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Evaluation of Customer Service Delivery in Banking Operation Using Python

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Abstract: With competition intensifying across service-oriented business, customer satisfaction is the name of the game. If customers did not perceive the orgnisation well, the company will definitely run out of business. This paper analysed the data collected from customer service unit of a particular bank using Jupyter note - a framework under Python programming language to know customers need and to improve customer satisfaction. From the analysis, it was discovered that there were six (6) purposes of customers' visitation to the banking hall i.e six services were rendered by the customer service unit of the bank, they are: account authentication; account list; authenticate user; balance check; fund transfer and register customer. All services except Balance Check and Fund Transfer are at their peak in the morning by 8am. Also, user authentication has highest queue length of 450 customers in the morning (8:00am). It was also discovered that customers call for services in the early part of the day and keeps decreasing until the break period when customers will be able to visit bank to make their transactions. Among all the services rendered by the bank, account authentication has the highest average queue length, followed by fund transfer, customers registration, user authentication, balance check and account listing with values 141.000, 131.600, 104.100, 103.500, 96.625 and 51.500 respectively for the month of April. This study was able to learn how customers really feel about the services rendered by the bank and the bank also has been able to know the level of the customers satisfaction, how to improve on the services render and where the immediate focus need to be in order to accelerate the bank growth because satisfied customers will buy more, stay longer and share their positive experience.

Keywords: Python, Jupyter Notebook, Heat Map

1. Introduction

In any service-oriented organization such as banking sector, the customer satisfaction is determined by the quality of service rendered by the organization. Customer satisfaction is determined by his or her perception of the quality of service received in transaction. An identified major factor in achieving success in business is the customer satisfaction which is enhanced by improved service in any service organization, the time that the customers are required to wait in receiving service is always of great concern to the management of such organization. For instance, service quality and delivery are taken to be the core area of concentration in banks to which special attention is always given. This is important because the banking sector is the core component of the financial system of any country that provides various financial services to support capital markets, insurance and asset management in terms of payment services, intermediation between savers and borrowers; and insurance against risk. These services mentioned are all essential to a functional economy [12].

This paper aimed at studying and analyzing raw data to determine the patterns, relationships, trend of services rendered by the system, the services demanded by customers, and the customers level of satisfaction using jupyter notebook. Jupyter notebook is a python substructure that allows researchers to utilize a computational information.

Primary data were collected from a particular bank

customer service unit for this study. The data were cleaned and analyzed for the purpose of reducing a large data into smaller ones. Three very important steps were taken while analyzing the data using jupyter notebook; these were: data organization, summarization and categorization.

2. Literature Review

In this section, data, process of data cleaning, analysis in jupyter notebook, other works done on customers' service and satisfaction, were reviewed.

A Data

Konstantina [1] defines data to consists facts and figures intended for a particular purpose, purposes like surveying and analytical study. An organized data is called information. Data sources can be primary or secondary. Data that has not been worked on are called primary data while the one that have been worked on either statically analysed the data or categorizing the data to get a particular pattern are called secondary data. Census data is an example of primary data while data that researchers have previously worked on and made available either in published or unpublished form is a type of secondary data [2].

Data are of two main types, namely: quantitative and qualitative. Quantitative data involves numbers and things objectively measurable, e.g time, price weight, temperature and so on. Quantitative data, which is also referred to as Numeric Data, has two types namely: Continuous and Discrete. According to Sileyew [3], counts are discrete and measurements are continuous.

Qualitative data includes properties and descriptions that cannot be measured easily, but can be observed subjectively. Example are: smells, tastes, textures, attractiveness, and color [4].

B Data Cleaning

The research focus of both Industries and academia are now on Big data analytics. Data science strives at extricating knowledge and information from data. Big data and data science can be applied in different fields of study like pattern recognition, signal processing, information science, statistics and machine learning. In other to successfully predict direction of future events, it is pertinent to integrate technologies and analysis effectively [5]. Raw data, also known as dirty data has the attributes of inconsistency, inaccuracy and incompleteness. are usually inconsistent, inaccurate and incomplete, which are called dirty data. Dirty data analytical results cannot be reckon with because top-quality decisions are based on data that are of top-quality. As a result of this, raw data cannot be used directly to carry out analytical processes, they have to undergo cleaning process. Cleaning of data is to remove the inconsistency, inaccuracy and incompleteness from data and this significantly improves the data quality [6].

C Python

Python is a high-level language that is easily interpreted, interactive and object-oriented. It is highly readable as its keywords are frequently English. Comparing python to other languages, its syntactical constructions are less [7]. Python is not processed at run-time by the interpreter. The python interpreter does not need to compile the whole program before executing it. It does it line by line as it progresses following a top-down approach. Python supports the development of a wide range of applications such as simulation, web developments, machine learning, cyber security and data analysis. Jupyter is a frame work under python known as computational notebook which is a free open-source and interactive web tool [8]. "Jupyter" is derived from the words Julia, Python, and R.

D Customer Services /Satisfaction

According to Anderson and Fornell [9], customer satisfaction is a virtue that should be treated like any other physical asset which requires proper monitoring and management. But traditional measurement is not good enough since most customers who are not satisfied do not complain or a good portion of the complaints do not get to the upper management. This is as a result of selective information feedback and subjective knowledge. (Singh, 2014) explains the issue of customer and he focus on bank. He explained that the issue of customer centricity in banks is to maintain the old customers and add newustomers to its portfolio. He further highlighted four key areas that banks need to focus on in other to becoming more customer-centric, these are:

i. Managing Customer Information.
ii. Using Multi-Channel Integration for processing plan.
iii. Excellent Delivery of Service.
iv. Intelligent Cross-Selling in Real-Time.

Also, according to Amritpal and Singh, (2017) customer behavior and customer satisfaction are part of the large assessment to figure out the best plan for queue management in any organization. Customer Flow Management (CFM) facilitates effective customer service. It is important for organizations to review the entire customer flow process and reduce the time spent on each section of the process to be as short as possible. Particularly, in business where there are physical dealings with the customers, such as in restaurants, banks, retail stores, government service office, financial service providers and hospitals, Organisations can boost their bottom line and level of customer satisfaction by effectively implementing the customer service practices. The organizations has to put together the following data for implementation of Customer Management:

i. The number of customers that arrive per day.
ii. Average Waiting Time of a customer before being served.
iii. A number of "open" service points at a particular time.
iv. The information about the peak customer time.
v. Customer feedback and identifiable patterns regarding the productivity of the staff that serves the customers.

E. Bank as a service system

Bank as a system mostly involves tellers, ATM machines, loan officers, and so on ordinarily. Customers representing system entity arrive to the service system, request the service, receive the service, and leave the service system [13]. For

instance, customers arrive at a bank and select/request the kind of service they wish to do such as making deposits, withdrawals, money transfers, and so on. Other examples include patients at a hospital and customers at a restaurant (Wiley, 2009). Appropriate facility layout both service providers and customers is critical to the performance of the service system [14]. Safety and operational requirements as well as building codes are essential when designing the service facility. The flow of service in the facility is a combination of art and design, regulations, and business needs [15].

F. Mathematical models of queuing theory

Mathematical models are idealized concise representations of a problem or system that are expressed usind mathematical symbols and expressions [10]. The various mathematical models of queueing theory are described as:

Single-channel with poisson arrivals and exponential service times (M/M/1)

i. The single-channel, single-phase model is one of the most widely used and simplest queueing models which are based on some assumptions like First In First Out (FIFO) arrival basis, no balking or reneging, arrivals are independent of preceding arrivals e.t.c [10, 11]. In modelling this system, the determination of the arrival rate (λ) and the services rate (μ) in queueing system are usually based on the same time period (Mohammad, 2013).

L_s is the average number of customers in the system and it is given by equation 1

$$L_1 = \frac{\rho}{1-\rho} = \frac{\lambda}{\mu-\lambda} \quad (1)$$

W_s is the average time a customer spends in the system, which is given by equation 2

$$W_S = \frac{1}{\mu-\lambda} \quad (2)$$

L_q is the average number of customers in the queue, is given by equation 3

$$L_q = \frac{(\lambda)^2}{\mu(\mu-\lambda)} \quad (3)$$

W_q is the average time a customer spends waiting in the queue, is given by equation 4

$$W_q = \frac{\lambda}{\mu(\mu-\lambda)} \quad (4)$$

The utilization factor for the system ρ, is given by equation 5

$$\rho = \frac{\lambda}{\mu} \quad (5)$$

The present idle time, P_o, is given by equation 6

$$P_0 = 1 - \frac{\lambda}{\mu} \quad (6)$$

Length of the non empty queue is given by equation 7

$$L_q^{'} = \frac{\mu}{\mu-\lambda} \quad (7)$$

Probability that waiting time is more than t is the system is given by equation 8

$$e^{-(\mu-x)}t - (\mu-\lambda)t \quad (8)$$

Probability that waiting time is more than t in the queue is given by equation 9

$$e^{-(\mu-\lambda t)} = \frac{\lambda}{\mu} \quad (9)$$

ii. Multiple-channels with poisson arrivals and exponential service times (M/M/S)

To take care of arriving customers, this type of system has at least two servers or channels available. Each of these channels has its exponential service time distribution with mean 1/μ. The arrival process is based on Poisson distribution where customers join a single queue and enter the first available service channel. Service is FCFS and all servers are assumed to perform at the same rate (Mohammad, 2013; Hui and Tao, 2000).

3. Methodology

In this paper, secondary data were collected, the data include customers date of visitation, customers arrival time, total time spent by customers and the purpose of visitation.

These data were cleaned and analysed using Jupyter notebook- a framewok under Python simulation package.

4. Results and Discussion

From Figure 1, there were six (6) purposes of customers' visitation to the banking hall i.e six services were rendered by the customer service unit of the bank, they are: account authentication; account list; authenticate user; balance check; fund transfer and register customer. The six services rendered were given code 1, 2, 3, 4, 5 and 6 respectively. Different colours show the hours of the day ranging from 8:00am, 9:00am, 11:00am, 12:00 pm, 13:00pm, 14:00pm, 15:00pm and 16:00pm. The vertical axis of the graph shows the number or frequency of customers calling for a particular servive per time, while the horizontal axis showing the purposes of visitation. Figure 1 shows the frequency of each services per hour across the day. From the chart, it can be seen that all services except Balance Check (4) and Fund Transfer (5) are at their peak in the morning by 8am. It also shows that user authentication has highest queue length of 450 customers in the morning (8:00am).

Figure 1. *Graph showing the purpose of visitation per hour.*

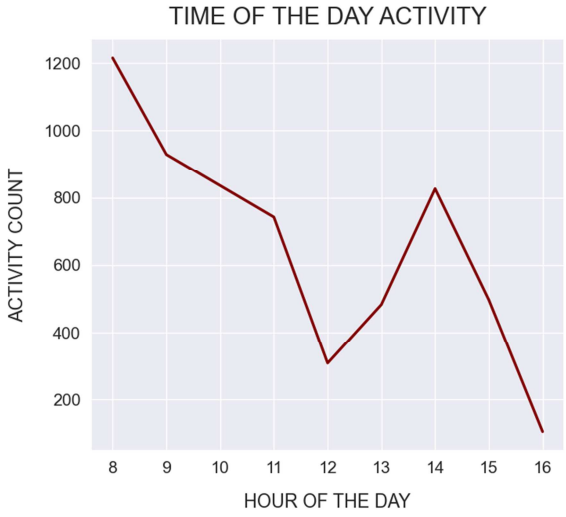

Figure 2. *Graph measuring the frequency of the day activities.*

Figure 2 shows the services are generally at the peak in the morning (8:00am). Its goes down at 11:00am and generally at the second half of the day services decreases. At around 12:00noon, the activities increase again till 14:00noo when the activities go down again. This graph shows that customers call for services in the early part of the day and keeps decreasing until the break period when customers will be able to visit bank to make their transactions.

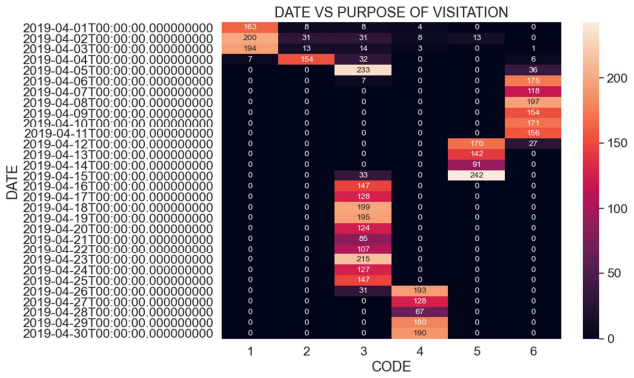

Figure 3. *Heatmap showing the cross table of the frequency of services rendered per day.*

Figure 3 is the heatmap that shows the cross table of the frequency count of each services for each day. It shows that some services happen mostly early in the month. User authentication happen mostly in the middle of the month, balance check happens mostly towards the end of the month.

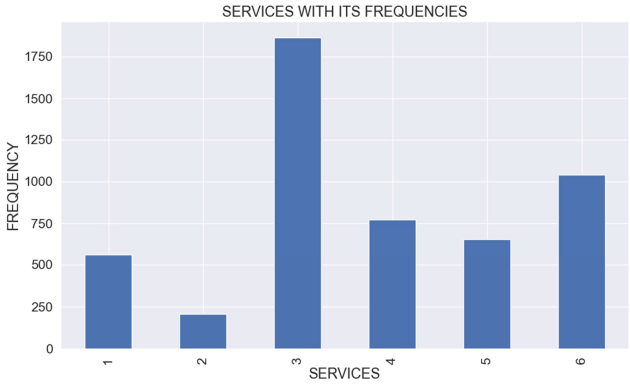

Figure 4. *Graph showing the average queue length.*

Figure 4 shows each service with its queue length. Its can be seen that user authentication has the highest queue length followed by customers registration, balance check, fund transfer, account authentication and account listing respectively.

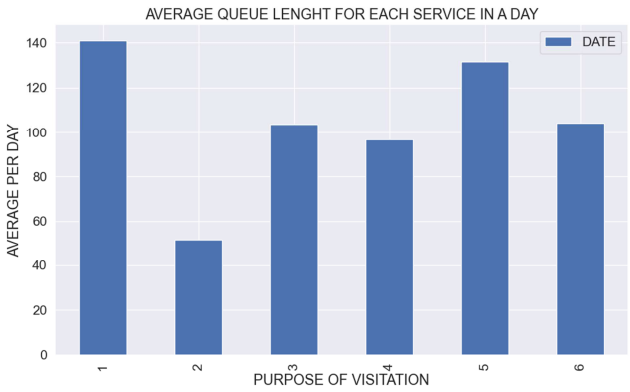

Figure 5. *Shows the average queue length for each of the services per day. Its can be seen that account authentication has the highest average queue length, followed by fund transfer, customers registration, user authentication, balance check and account listing with values 141.000, 131.600, 104.100, 103.500, 96.625 and 51.500 respectively for the month of April. This average is calculated from the period of time its happened.*

5. Conclusion

In this work, Jupyter notebook – a framework in python software was used to analyse data from customer service unit of a particular bank. The result from the analysis showed that customers call for services in the early part of the day and keeps decreasing until the break period when customers will be able to visit bank to make their transactions. Its can be seen that account authentication has the highest average queue length, followed by fund transfer, customers registration, user authentication, balance check and account listing.

From the above result, the management of the bank will be able to learn how customers really feel about the services rendered and know the level of the customers satisfaction,

how to improve on the services render and where the immediate focus need to be in order to accelerate the bank growth because satisfied customers will buy more, stay longer and share their positive experience.

References

[1] Fifli Konstantina, (2016). "Supervision of Data transfer with Python". Department of Informatics and software Engineering, Institute of Educational Technology, Crete.

[2] Barnhart C., Johnson E. L., and Nemhauser G. L., (1998); "Column Generation for Solving Huge Integer Programs". Georgia Institute of technology.

[3] Kassu Jilcha Sileyew, (2019). "Research Design and methodology". www.intechopen.com.

[4] Chinelo Igwenagu, (2016). "Fundamentals of research methodology and data collection". Enugu State University of Science and Technology, Enugu State, Nigeria.

[5] Acharjya D. P. and Kauser Ahmed P, (2016). "A Survey on Big Data Analytics: Challenges, Open Research Issues and Tools". Article Published in International Journal of Advanced Computer Science and Applications (IJACSA), Volume 7 Issue 2.

[6] Fakhitah Ridzuan, Wan Mohd Nazmee Wan Zainon (2019). "A Review on Data Cleansing Methods for Big Data". The Fifth Information Systems International Conference 2019. Procedia Computer Science 161 (2019) 731–738.

[7] John Alexander Miller, (2004). "Promoting computer literacy through programming Python". PhD thesis of The University of Michigan.

[8] Jeffrey M. Perkel, (2018). "Why Jupyter is data scientists' computational notebook of choice". Nature research Academies.

[9] Anderson, E. and Fornell, C. 2000. Foundations of the American Customer Satisfaction Index. *Total Quality Management*, 11 (7) pp. 869-883.

[10] Hui, L. and Tao, Y. (2000): "Theory and methodology queues with a variable number of servers". European journal of operational research, Vol. 124, No 3. Pp. 615-628.

[11] Mohammad, S. (2013): "Queueing theory model used to solve the waiting line of a bank -a study on Islami bank bangladesh limited, Chawkbazar branch, Chittagong". Published in ASIAN Journal of Social Sciences & Humanities. Vol. 2, No 3, pp. 468-478.

[12] Richard, Davies, Peter, and Richardson (2010): "Evolution of the UK banking system". Quarterly Bulletin 2010 Q4.

[13] Wiley (2009): "Banking Reforms for the 21st Century: A Perfectly Stable Banking System Based on Financial Innovations". International Review of Finance. Vol. 9, No 3, pp 177–209.

[14] Kunze B. and Poddig P., 2007. Uberwachung op-erationeller Risiken bei Banken: Interne und externe Akteure im Rahmen qualitativer und quantitativer Uberwachung. Gabler Edition Wissenschaft. Deutscher Universit¨atsverlag. ISBN 9783835006430.

[15] Selhausen P., and Hechenblaikner A. (2006): "Operational Risk in Banken: Eine Methodenkritische Analyse Der Messung Von It-Risiken. Bank- Und Finanzwirtschaft". Deutscher Universit¨atsverlag. ISBN 9783835004245.