Journal of Basics and Applied Sciences Research (JOBASR)
ISSN (print): 3026-9091, ISSN (online): 1597-9962
Volume 4(3) June 2026
DOI: https://dx.doi.org/10.4314/jobasr.v4i3.2s

Application of Queueing Theory at the Papua New Guinea University of Technology Mess

Pijay Patili[1*], Meysam Khoshnava[2], Abuzo Sankwi[3] & Mohsen Aghaeiboorkheili[4]
[1,3,4]School of Mathematics and Computer Science, Papua New Guinea University of Technology, Lae, Morobe Province, Papua New Guinea
[2]School of Architecture and Construction Management, Papua New Guinea University of Technology, Lae, Morobe Province, Papua New Guinea
[*]Corresponding Author Email: mohsen.aghaeiboorkheili@pnguot.ac.pg

ABSTRACT
Queueing Theory has been used in this research work to examine congestion in the mess of Papua New Guinea University of Technology (PNG UNITECH) in Lae, Morobe province. This study aims to perform analysis of the current queuing system and find the number of servers needed in order to optimize service operations. Multiple server Queuing model (M/M/C) was applied using data obtained through observation in the mess hall. The traffic intensity, average queue length, waiting time, system utilization, and the probability of zero customer in the system were among other parameters analysed. The research findings reveal that the current queuing system which has two servers is not stable owing to the fact that the system experiences high traffic intensity and lengthy waiting times. In analysing the other scenarios, it can be concluded that the queuing system would become stable when there are at least six servers. With this number of servers, the average queue length and waiting time are minimized.

Keywords:
Queueing Theory,
Multiple Server,
Traffic Intensity,
M/M/c Model,
Papua New Guinea University of Technology

INTRODUCTION

Queues are part of everyday life (Perera, Sandeepani, Narthana, & Abeygunawardana, 2025). We experienced queues everywhere. Queue is a long man-made line that results from people standing right after one another in a straight forward manner. Queues are experienced at business centres, trade centres and other important centres where a large number of people gather. A queue is a man-made waiting line formed when people stand one after another to receive a service. The need for customer to be served on time but due to limited servers it results in queue. Queues sometimes result from poor time management. As the servers slow in their work or taking more time to sort out customers then it results in queue. Sometimes lack of background knowledge about queueing Theory leads to queueing. Queueing Theory is administered by some characteristics such as waiting time, arrival time taken to serve each customer, time taken to wait on the queue and time taken for each server to serve the customers. By using queueing theory to model the above characteristics, it is easy for designing better systems and do away with queues (Patricia & Abirami, 2024).

One of the everyday problems faced at PNG UNITECH is the queue at the student mess. The mess is one of the places where students have access to foods. In most cases, students have more to be done. Assignments to be done, tests to be study, lab to be done and projects to be done. During peak times large number of students attend mess which results in waiting lines. The time needed to spend on assessable tasks are always spend on queue. Reducing students waiting time at the mess remains one of the most discussed topics among students. Thus, Queueing theory is used to analyse the queue problem at the mess. Queueing Theory is defined as a branch of Mathematics that studies and models the act of waiting in line (Goswami, Rao, & Verma, 2023).

There are two different types of models under queueing theory: **the Single Server Model and the Multiple Server Mode**. They are denoted by **M/M/1** and **M/M/**c respectively. The first M in each notations represents Markovian (Exponential) arrival times. The second M represents Markovian(exponential) service time. The 1 at the end of first formula represents single server while c in the second formula stands for multiple servers. Single Server Model(M/M/1) is applicable where there's single counter or server with fewer people. Multiple Server Model(M/M/c) is used where there are more than one counters or servers. However, in this paper about PNG UNITECH mess queue, Multiple Server Model(M/M/c) is used. Due to having multiple servers at the mess which operates simultaneously.

The main research question guiding this study is:

How to cite this article: Pijay P., Meysam K., Abuzo S. & Mohsen A. (2026). Application of Queueing Theory at the Papua New Guinea University of Technology Mess. *Journal of Basics and Applied Sciences Research*, *4*(3), 13-21. https://dx.doi.org/10.4314/jobasr.v4i3.2s

How can the Multiple Server Model be used to reduce the waiting time problem at the queue at PNG Unitech mess? To answer this question, traffic intensity, waiting probabilities and system utilization are carefully studied in this paper.

First paper about queueing theory was published way back in early 1900s titled "The Theory of Probabilities and Telephone Conversations" by Agner Krarup Erlang (A.K Erlang) a Danish mathematician. His work at the Copenhagen Telephone Company motivates him to fully delve into this field (Keerthika, Niranjan, & Komala Durga, 2025). He now considers as the father of the queueing theory field. At the time, there were no mobile phones but only telephones. He came up with an idea of how the waiting time at the telephone station would be solved. He invented his first formula then saw that his formula can be applied to situations where there need to be a queue so he further invented more formulae which are called Erlang formula. He first invented Erlang B then in 1917 he invented Erlang C then invented Erlang A. His work on telephone queue laid the foundation on todays queueing theory problem. Where modern researchers used his ideas to delve more deeply into modern queueing theory.

Various researchers have employed the application of Queueing Theory to study and optimize operations of services in industries like hotels, health care facilities, canteens and transportation systems. Goswami et al. (2023) showed how applications of queueing models could improve service operations in hotels. Moreover, Yaduvanshi et al. (2019) used queueing theories to optimize wait times in hospital settings. Perera et al. (2025) further studied the operations of service flow in a higher education cafeteria setting. These pieces of research show the significance of queueing models for analysing waiting times and overall efficiency in organizations. Nevertheless, there is very scant research done on queue management systems at higher educational institutions in Papua New Guinea, specifically in PNG UNITECH mess. Additionally, most previous researches on queue management systems are done in commercial or health care sectors with only few pieces focusing on students' services in developing nations. This study seeks to contribute to this area of knowledge by applying the M/M/c model of queues to evaluate the congestion in PNG UNITECH mess and establish the minimum number of servers necessary to stabilize the system's performance.

The purposes of the study are to: (i) use the M/M/c model in analysing queue congestion at PNG UNITECH mess, (ii) assess the performance and stability of the current system through traffic intensity and waiting time measures, and (iii) find out the minimum number of servers needed for efficient operation.

This paper also contributes to the applications of mathematics in real life. Applying mathematical concepts such as mathematical model to a real-world problem. It shows how queueing theory can help students and staffs at PNG Unitech mess. It also provides real analyses for mess operations which can be helpful for future adjustments.

The use of mathematical models in solving practical operational issues has also been observed in literature reviews recently conducted. In fact, Shimishi et al. (2025) used a set covering optimization model in an effort to enhance the process of making decisions in the strategic sourcing process. They proved the efficacy of mathematical models in operation management. In this particular study, Queueing Theory is employed in the analysis of service operations at PNG UNITECH mess.

MATERIALS AND METHODS

Mathematical Model/Methodology

Unitech Mess Hall system is analysed using M/M/c queueing Theory model. The data used in this research were obtained by conducting an observational study at the PNG UNITECH mess during the peak hours when meals are being served. The data on the number of students who come to the mess, the number of serving people available, and the average service time were noted. This helped us estimate the arrival rate (λ) and service rate (μ) that were applied in the M/M/c queue model. Each food counter at the mess hall is seen as servers and the students attending the mess are seen as customers. M/M/c model has been chosen because it fits perfectly with the ongoing issue with the queue at the mess hall. Students' arrivals are not regular. It occurs randomly; more students attend mess during peak hours. The student arrivals follow a Poisson distribution. The time taken to for each server to serve each student also differs. It depends on how fast a server serves each student and is represented by exponential distribution. The mess hall is seen as the multiple -server system where multiple servers serve students simultaneously. Discussed below are the findings:

Assumptions

The following are the assumptions made to the M/M/c model:

- **The arrival rate of students retains Poisson Distribution.**

This means the arrival of one student does not affect the arrival rate of another student, and also the average rate of past doesn't affect the current rate. They are said to be independent to each other.

- **Service time follows exponential distribution**

It simply means the service time occurs continuously at an independent rate without stopping.

- **The food counters operate parallel to each other**

The food counters are next to each other. Students are served parallel to each other.

- **Students are served in First Come First Serve (FCFS) manner.**

Meaning food is served to students who arrive first at the mess and follow the same process until everyone have their turn until the last person. Which in other word means no one came last and be the first to be served but first come first serve.

- **The Queue at the mess is Infinite**

The line at the mess never stops, as time passes by the queue continuously building up, getting longer and longer every minute.

- **The arrival time and service time of each student at the mess is independent**

Means each student arrives at different times and their service time at the mess also differs from one another. The arrival time and service time of one student does not affect the other.

Variables and Notations

The variables and mathematical symbols used are defined below:

- ρ : Traffic intensity
- **λ:** the arrival rate of students
- μ: is the service rate provided by each server
- k: is number of students
- n: is the number of servers in the mess
- P_n: Probability of n students at the Mess
- L_q: Average length of the student Queue
- L: Average number of students in the Mess Hall
- W_q: Average waiting time in the Queue at mess
- W: Total expected time a student spends in the mess
- P: Probability of zero student at the mess
- FCFS: First Come First Serve
- ∞**:** Infinity

M/M/c Model

(a) Traffic intensity

Traffic intensity(ρ) is the ratio of arrival and service rate of students.

$$\rho = \frac{\lambda}{k\mu} \quad (1)$$

(b) P_n = Probability of n students in the Mess

Probabilty of n students refers to probabilty of a single student in the mess.

$$P_n = \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n P_o \quad (2)$$

(c) L_q=Average length of the student Queue

Is simply the length of the queue that student.

$$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o \quad (3)$$

(d) L=Expected number of students in the Mess Hall

Refers to the expected number of students who are at the mess or will be attending mess.

$$L = L_q + \frac{\lambda}{\mu} \quad (4)$$

(e) Wq =Average waiting time in the Queue at Mess

The time taken for the students to wait at mess queue. Wq is equals the ratio of Lq and **λ.**

$$W_q = \frac{L_q}{\lambda} \quad (5)$$

(f) W =Expected waiting time at the Mess

Refers to time expected to wait at the mess.

$$W = W_q + \frac{1}{\mu} \quad (6)$$

(g) P= Probability of zero student at the mess

Probability that no student is served at the mess.

$$P_0 = \left[\sum_{n=0}^{K-1}\frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^K}{K!\cdot(1-\rho)}\right]^{-1} \quad (7)$$

Application of Queueing theory at PNG Unitech Mess.

From observation, PNG UNITECH has two servers and on a particular evening it is observed that students arrived at a rate of 50 students per hour for dinner. The service time is 6 minutes per student. Students are served at First Come First Serve (FCFS) manner. From the observation k=2 but discussed below are the cases where k =1,2,3,4,5,6, λ= *50*/hr and μ = 1/6* 60 =10/hr. Traffic intensity formular is used to know whether the system is stable or unstable before further calculations are carried out. In order for system to be stable ρ < 1, ρ > 1 is unstable system and so no further calculations or further analysis is made. Discussed below are the two cases:

(1) Case 1: ρ > 1

- **when k = 1**

(a) Traffic intensity:

$$\rho = \frac{\lambda}{K\mu}\ ,\ 0<\rho<1 \quad \rho = \frac{50}{1(10)} = \frac{50}{10} = 5 \quad (8)$$

(b) The probability that there are no students at the mess:

$$P_0 = \left[\sum_{n=0}^{K-1}\frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^K}{K!\cdot(1-\rho)}\right]^{-1} \; P_0 = \left[\sum_{n=0}^{k-1}\frac{(50/10)^0}{0!} + \frac{(50/10)^1}{1!} + \frac{(50/10)^2}{2!(1-2.5)}\right]^{-1} = 0 \quad (9)$$

(c) Length of the student queue at the mess:

$$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o \text{ since } P_0 = 0 \text{ then } L_q = 0 \quad (10)$$

(d) Average waiting time in the Queue at mess:

$$W_q = \frac{L_q}{\lambda} = 0 \quad (11)$$

(e) Expected time a student spends in the mess hall

$$W = W_q + \frac{1}{\mu} = 0 + 1/10 = 0.1/\text{hr} \quad (12)$$

(f). Probability of n student in the mess

$$P_n = \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n P_o = 0 \quad (13)$$

(g) Average length of the student Queue

$$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o = 0 \quad (14)$$

- **When k = 2**

(a) Traffic intensity:

$$\rho = \frac{\lambda}{K\mu}\ ,\ 0<\rho<1 \quad \rho = \frac{50}{2(10)} = \frac{50}{20} = 2.5 \quad (15)$$

(b) The probability that there are no students at the mess:

$P_0 = \left[\sum_{n=0}^{K-1}\frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^K}{K!\cdot(1-\rho)}\right]^{-1}$ $P_0 = \left[\sum_{n=0}^{k-1}\frac{(50/10)^0}{0!} + \frac{(50/10)^1}{1!} + \frac{(50/10)^2}{2!(1-2.5)}\right]^{-1} = 0$ (16)

(c) Length of the student queue at the mess:

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o$ since P_0= 0 then $L_q = 0$ (17)

(d) Average waiting time in the Queue at mess:

$W_q = \frac{L_q}{\lambda} = 0$ (18)

(e) Expected time a student spends in the mess hall

$W = W_q + \frac{1}{\mu}$ = 0 + 1/10 = 0.1/hr (19)

(f). Probability of n student in the mess

$P_n = \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n P_o = 0$ (20)

(g) Average length of the student Queue

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o = 0$ (21)

- **When k =3**

(a) Traffic intensity:

$\rho = \frac{\lambda}{K\mu}$, $0 < \rho < 1$ $\rho = \frac{50}{3(10)} = \frac{50}{30} = 1.66$ (22)

(b) The probability that there are no students at the mess:

$P_0 = \left[\sum_{n=0}^{K-1}\frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^K}{K!\cdot(1-\rho)}\right]^{-1}$ $P_0 = \left[\sum_{n=0}^{k-1}\frac{(50/10)^0}{0!} + \frac{(50/10)^1}{1!} + \frac{(50/10)^2}{2!(1-2.5)}\right]^{-1} = 0$ (23)

(c) Length of the student queue at the mess:

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o$ since P_0= 0 then $L_q = 0$ (24)

(d) Average waiting time in the Queue at mess:

$W_q = \frac{L_q}{\lambda} = 0$ (25)

(e) Expected time a student spends in the mess hall

$W = W_q + \frac{1}{\mu}$ = 0 + 1/10 = 0.1/hr (26)

(f). Probability of n student in the mess

$P_n = \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n P_o = 0$ (27)

(g) Average length of the student Queue

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o = 0$ (28)

- **When k =4**

(a) Traffic intensity:

$\rho = \frac{\lambda}{K\mu}$, $0 < \rho < 1$ $\rho = \frac{50}{4(10)} = \frac{50}{40} = 1.25$ (29)

(b) The probability that there are no students at the mess:

$P_0 = \left[\sum_{n=0}^{K-1}\frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^K}{K!\cdot(1-\rho)}\right]^{-1}$ $P_0 = \left[\sum_{n=0}^{k-1}\frac{(50/10)^0}{0!} + \frac{(50/10)^1}{1!} + \frac{(50/10)^2}{2!(1-2.5)}\right]^{-1} = 0$ (30)

(c) Length of the student queue at the mess:

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o$ since P_0= 0 then $L_q = 0$ (31a)

(d) Average waiting time in the Queue at mess:

$W_q = \frac{L_q}{\lambda} = 0$ (31b)

(e) Expected time a student spends in the mess hall

$W = W_q + \frac{1}{\mu}$ = 0 + 1/10 = 0.1/hr (32)

(f). Probability of n student in the mess

$P_n = \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n P_o = 0$ (33)

(g) Average length of the student Queue

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o = 0$ (34)

- **When k =5**

(a) Traffic intensity:

$\rho = \frac{\lambda}{K\mu}$, $0 < \rho < 1$ $\rho = \frac{50}{5(10)} = \frac{50}{50} = 1$ (35)

(b) The probability that there are no students at the mess:

$P_0 = \left[\sum_{n=0}^{K-1}\frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^K}{K!\cdot(1-\rho)}\right]^{-1}$ $P_0 = \left[\sum_{n=0}^{k-1}\frac{(50/10)^0}{0!} + \frac{(50/10)^1}{1!} + \frac{(50/10)^2}{2!(1-2.5)}\right]^{-1} = 0$ (36)

(c) Length of the student queue at the mess:

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o$ since P_0= 0 then $L_q = 0$ (37)

(d) Average waiting time in the Queue at mess:

$W_q = \frac{L_q}{\lambda} = 0$ (38)

(e) Expected time a student spends in the mess hall

$W = W_q + \frac{1}{\mu}$ = 0 + 1/10 = 0.1/hr (39)

(f). Probability of n student in the mess

$P_n = \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n P_o = 0$ (40)

(g) Average length of the student Queue

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2}\cdot P_o = 0$ (41)

(2) Case 2 : $\rho < 1$,

- **when k = 6**

(a) Traffic intensity:

$\rho = \frac{\lambda}{K\mu}$, $0 < \rho < 1$ $\rho = \frac{50}{6(10)} = \frac{50}{60} = 0.83$ (42)

(b) The probability that there are no students at the mess:

$P_0 = \left[\sum_{n=0}^{K-1} \frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^K}{K!\cdot(1-\rho)}\right]^{-1}$ $P_0 = \left[\sum_{n=0}^{k-1} \frac{(50/10)^0}{0!} + \frac{(50/10)^1}{1!} + \frac{(50/10)^2}{2!(1-2.5)}\right]^{-1} = 0.4512$ (43)

(c) Length of the student queue at the mess:

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2} \cdot P_o = 2.9376$ (44)

(d) Average waiting time in the Queue at mess:

$W_q = \frac{L_q}{\lambda} = 0.05875$ (45)

(e) Expected time a student spends in the mess hall

$W = W_q + \frac{1}{\mu} = 0.05875 + 1/10 = 0.1588$ (46)

(f). Probability of n student in the mess

$P_n = \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n P_o = 9.79\%$ (47)

- **when k = 7**

(a) Traffic intensity:

$\rho = \frac{\lambda}{K\mu}$, $0 < \rho < 1$ $\rho = \frac{50}{7(10)} = \frac{50}{70} = 0.7142$ (48)

(b) The probability that there are no students at the mess:

$P_0 = \left[\sum_{n=0}^{K-1} \frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^K}{K!\cdot(1-\rho)}\right]^{-1}$ $P_0 = \left[\sum_{n=0}^{k-1} \frac{(50/10)^0}{0!} + \frac{(50/10)^1}{1!} + \frac{(50/10)^2}{2!(1-2.5)}\right]^{-1} = 0.5975$ (49)

(c) Length of the student queue at the mess:

$L_q = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^K}{(k-1)!\cdot(k\mu-\lambda)^2} \cdot P_o = 0.8104$ (50)

(d) Average waiting time in the Queue at mess:

$W_q = \frac{L_q}{\lambda} = 0.0162$ (51)

(e) Expected time a student spends in the mess hall

$W = W_q + \frac{1}{\mu} = 0.0162 + 1/10 = 0.1162$ (52)

(f). Probability of n student in the mess

$P_7 = \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n P_o = 9.26\%$ (53)

RESULTS AND DISCUSSION

Summarized below are the results obtained from numerical approach discussed above. The data are summarised on the Table 1.

Number of Servers(k)	Waiting time (Wq)	Length of Queue (Lq)	Traffic Intensity(p)
1	unstable	infinity	5 (p>1)
2	unstable	infinity	2.5 (p>1)
3	unstable	infinity	1.66 (p>1)
4	unstable	infinity	1.25 (p>1)
5	unstable	Infinity	1
6	0.05875hrs	2.9376 students	0.83(p<1)
7	0.0162hrs	0.8104 students	0.7142(p<1)

Table 1: Summary of the numerical problems solved above.

Interpretation: From the summary table above, it shows clearly that as Number of Servers increases the Waiting Time (Wq) and Length of the queue (Lq) decreases. It shows that we can have maximum of 5 servers at the mess and still facing queue problems. From the traffic intensity column, it clearly shows system stability. When p> 1, system is said to be unstable and when p<1 system is stable. When k= 6 and 7 the system is stable, where waiting time and length of the queue decreases rapidly. To sum up, PNG Unitech mess needs exactly k≥ 6 servers for system to be stable and to solve the queue problem for once and for all.

To further the demonstrate the M/M/2 model, fifteen students are selected at random from PNG Unitech mess. The estimation of time taken for the 15 randomly selected students are displayed on the table and also graphed. Below are the results obtained from Excel. Table below shows the multiple server model M/M/2 for students at the mess. It shows number of students, the arrival time, service start time, service time, waiting time and system time. Where $\lambda = 50$/hr, $\mu = 10$/hr and k= 2 (Yaduvanshi et al., 2019). This part is divided into three (3) sections:

(i) Table 2: Summarizes the time taken for each student at each activity at the mess.

Student #	Arrival time	Service Start	Service time	Waiting time	System time	Student Count
1	0.01096979	0.010969789	0.010270158	0	0.010270158	1
2	0.02597839	0.025978387	0.026822578	0	0.026822578	2
3	0.04963828	0.052800965	0.042850189	0.003162682	0.046012871	3
4	0.0651049	0.095651154	0.063730508	0.030546255	0.094276763	4
5	0.11933718	0.159381662	0.070079826	0.040044484	0.11012431	5
6	0.12232544	0.229461488	0.123954691	0.107136044	0.231090735	6
7	0.1425022	0.353416178	0.102663891	0.210913974	0.313577864	7
8	0.15153091	0.456080069	0.002761415	0.304540154	0.307301569	8
9	0.15991251	0.458841434	0.080098827	0.298928974	0.379027801	9
10	0.17672716	0.53894031	0.015805835	0.362213154	0.378018989	10
11	0.1825635	0.554746145	0.075983924	0.372182648	0.448166572	11
12	0.18538153	0.630730069	0.213966814	0.445348543	0.659315357	12
13	0.18752438	0.844696883	0.100647883	0.657172504	0.757820387	13
14	0.2239183	0.945344766	0.013369482	0.721426465	0.734795947	14
15	0.23001197	0.958714248	0.12713792	0.728702282	0.855840203	15

(ii)Graph representation: Graph below shows the information on Table 2. It shows the number of students on the x- axis, ranging from (1-15) and the time taken on y-axis ranging from (0-35).

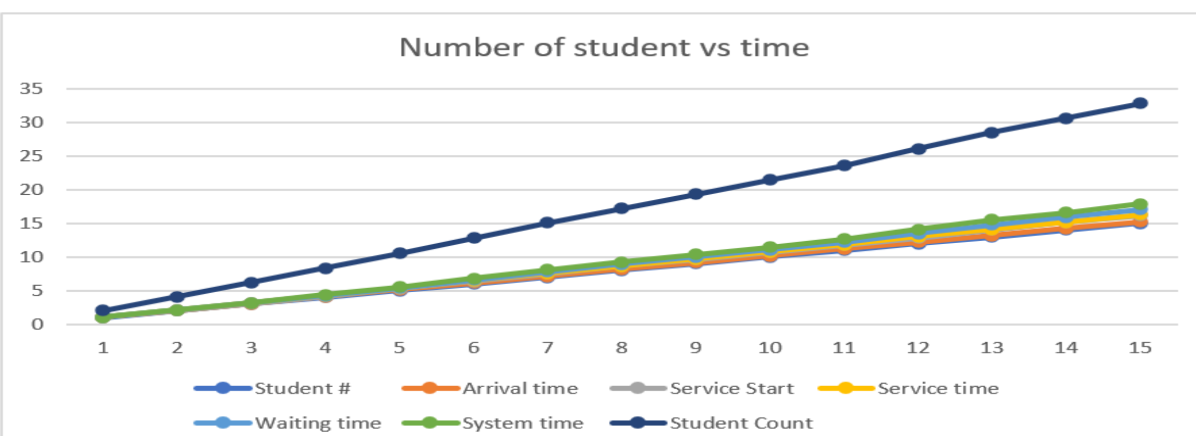
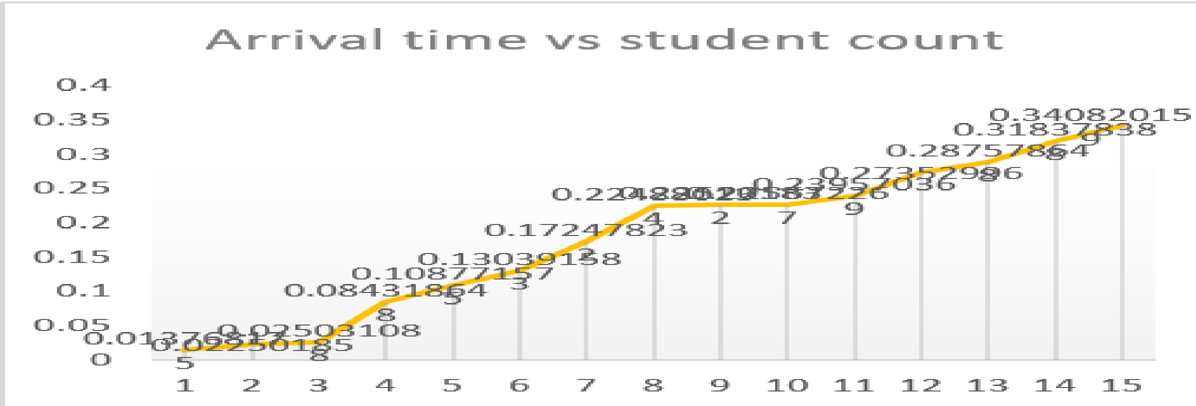
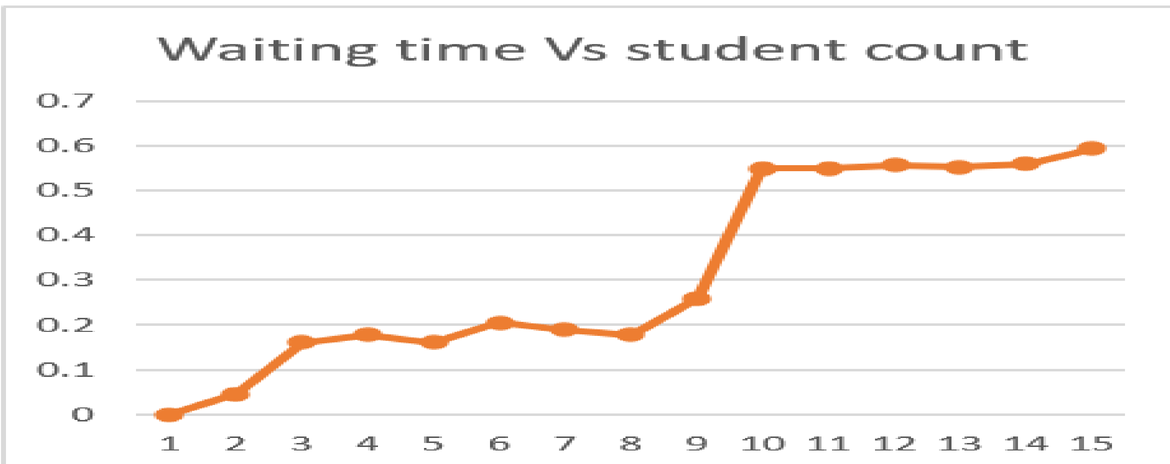
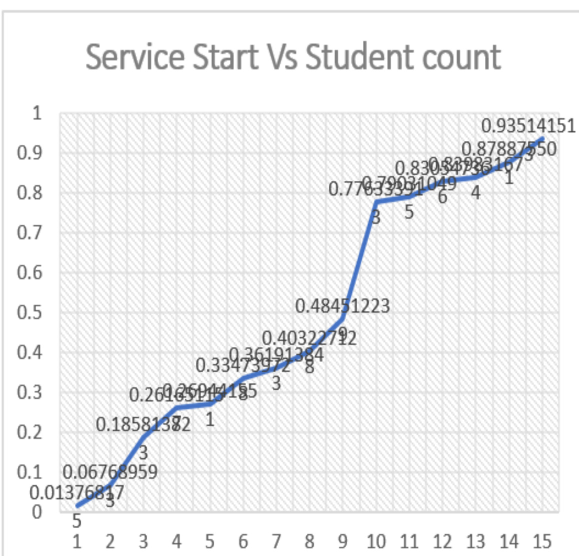


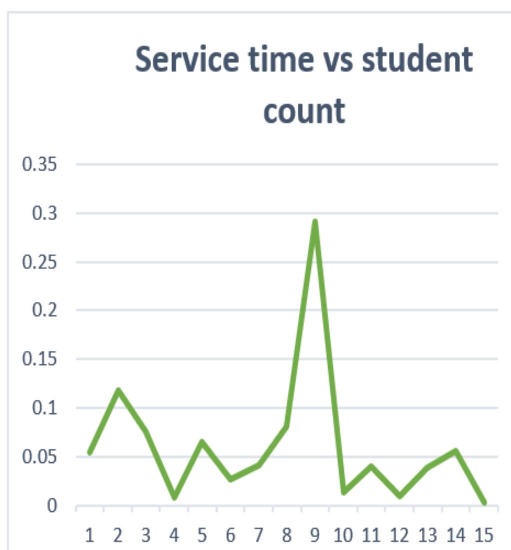
Figure 1: Graph representing the number of students and the average time taken at the

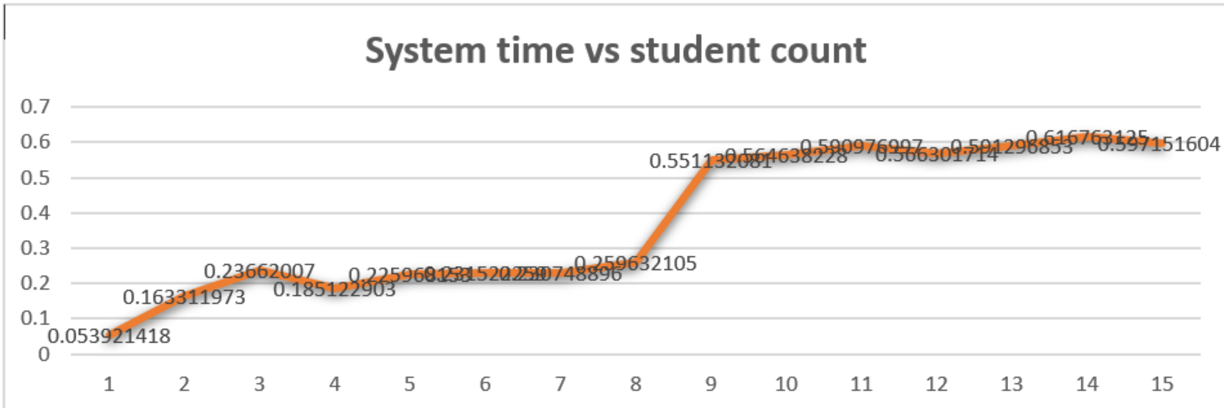
(iii) Graph above is separated into its constituent parts:











The results from Table 1 shows clearly the stability of the system. It shows that when number of servers(k) increases, the waiting time and the service time decreases. When k ≥ 6 the system is stable and the traffic intensity is less than 1. Which means there's no queue at the mess. From Table 2, it shows that as number of student increases, the time taken also increases exponentially. This exponential behaviour was also shown by the graph representation in Figure 4. The Figures on (iii) are the constituent parts of graph on Figure 1. The graphs demonstrated clearly that when more students are at the mess, it takes more time to serve them but when a smaller number of students are attending mess, it takes less time to serve them. The greater the number of students(customers) the longer the queue. This research confirms the results found by other studies in queueing theory, where an increase in the number of servers leads to a decrease in waiting time and improved performance of the process. It is evident from this research that the number of servers at PNG UNITECH mess is inadequate, leading to the instability of queues. In terms of practice, an increase in the number of servers can make the processes more efficient and help the students save their time while eating their meals. This paper is also in contrast with the paper written. Furthermore, this paper only analysed queueing problem using multiple server theory in the case where traffic intensity is less than one (p<1). To know more, the future researchers should carry out similar research using queueing theory on other scenarios where queueing is the problem.

There are some limitations of this research study. First, the observations made for this research were made for a certain time period, assuming that the distribution of arrival rates is Poisson distribution and that of service time is exponential distribution. Queue behaviour may differ depending upon various factors. Another future scope of this research is to gather data over a long period.

CONCLUSION

In this study, an analysis was conducted using the M/M/c Queueing Theory to identify the congestion problem in queues at PNG UNITECH mess. It was found out that with the current server setup of two servers, the system is inefficient and unstable because the arrival rate cannot be handled by the service system leading to extended waiting times. From the alternative solutions, it was discovered that for stability to occur, six servers must be considered, thus decreasing waiting time and queue lengths.

In conclusion, this paper has presented valuable information on how queue systems may be managed at the PNG UNITECH mess. This study further illustrates the effectiveness and application of Queueing Theory in solving practical issues and is applicable to educational settings among other settings.

Acknowledgement

I would like to express my gratitude to Papua New Guinea University of Technology, school of Mathematics and Computer Science for providing the guidance, support and resources that made this work possible. The University's input towards my studies is greatly appreciated.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

REFERENCE

Goswami, P., Rao, G. J., & Verma, A. (2023). The use of queuing theory improved the service of a restaurant. *Mathematical Statistician and Engineering Applications, 72*, 51–59.

Keerthika, R., Niranjan, S. P., & Komala Durga, B. (2025). A survey on the tandem queueing models. *Scope, 14*, 134–148. https://doi.org/10.2139/ssrn.4758285

Liu, S., Xu, X., & Liu, K. (2026). Game equilibrium and simulation in M/M/1 retrial queues with standby mechanism. *Methodology and Computing in Applied Probability, 28*, 37. https://doi.org/10.1007/s11009-026-10272-z

Liu, X., Xu, X., & Liu, M. (2024). Strategy analysis of retrial queue with parallel customer and standby server. *Methodology and Computing in Applied Probability*, *26*, 27. https://doi.org/10.1007/s11009-024-10098-7

Patricia, F., & Abirami, S. (2024). Managing traffic intensity with queuing theory. *Louis Savinien Dupuis Journal of Multidisciplinary Research*, 132–138. https://doi.org/10.21839/lsdjmr.2024.v3.116

Perera, U., Sandeepani, S., Narthana, A., & Abeygunawardana, R. (2025). *An analysis of service flow in a higher education cafeteria in Colombo using queuing theory.*

Shimishi, S. T., Abdullahi, N., Dari, S., & Awwalu, H. B. (2025). A set covering model for optimizing selection of contract bidding in a strategic sourcing process: A case study of the Nigerian Airforce. *Journal of Basics and Applied Sciences Research, 3*(4), 78–91. https://doi.org/10.4314/jobasr.v3i3.10

Yaduvanshi, D., Sharma, A., & More, P. V. (2019). Application of queuing theory to optimize waiting-time in hospital operations. *Operations and Supply Chain Management*, *12*(3), 165–174. https://doi.org/10.31387/oscm0380240