Data Article

Survey dataset on analysis of queues in some selected banks in Ogun State, Nigeria

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A B S T R A C T

Queuing theory is the mathematical study of waiting queues (or lines). The theory enables the mathematical analysis of several related processes such as arriving at the queue, waiting in line and being served by a server. This data article contains the analysis of queuing systems obtained from queues from the observed data of some selected banks in Ogun State. One of the gains expected from this survey, is to help review the efficiency of the models used by banks in such geographical locations in sub-Saharan countries. The Survey attempts to estimate the average waiting time and length of queue(s).

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Specifications Table

| Subject area       | Decision sciences                  |
|--------------------|------------------------------------|
| More specific subject area | Queuing analysis, operations research, statistics |
| Type of data       | Tables                             |
| How data was acquired          | Field Survey and with the aid of stop watch and a recorder. |
| Data format         | Analyzed                           |
| Experimental factors | Simple random sampling of some selected Banks in Urban areas of Ogun State, Nigeria. |

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Experimental features | Analysis of the waiting and service times of selected customers.
---|---
Data source location | Covenant University Ota, Ogun State, Nigeria
Data accessibility | All the data are in this data article

Value of the data

- The data could be useful in detecting the causes and proffering solutions to the problem of queues.
- Queues are necessary if order is to be maintained in the society, but most queues in sub-Saharan countries constitute a menace and sometimes end in riot and mob actions. Hence the data can be useful for security agents responsible for maintaining law and order [1,2].
- The data could be used by banking regulatory bodies in Nigeria.
- The analysis of the data could be helpful in time management especially at peak periods [3].
- The data can also help the banks to improve on their services [4–6].
- The data can also help to rate the banks in terms of customers services satisfaction.

1. Data

The data was collected from three banks in three different urban areas of Ogun State. The data was generated using a stop watch and a recorder to note the arrival time, the time spent on the queue (waiting time) before being attended to and the time used to serve a customer (Service time).

The notations used for the presentation of data are $X_1, X_2, X_3,$ and $N_1$ for the first bank $Y_1, Y_2, Y_3,$ and $N_2$ for the second bank and $Z_1, Z_2, Z_3,$ and $N_3$ for the third bank respectively. They denote the following:

- $X_1, Y_1$ and $Z_1$ represents the time range when a customer arrives at the bank and the time his/her cheque or withdrawal booklet was collected for the first, second and third bank respectively.
- $X_2, Y_2$ and $Z_2$ represents the time used to process the cheque or withdrawal booklet in the first, second, and third banks respectively.
- $X_3, Y_3$ and $Z_3$ represents the total time in the system in the first, second, and third banks respectively.
- $N_1, N_2$ and $N_3$ represents the number of people who came to the first, second and third banks and were attended to.

The data taken covers only twelve weeks. Four weeks for each bank and the time is measured in minutes.

2. Experimental design, materials and methods

The study of queues is the study of waiting times which often results to models that predicts queue length and waiting time. The models are also used to make decisions on how to increase servers, optimize queue length and waiting time. Queue is often characterized by the following presented in Table 1.

Table 1

Features of queue.

|   |
|---|---|
| 1 | Queue is a linear data structure. |
| 2 | In queues insertion can take place at only one end called rear. |
| 3 | In queues deletions can takes place at the other end called front. |
| 4 | Queues are called FIFO (first in first out). The element first into the queue is the element deleted first from the queue. |
| 5 | Queues are also called LILO (last in last out). The element entered last into the queue is the element deleted last from the queue. |
Several operations can be done on queues which are listed as:

1. **Insertion**: inserting a new element into the queue.
2. **Deletion**: deleting a new element from the queue.
3. **Display**: visit each node at least once.

- Queue is full - there is no room to insert a new element.
- Queue is empty - there is no element to delete from queue.

There are several methods of investigating phenomena that are modeled as queuing problems. Some are mentioned as follows:

i. Direct observation of practical situation
ii. The planned experiment under artificial conditions
iii. The simulation method
iv. The Mathematical Analysis method
v. Product-form solutions method
vi. Methods from complex-function theory
vii. Analytic-algorithmic methods
viii. Heavy and light traffic approximations

It is noteworthy that not all queuing problems can be investigated mathematically. Some investigators using (i) and (ii) above require a clear out study of the situation and therefore, necessary adjustments and manipulations are made.

### Table 2
The queuing data for the first bank.

| Weeks | Days       | X₁ | X₂ | X₃ | N₁   |
|-------|------------|----|----|----|------|
| 1st   | MONDAY     | 12 | 26 | 38 | 880  |
|       | TUESDAY    | 5  | 19 | 24 | 720  |
|       | WEDNESDAY  | 6  | 8  | 14 | 1020 |
|       | THURSDAY   | 11 | 20 | 31 | 802  |
|       | FRIDAY     | 17 | 15 | 32 | 522  |
|       | MONDAY     | 20 | 13 | 33 | 989  |
|       | TUESDAY    | 22 | 18 | 40 | 684  |
| 2nd   | WEDNESDAY  | 24 | 19 | 43 | 548  |
|       | THURSDAY   | 23 | 9  | 32 | 1021 |
|       | FRIDAY     | 25 | 20 | 45 | 789  |
|       | MONDAY     | 8  | 15 | 23 | 1000 |
|       | TUESDAY    | 10 | 22 | 32 | 990  |
| 3rd   | WEDNESDAY  | 11 | 10 | 21 | 1001 |
|       | THURSDAY   | 10 | 15 | 25 | 1051 |
|       | FRIDAY     | 7  | 17 | 24 | 982  |
|       | MONDAY     | 7  | 9  | 16 | 857  |
|       | TUESDAY    | 10 | 9  | 19 | 981  |
| 4th   | WEDNESDAY  | 10 | 6  | 16 | 1057 |
|       | THURSDAY   | 5  | 20 | 25 | 899  |
|       | FRIDAY     | 10 | 12 | 22 | 996  |
| Total |            | 253| 302| 555| 17,789|
Table 3
The queuing data for the second bank.

| Weeks | Days     | $Y_1$ | $Y_2$ | $Y_3$ | $N_2$ |
|-------|----------|-------|-------|-------|-------|
| 1st   | MONDAY   | 16    | 8     | 24    | 1034  |
|       | TUESDAY  | 17    | 15    | 32    | 789   |
|       | WEDNESDAY| 18    | 8     | 26    | 1002  |
|       | THURSDAY | 13    | 15    | 28    | 910   |
|       | FRIDAY   | 10    | 6     | 16    | 931   |
|       | MONDAY   | 16    | 14    | 30    | 748   |
|       | TUESDAY  | 14    | 9     | 23    | 924   |
| 2nd   | WEDNESDAY| 9     | 17    | 26    | 872   |
|       | THURSDAY | 18    | 10    | 28    | 764   |
|       | FRIDAY   | 15    | 10    | 25    | 890   |
|       | MONDAY   | 15    | 19    | 34    | 971   |
|       | TUESDAY  | 23    | 18    | 41    | 685   |
| 3rd   | WEDNESDAY| 30    | 10    | 40    | 724   |
|       | THURSDAY | 28    | 9     | 37    | 873   |
|       | FRIDAY   | 26    | 18    | 44    | 605   |
|       | MONDAY   | 10    | 32    | 42    | 1017  |
|       | TUESDAY  | 7     | 17    | 24    | 1009  |
| 4th   | WEDNESDAY| 12    | 19    | 31    | 891   |
|       | THURSDAY | 11    | 26    | 37    | 948   |
|       | FRIDAY   | 13    | 14    | 27    | 901   |
|       | **Total**| **321**| **294**| **615**| **17,488** |

Table 4
The queuing data for the third bank.

| Weeks | Days     | $Z_1$ | $Z_2$ | $Z_3$ | $N_3$ |
|-------|----------|-------|-------|-------|-------|
| 1st   | MONDAY   | 10    | 12    | 22    | 767   |
|       | TUESDAY  | 12    | 11    | 23    | 930   |
|       | WEDNESDAY| 7     | 7     | 14    | 921   |
|       | THURSDAY | 22    | 10    | 32    | 878   |
|       | FRIDAY   | 11    | 12    | 23    | 790   |
|       | MONDAY   | 11    | 18    | 29    | 876   |
|       | TUESDAY  | 18    | 14    | 32    | 923   |
| 2nd   | WEDNESDAY| 12    | 14    | 26    | 910   |
|       | THURSDAY | 10    | 18    | 28    | 1002  |
|       | FRIDAY   | 9     | 8     | 17    | 949   |
|       | MONDAY   | 16    | 10    | 26    | 934   |
|       | TUESDAY  | 8     | 6     | 14    | 1011  |
| 3rd   | WEDNESDAY| 12    | 7     | 19    | 874   |
|       | THURSDAY | 8     | 10    | 18    | 762   |
|       | FRIDAY   | 6     | 9     | 15    | 631   |
|       | MONDAY   | 13    | 12    | 25    | 989   |
|       | TUESDAY  | 15    | 8     | 23    | 784   |
| 4th   | WEDNESDAY| 16    | 14    | 30    | 648   |
|       | THURSDAY | 10    | 8     | 18    | 891   |
|       | FRIDAY   | 11    | 15    | 26    | 752   |
|       | **Total**| **237**| **223**| **460**| **17,222** |
### Table 5
Description statistics for the queuing data of the first bank.

| Statistic          | $X_1$ | $X_2$ | $X_3$ | $N_1$ |
|--------------------|-------|-------|-------|-------|
| Mean               | 12.65 | 15.1  | 27.75 | 889.45 |
| Standard Error     | 1.483728 | 1.220224311 | 2.028578709 | 36.38272255 |
| Median             | 10    | 15    | 25    | 981.5 |
| Mode               | 10    | 20    | 32    | N/A   |
| Standard Deviation | 6.635431 | 5.457009013 | 9.072079782 | 162.7084816 |
| Sample Variance    | 44.02895 | 29.77894737 | 82.30262158 | 26474.05 |
| Kurtosis           | 0.78814 | 0.85103544 | 0.74558109 | 0.31834698 |
| Skewness           | 0.800322 | 0.058384533 | 0.371099032 | −1.13689222 |
| Range              | 20    | 20    | 31    | 535   |
| Minimum            | 5     | 6     | 14    | 522   |
| Maximum            | 25    | 26    | 45    | 1057  |

### Table 6
Description statistics for the queuing data of the second bank.

| Statistic          | $Y_1$ | $Y_2$ | $Y_3$ | $N_2$ |
|--------------------|-------|-------|-------|-------|
| Mean               | 16.05 | 14.4  | 30.75 | 874.4 |
| Standard Error     | 1.418812 | 1.350244 | 1.669975 | 26.63826 |
| Median             | 15    | 14.5  | 29    | 896   |
| Mode               | 16    | 10    | 24    | N/A   |
| Standard Deviation | 6.345118 | 6.038473 | 7.468354 | 119.1299 |
| Sample Variance    | 40.26053 | 36.46316 | 55.77632 | 14191.94 |
| Kurtosis           | 0.177576 | 2.405767 | −0.61616 | −0.19879 |
| Skewness           | 0.906584 | 1.132334 | 0.190103 | −0.71182 |
| Range              | 23    | 26    | 28    | 429   |
| Minimum            | 7     | 6     | 16    | 605   |
| Maximum            | 30    | 32    | 44    | 1034  |

### Table 7
Description statistics for the queuing data of the third bank.

| Statistic          | $Z_1$ | $Z_2$ | $Z_3$ | $N_3$ |
|--------------------|-------|-------|-------|-------|
| Mean               | 11.85 | 11.15 | 23    | 861.1 |
| Standard Error     | 0.880416 | 0.785644 | 1.289635 | 24.48328 |
| Median             | 11    | 10.5  | 23    | 884.5 |
| Mode               | 10    | 12    | 23    | N/A   |
| Standard Deviation | 3.937338 | 3.513508 | 5.767422 | 109.4926 |
| Sample Variance    | 15.50263 | 12.34474 | 33.26316 | 11988.62 |
| Kurtosis           | 0.97078 | −0.48582 | −1.07621 | −0.24494 |
| Skewness           | 0.940453 | 0.516912 | −0.0823 | −0.69166 |
| Range              | 16    | 12    | 18    | 380   |
| Minimum            | 6     | 6     | 14    | 631   |
| Maximum            | 22    | 18    | 32    | 1011  |

### Table 8
ANOVA result.

| Source of Variation | SS     | df | MS    | $F$    | $P$-value | $F$ crit |
|---------------------|--------|----|-------|--------|-----------|----------|
| Between Groups      | 610.8333 | 2  | 305.4167 | 5.347489 | 0.00744  | 3.158843 |
| Within Groups       | 3255.5  | 57 | 57.11404 |        |           |          |
| Total               | 3866.333 | 59 |        |        |           |          |
2.1. **Method of data collection**

The investigators made use of (i) and (ii) mentioned above and with the aid of a stop watch and a recorder.

2.2. **Data presentation**

The data are presented in Tables 2–4. It should be noted that the departure time was not captured because the customers often wait behind to count their money, wait for those that accompanied them or make non-transaction activities such as renewal of Automated teller machine (ATM) cards, registration of bank verification number, enquiries on new banking products and other complaints. The raw data containing the arrival times of the customers can be assessed as Supplementary Data.

2.3. **Descriptive statistics**

The descriptive statistics for the data are summarized as follows for the data of the first, second and the third banks respectively. These are shown in Tables 5–7.

2.4. **Analysis of variance**

Analysis of variance (ANOVA) is done to investigate mean differences among the total time spent by the customers in the three banks. The result is presented in Table 8.

There are significant mean differences among the total time spent by the customers in the three banks at 0.05 level of significance.

Further analysis of data can be carried out in the following areas using any of the statistical tools applied in Refs. [7–11].

i. The utilization factor or traffic intensity can be calculated using the arrival rate and the service time. This can used to determine average needed servers, number of automated banking machines (ATM). See Refs. [2,4–6].

ii. The confidence intervals for average service rate and average arrival rate can be estimated assuming the service time and arrival time are independent and identically distributed.

iii. The data can be analyzed pictorially, that is using a Bar chat, Pie chat to show the traffic intensity and efficiency of the servers.

iv. The results from each bank can be compared to determine the level of service efficiency.

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**Transparency document. Supporting information**

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.05.101.
Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.05.101.

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