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Discrete Event Simulation Investigation Into The Impact Of Distinct Service Rate Attributes Of Servers In A Multi-Server Queuing System

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Queues are a common feature of daily life, which both service providers and customers strive to avoid. However, eliminating queues may not be possible for service providers, such as Nigerian banks, where the rate of customer arrivals exceeds most Nigerian banks' capacity to process customers' requests. Several studies have theorised that increasing the number of servers and increasing service rate of servers are valid solutions to minimize the waiting time of customers in a queue system. This study was designed to investigate the impact of distinct service rate attributes of servers in a multi-server queuing system through discrete event simulation technique.

A convenient sampling technique was used to select a Nigerian bank, and their customer-care section was selected for this study. A stratified purposive sampling was used to collect data on 427 customer transactions via direct observation using a stopwatch, with the inter-arrival and service times of customers recorded. The customer-care section consists of two distinct parallel servers. The Discrete Event Simulation (DES) technique was employed using Arena to model the queuing system to analyse service times of 210 bank customers served by Server-1 and 217 of the bank customers served by Server-2 using Arena's Input-Analyser.

It was found that by experimental modelling of replacing Server-2 with a server matching Server-1's service rate, the waiting time increased to 78.36 minutes, while replacing Server-1 with a server matching Server-2's service rate reduced customer waiting time to 29.10 minutes from 32.42 minutes of the control scenario of a system of Server-1 and Server-2. Hence, replacing Server-1 with server that has the same attribute with Server-2 reduced bank customers' waiting time, while replacing Server-2 with server that has Server-1 attributes increased bank customers' waiting time.

The study highlights that Arena DES accurately captures varied service rate distributions, emphasizing the importance of modelling distinct server attributes for realistic queue analysis. The DES can be adopted for precise queue management and help banks assess individual server performance to minimize customer waiting time and staffing allocation. Future research should explore additional server configurations and larger datasets to enhance generalizability.

Keywords: Input-Analyser, DES, Queue, Nigerian bank, Arena

Primary author: Ms ALONGE, Ayobami

Co-authors: Dr MUYIWA, Omotunde; Prof. ANYAECHE, Osita

Presenter: Ms ALONGE, Ayobami

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