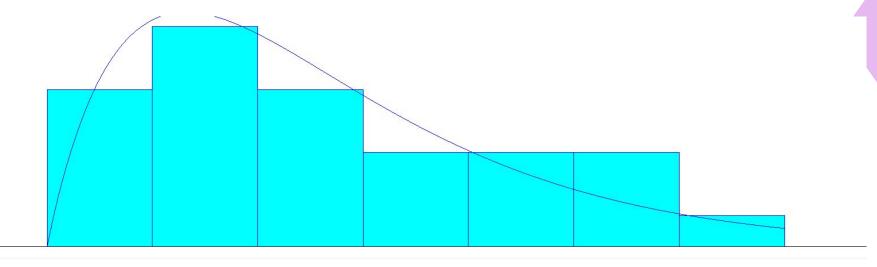
Online Public Access Catalog (OPAC)



Distribution: Beta

Expression: -0.5 + 11 * Beta(0.477, 0.689)

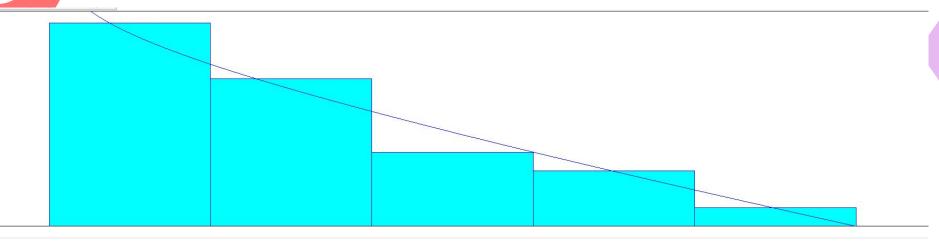
Digital Knowledge Access Center (Weekday)



Distribution: Gamma

Expression: -0.5 + GAMM(1.37, 1.96)

Digital Knowledge Access Center (Weekend)

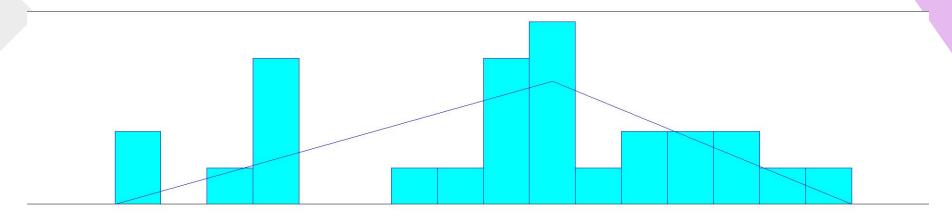


Distribution Summary

Distribution: Beta

Expression: -0.5 + 5 * BETA(0.916, 1.99)

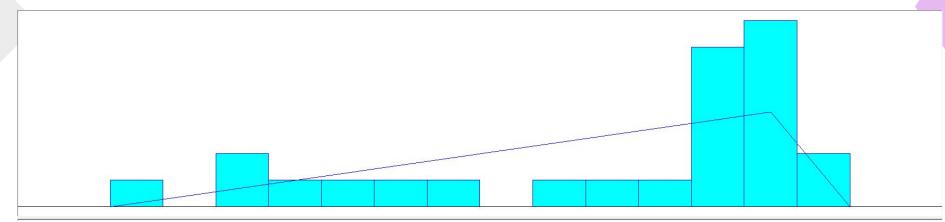
Book Issue (Weekend)



Distribution: Triangular

Expression: TRIA(-0.5, 9, 15.5)

Book Issue (Weekdays)



Distribution: Triangular

Expression: TRIA(1.5, 14, 15.5)

Summary

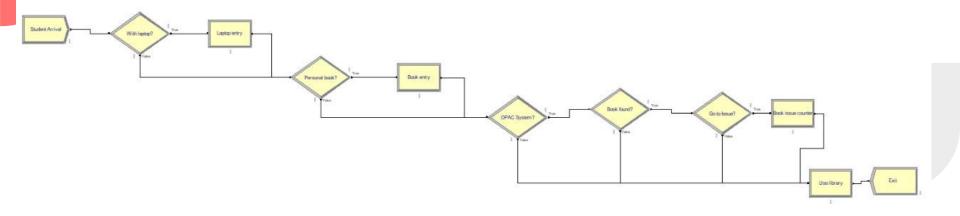
Sr No.	Attribute	Distribution	Expression
1	Laptop and Book Entry (Weekday)	Lognormal	-0.5 + LOGN(3.42, 5)
2	Laptop and Book Entry (Weekend)	Lognormal	-0.5 + LOGN(1.65, 1.92)
3	Cycle Stand (Weekday)	Lognormal	-0.5+LOGN(2.18,1.5)
4	Cycle Stand (Weekend)	Erlang	-0.5+ERLA(0.436,3)
5	Digital Access Center (Weekday)	Gamma	-0.5+GAMM(1.37,1.96)
6	Digital Access Center (Weekend)	Beta	-0.5 + 5 * BETA(0.916,1.99)

Summary

Sr No.	Attribute	Distribution	Expression
7	OPAC	Beta	-0.5 + 11 * Beta(0.477, 0.689)
8	Book Issue (Weekday)	Triangular	TRIA(1.5, 14, 15.5)
9	Book Issue (Weekend)	Triangular	TRIA(0.5, 9, 15.5)

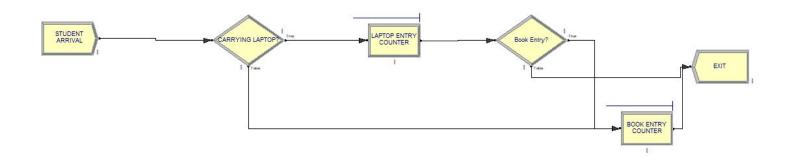
Arena Models

Library Model:



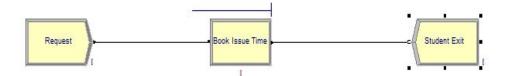
Cycle Stand OPAC SYSTEM Incoming Cycle Cycle Parked Cycle Exit OPAC OPAC OPAC

Library Entry

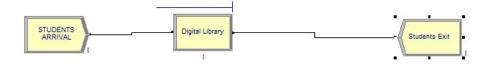


Student Exit

Book Issue Counter



Digital Knowledge Access Centre



Results

Weekday Data	
Laptop entry register	
Configuration	Maximum Waiting Time
1 laptop entry, 1 personal	
book entry	154.05 seconds
2 laptop entry, 1 personal	
book entry	50.12 seconds

Weekend	Maximum Waiting Time
1 laptop entry, 1 personal book	
entry	379.44 seconds
2 laptop entry, 1 personal book	
entry	239.95 seconds
3 laptop entry, 1 personal book	
entry	69.51 seconds

Results

Digital Library	
Number of systems	Average Wait Time
69	2.11 hours
80	1.57 hours
100	0.72 hours

Book Issue Counter		
Number of Counters	Average Wait Time	Utilization
2	3 minutes	0.67

Results

Cycle stand	Weekends	
Configuration	Queue Waiting Time	Average Waiting Time
350(capacity)	64.775	59.269
500(capacity)	20.77	17.46

Digital Library	
Number of systems	Average Wait Time
69	2.11 hours
80	1.57 hours
100	0.72 hours

Suggestions

Suggestion 1

Add one more register for laptop entry on weekdays, two more on weekends

Suggestion 2

Install and increase number of computers in Digital Knowledge Access Center to 100 to reduce average wait time

Suggestion 3

Construct a new cycle stand with capacity upto 150 to bring down average wait time and queue waiting time significantly

Future Work

- An analysis of number of copies of in-demand books required to serve a significant percentage of needy students
- Seating Capacity and the optimum number of charging ports in each hall

OPAC Machines		
Number of Machines(Hall 1)	Average Wait Time	Utilization
2	4.2 minutes	0.63

THANK YOU