IMBD Help Desk

Yixuan Chen, Arohit Talari, Junhao Wang, Yuyang Zeng, Yangyuechen Zhao

Administrative Sciences, Boston University MET

Prof. John Maleyeff

11/06/2024

Introduction

The IMD Help Desk is facing challenges related to long and inconsistent wait times for resolving customer issues. To address these concerns, Judy Lee, an analyst with a background in applied business analytics, is tasked with evaluating two alternative queuing systems: either maintaining the current system, where jobs are segmented by problem type, or transitioning to a combined system with a common set of technicians trained to handle both hardware and software problems, to improve efficiency. To do so effectively, she needs to apply the M/M/s queueing model. This model is suitable for analyzing service systems where there is variability in service and arrival times, but its application depends on certain assumptions being valid for the system under consideration.

Assumptions of the M/M/s Queueing Model

1) Poisson Arrival Process: Customer arrivals occur independently of one another.
2) Exponential Service Time: Service times for both hardware and software issues follow an exponential distribution.
3) Constant Arrival Rates: The rates at which customers arrive are known and remain constant.
4) Independent and Identically Distributed Service Times: Service times are independent of each other and share the same probability distribution.
5) Infinite Population and Queue Capacity: The model assumes an unlimited number of potential customers and queue length, with an infinite number of servers.
6) Steady-State Conditions: All servers possess equal skills and are capable of handling both hardware and software issues.

Criteria for Evaluating IMD Help Desk Queue

2.

b) Implementing differentiated queue lengths - three customers for hardware tickets and four for software tickets, with a combined maximum of seven customers - optimizes service delivery while maintaining manageable wait times. This structured approach balances operational efficiency with customer satisfaction by preventing queue overflow and service personnel burnout. The defined thresholds reflect IMD's commitment to delivering high-quality support while meeting service level agreements. This strategy enables effective resource allocation and workload management while ensuring sustainable service delivery. The calibrated queue lengths demonstrate IMD's data-driven approach to operations management and dedication to continuous service improvement. This framework acknowledges varying service complexities between hardware and software support

Analysis Using the M/M/s Queuing Model

To find the optimal number of servers, we used the M/M/s queuing model to evaluate the server requirements for the IMD help desk across three time periods: Weekday Early, Weekday Late, and Saturday. To accomplish this, we compute the arrival rate (λ), which represents the number of clients entering the system per minute, by dividing the hourly arrival rate by 60. The service rate (μ) is the number of clients a single server can handle per unit of time, i.e., 1 divided by the reciprocal of the average service time. (Arrival rate and service rate show in the **Table 1** and **Table 2**)

Table 1: Arrival Rates (λ) for Different Timeframe and Option

Timeframe	**Option**	**Arrival Rate (customers/minute)**
Weekday Early	Software	8.6/60 = 0.1433
	Hardware	5.1/60 = 0.085
	Common	0.085+0.1433 = 0.2283
Weekday Late	Software	3.9/60 = 0.065
	Hardware	2.9/60 = 0.0483
	Common	0.0483+0.065 = 0.1133
Saturday	Software	2.7/60 = 0.045
	Hardware	1.7/60 = 0.0283
	Common	0.0283+0.045 = 0.0733

Table 2: Service Rates (μ) for Option 1 and Option 2

	Option 1: Software	**Option 1: Hardware**	**Option 2: Common**
Service Rate (customers/minute)	1/16 = 0.0625	1/45 = 0.02	1/32 = 0.03125

In analyzing server configurations, we identified the optimal setup by comparing key metrics such as utilization, average queue length, and average wait time across various server counts.

In our selection process, we prioritized configurations that met target wait time requirements while maintaining server utilization within an efficient range. For instance, too few servers can lead to wait times exceeding targets, negatively impacting customer experience, while too many servers can cause underutilization and idle resources. Thus, we selected configurations that ensure customer service within the target wait time while minimizing resource wastage, achieving a balance between service quality and resource efficiency. Results are in **Table 3**, **4**, and **5**.

Table 2: Server Configurations for Software Problems

Option 1: Software Problems				
Timeframe	**Servers**	**Utilization**	**Average Queue Length**	**Average Time in Queue (minutes)**
Weekday Early	3	76.4%	1.9	13.37
Weekday Early	4	57.3%	0.3	2.38
Weekday Late	2	52.0%	0.4	5.93
Weekday Late	3	34.7%	0.1	0.82
Saturday	1	72.0%	1.9	41.14
Saturday	2	36.0%	0.1	2.38

Table 3: Server Configurations for Hardware Problems

Option 1: Hardware Problems				
Timeframe	**Servers**	**Utilization**	**Average Queue Length**	**Average Time in Queue (minutes)**
Weekday Early	5	76.5%	1.6	18.71
Weekday Early	6	63.8%	0.4	5.05
Weekday Late	3	72.5%	1.4	28.88
Weekday Late	4	54.4%	0.3	5.42
Saturday	2	63.8%	0.9	30.81
Saturday	3	42.5%	0.1	4.25

Table 4: Server Configurations for Common Problems

Option 2: Common Problems				
Timeframe	**Servers**	**Utilization**	**Average Queue Length**	**Average Time in Queue (minutes)**
Weekday Early	8	91.3%	7.8	34.37
Weekday Early	9	81.2%	2	8.92
Weekday Late	5	72.5%	1.1	9.77
Weekday Late	6	60.4%	0.3	2.72
Saturday	3	78.2%	2.2	30.29
Saturday	4	58.7%	0.4	5.23

Table 5 shows recommended server configurations, balancing efficiency with target wait times. Option 1 needs fewer servers, while Option 2 requires more due to higher workloads, optimizing resources without sacrificing service quality.

Table 5: Servers Recommended by Waiting Line Analysis

Timeframe	Option 1: Software Problems	Option 1: Hardware Problems	Option 2: Common Problems
Weekday Early	3	5	9
Weekday Late	2	4	5
Saturday	2	3	4

Recommendation