DOI: 10.36347/sjebm.2016.v03i07.001

Scholars Journal of Economics, Business and Management e-ISSN 2348-5302
Joel Efiong *et al.*; Sch J Econ Bus Manag, 2016; 3(7):347-359 p-ISSN 2348-8875
© SAS Publishers (Scholars Academic and Scientific Publishers)
(An International Publisher for Academic and Scientific Resources)

The Distribution of Automated Teller Machine (ATM) in Calabar Metropolis, Cross River State, Nigeria

Joel Efiong[1], Eme Joel Efiong[2], Augustine Okorie Ogba[1]
[1]Department of Geography and Environmental Science, [2]Department of Accounting,
University of Calabar, P. M. B. 1115, Calabar, Nigeria

*Corresponding Author
Joel Efiong
Email: joel_efiong@yahoo.com

Abstract: The study examined the distribution of automated tell machines in Calabar Metropolis in view of the Central Bank of Nigeria's policy on cashless economy. Data were obtained from both primary and secondary sources using direct field measurement of ATM locations and enumeration of ATMs across the wards, questionnaire and National Population Commission records. The data were presented in tables and analyzed using geographical information systems and statistics. The result revealed a total of 134 ATMs, located across the Metropolis. It was discovered that while some areas had excess ATMs, many other places had deficits, making it difficult for customers to access ATMs services, except at some cost. It was discovered that there is a significant variation ($F = (d.f. = 1, 400) = 27.472$, $p < 0.05$) in the cost of transportation to the nearest ATM location across the 22 Wards in Calabar Metropolis. Again, the study revealed that ATMs are significantly clustered in the Metropolis with Max. D of 0.2459 > critical D of 0.136 and disproportionately distributed. It is recommended that more ATMs should be located near the people for easy access at minimal cost so as to enhance the Central Bank of Nigeria policy on cashless economy.
Keywords: Automated Teller Machine, spatial distribution, Calabar Metropolis, cashless economy

INTRODUCTION

At the core of any growing economy is the need to have a stable financial sector. One factor of a stable financial economy is the discouragement in direct cash transactions. This has been achieved by most developed nations where they have moved away from a cash based economy to a cashless one. The paradigm that brought such transformation in the economy of these advanced nations created the need for economic reformation policy in less developed nations such as Nigeria.

In line with global trends, the Central Bank of Nigeria (CBN) introduced a cashless policy to the Nigerian economy in 2011. The aim of the policy is to reduce the volume of physical cash in circulation, thereby encouraging the use of alternative electronic products and channels, such as the automated teller machine (ATM), point-of-service (POS), internet banking, and so on, for financial transactions. The cashless policy of the CBN further stipulates a daily cumulative free cash withdrawal limit of ₦150, 000. However, withdrawals above the limits were to be charged as service fee. Similar limits also apply to cash lodgments. Other stipulations of the cashless policy have been discussed by Muyiwa, Tunmibi and Dewole [1].

Cashless policy has been of importance since the advancement of technology; facilitating funds transfer thereby reducing time wasted in banks, help low income earners to make financial transactions across long distances, reducing risk of carrying cash and avoiding bank charges at its lowest. In view of becoming one of the best economies in 2020, the CBN started implementing the cashless policy/banking in some major states/cities in Nigeria such as Lagos, Abuja, Kano, Port-Harcourt. The CBN and other stakeholders have asserted reduction in crime rates, political corruption, banking cost, and improvement on monetary policy on inflation and the overall growth and development of the economy of Nigeria as advantages associated with the implementation of the cashless policy. The implementation of this policies has since been extended to other parts of the country including Calabar.

One avenue of encouraging the cashless economy is through the automated teller machine (ATM). The distribution of the ATM's is important in achieving the cashless policy. The ATM is an electronic computerized telecommunications device that allows financial institutions (e.g. bank or building society) customers to directly use a secure method of communication to access their bank accounts. ATMs should therefore be cited not only where they are accessible, but where they can be easily located by visitors. They should be placed where they will be little danger, with less congestion as much as possible.

In spite of the much talk about policy on cashless economy by the CBN, it is not clear if the banks are ready for it vis-à-vis the various channels (point of service: POS, ATM, Web, etc.) that are often used to implement the policy. Of particularly interest in this study is the distribution of the ATMs service, since it is the most commonly used and easily accessible of the available channels. It is not also clear if the distribution of the ATM is even, in terms of population distribution in Calabar Metropolis. Moreover the cost in terms of distance, incurred by customers to access an ATM from their residences has not been discussed in the available literature. These constitute the gap of which this study seeks to fill. In this study an attempt is made at analyzing the spatial distribution of automated teller machines (ATMs) in Calabar Metropolis and their accessibility in view of the cashless policy of the CBN.

Many studies have been conducted on location of facilities. However, only a few has been carried out on the location ATM. Munro, Deighton, and Leong [2] in their study on ATM banking and gaming theory found out that the best-located ATMs generate three to seven times more volumes of access than those in less-traveled locations. While volume is not the only criteria for determining productivity, lower volume ATMs in remote location can help meet service requirements or increase market share which is a demonstration of the potential to increase profitability. They therefore submitted that banks can create significant value by improving their lowest performing ATMs.

Alhaffa and Abdulal [3] argued that ATMs are critical to the success of any financial institution. The observe that many bank customers list the location of ATMs as one of their most important factor for their choice of a financial institution. Following this reason, they recommended that banks should locate ATMs nearer to their expected customers so as to attract patronage. An alternative spatial model was examined by McAndrews [4] to find out banks' equilibrium choices of foreign fees and surcharges. The assumption was that customers had random itineraries around a circular city. They experienced random needs for cash and were unaware of the locations of their own bank's ATMs.

Several studies reveal that there exist relationships between service centres and population density [5]. Eni and Abua [6] also observed that economic activities of an area are influenced by the population and the nature of the environment. Hence, they argued that the higher the population, the more the economic activities in that area. Accordingly, the central place theory [7], which supports the fact that service point could be distributed rationally according to the size, spacing or distance and population to be served applies in this study.

In the light of the above, this study examined the spatial distribution of automated teller machines in Calabar Metropolis in consideration of government policy on cashless economy. Specific objectives of the study included: to map ATM locations with the use of Geographic Information Systems (GIS); to assess the relationship between population density and ATM distribution, and to evaluate the distance in terms of cost, that customers cover to find an ATM.

CONCEPTUAL FRAMEWORK

There was a marked increase in the use of point pattern analysis in the 1950s and early 1960s [8, 9]. However, there a renewed interest in the statistical analysis of point patterns [10]. This is due mainly to developments in geographical information systems (GIS) [11]. Gatrell *et al* [10] have reviewed many of the GIS tools that have been developed for the analysis of point data. Point pattern analysis have been adopted in several studies including health and epidemiology [10], crime location, locating archaeological sites and landforms [12, 13], urban studies, including location of shops and retail outlets, settlement distribution, and so on[9].

Four kinds of spatial data are identified in literature – points, lines, polygons and surfaces. However, the simplest of the four is point or point patterns [12], though not in terms of analysis. A point pattern basically consist of a set of locations in a demarcated study area at which objects of interest have been recorded [10].

O'Sullivan and Unwin [12] submit that point pattern analysis involves two main activities. Firstly, the description of the patterns made by point event and, secondly, the test whether or not the events are random or concentrated (clustered) within particular location(s). The simplest theoretical model for analysis of point pattern is the complete spatial randomness (CSR). With the CSR, events are distributed independently based on a uniformed probability distribution over the study region. The CSR seeks to answer the question, whether the observed distribution display any systematic spatial pattern or there is a departure from randomness by way of clustering or regularity.

Point pattern analysis are based on two interrelated approaches of 'point density' and 'point interaction' [10]. These two approaches are also related to two distinct aspects of spatial patterns known as the first-order and second-order effects [12]. First-order effects relate with variations in the intensity of the process across space. They are estimated as observed spatial density of events, shown as clear variations across space in the occurrence of the event per unit area. Practically, they allow one to make a distinction between high, low and varying intensity. Second-order effects, on the other hand, are due to interactions between locations and are expressed in terms of reduced or increased distances between nearby events. With second-order effects, one can distinguish between regular and clustered patterns.

Furthermore, measurement of variations in the first- and second-order properties in point pattern can be density- based or distance-based. Density-based measures include the use of density maps [14], quadrat analysis [12], Poisson distribution [14] and kernel estimation [15]. Each of these measures have their advantages and disadvantages. Their discussions are beyond the scope of the present paper.

Similarly, distance-based measures include the simple nearest-neighbour distance [14], with its various extensions, including the G and F functions [12]. However, the major shortcoming of the nearest-neighbour distance and its extensions is that of measuring only the nearest neighbour for each event in the pattern [12]. Moreover, with closely clustered points, G increases at short distances, but if points are evenly spaced, G will increase slowly up the range of distances at which most events are spaced before it begins to increase rapidly. The K-function, better known as the Ripley's K-function [15], and the improved K-function known as the L-function [16] provide better alternatives to the nearest neighbour distance. Zhang *et al* [17] adopted the Ripley's L for the analysis of the spatial distribution of *Picea schrenkiana*. The Ripley's K-function, is presently the most important technique for the analysis of spatial distribution patterns of populations [17].

METHOD OF STUDY
Study area
This study was carried out in Calabar Metropolis. Calabar is the headquartres of Cross River State, located in the south-south geo-political zone of Nigeria. It has an area of about 604 sq km and a projected population of 454,947 persons as at 2015. Calabar Metropolis lies within Longitudes 8° 20' E and 8° 40' E, and Latitudes 4° 50' N and 5° 05' N (Figs. 1& 2). It is bounded in the North by Odukpani Local Government Area and in the North-East by the Great Kwa River. Southern shores are bounded by the Atlantic Ocean and on the west by the Calabar River [18-20]. It comprises two local government areas; Calabar Municipality and Calabar South.

Calabar Metropolis is generally acclaimed as one of the leading tourism destinations in Nigeria because of its numerous tourism hotspots within the City. There are several financial institutions in Calabar Metropolis including the Calabar Branch Office of the Central bank of Nigeria, commercial banks, microfinance banks, etc. The banks seem to be located along major routes in the City including Murtala Mohammed Highway, Calabar Road, Mary Slessor Avenue, Eta Agbo Road and Ndidem Usang Iso Road.

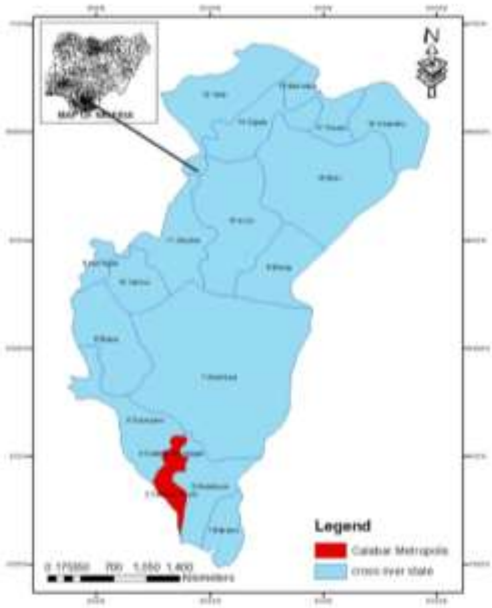

Fig-1: Cross River State of Nigeria showing Calabar Metropolis

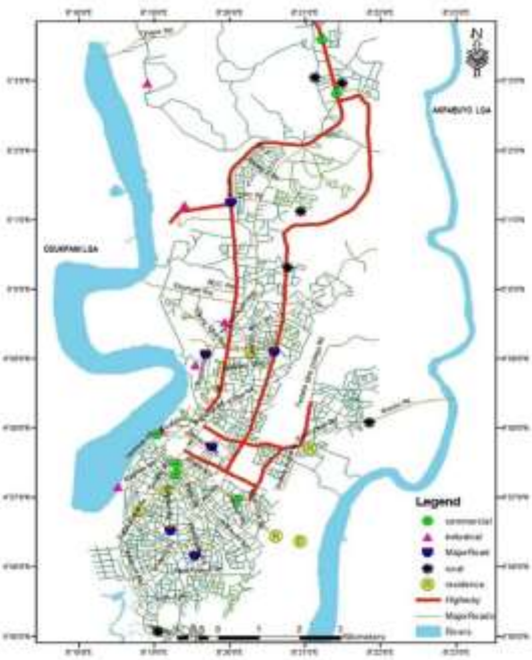

Fig-2: Calabar Metropolis

Method of data collection

Data for this study were collected from both primary and secondary sources. Primarily, data were collected on geographic locations of ATM stations using the geographic positional system (GPS) and counting the number of ATMs at each station in the study area. Data were also obtained through the use of questionnaire with a minimum sample size of 400 based on Yamene [21] formula for determination of minimum sample size. Secondarily, population data were from the National Population Commission. Esri shape files containing boundaries of the 22 political wards (10 for Calabar Municipality and 12 for Calabar South L. G. A.) in the study were obtained from the Geographical Information Systems Unit, Department of Geography and Environmental Science, University of Calabar, Calabar. Table 1 shows data on population distribution, number of ATMs and proportionate minimum sample size for each ward in Calabar Metropolis.

Table 1: Population distribution, number of ATMs, proportionate minimum sample size and population for each ward in Calabar Metropolis

Calabar Metropolis	Population by wards *	Proportionate sample**	No of ATMs**	Population Density**
Calabar Municipality				
Ward 1	62391	55	12	0.01292
Ward 2	11797	10	14	0.00145
Ward3	13867	12	0	0.0006
Ward 4	15806	14	0	0.00092
Ward 5	10231	9	6	0.00114
Ward 6	24634	22	12	0.00271
Ward 7	10537	9	16	0.00294
Ward 8	30599	27	4	0.00105
Ward 9	15222	13	2	0.00052
Ward 10	14313	13	0	0.0015
Calabar South L. G. A.				
Ward 1	13530	12	35	0.15535
Ward 2	17189	15	12	0.00774
Ward 3	22100	19	0	0.12752
Ward 4	18416	16	0	0.03789
Ward 5	18637	16	1	0.07085
Ward 6	24555	22	6	0.21352
Ward 7	14733	13	7	0.03978
Ward 8	11197	10	0	0.01138
Ward 9	36489	32	3	0.00629
Ward 10	12278	14	0	0.0016
Ward 11	20823	18	3	0.00017
Ward 12	35605	31	2	0.00012
Total	**454947**	**402**	**134**	

Sources: * National Population Commission, ** Authors' fieldwork and compilation

Techniques of data analysis

Data obtained in this study were analysed mostly within the GIS. The Splancs package in the R-program, ArcGIS 10.1 and IBM SPSS version 22 served as the major packages for the analysis. In analysing the spatial distribution of ATM points in the study area, both the first- and second-order effects were examined. First-order intensity was examined using density-based measures which included the use of dot-density maps, quadrat analysis and Poisson distribution and kernel estimation. Second-order intensity was examined using the simple nearest-neighbour distance and its various extensions, including the G function and the alternative K-function and L-function.

Three hypotheses were stated for testing in this study. There are:

Hypothesis 1

H0: There is no significant difference between the distribution of ATMs and a random distribution in Calabar Metropolis.

H1: There is a significant difference between the distribution of ATMs and a random distribution in Calabar Metropolis.

Hypothesis 2

H0: There is no significant relationship between the number of ATMs and population density in Calabar Metropolis.

H1: There is a significant relationship between the number of ATMs and population density in Calabar Metropolis.

Hypothesis 3

H0: There is no significant variation in the cost of transportation by bank customers to ATM stations across the various residential districts in Calabar Metropolis.

H1: There is a significant variation in the cost of transportation by bank customers to ATM stations across the various residential districts in Calabar Metropolis.

Hypothesis 1 was tested based on the complete spatial randomness in the data set. This was because, as argued earlier in the paper, the CSR is the simplest theoretical model for spatial point pattern analysis. On the other hand, hypotheses 2 and 3 were tested using the Spearmen's Ranked-Order Correlation and the one-way analysis of variance respectively. The results and discussions are found in the next section.

RESULTS AND DISCUSSION

Table 2 shows data on the location of ATM stations in Calabar Metropolis. It reveals the coordinates of the stations in Eastings and Northings using a projected coordinate system, UTM zone 32 N (Fig. 3).

Table 2: Location of ATM stations across Calabar Metropolis

S/N	NAME & ADDRESS OF ATMS	Eastings	Northings	No of ATMS
1	Microfinance ATM Unical	427096.8	547569.6	1
2	Microfinance ATM Unical Malabor	427500.0	546764.7	1
3	Diamond Bank ATM CRGIS	425405.3	549367.6	1
4	Heritage Bank ATM Highway	425405.3	549367.6	1
5	Fidelity Bank ATM Highway	425658.1	549582.4	3
6	ECO Bank ATM Highway	425704.2	549637.6	2
7	Keystone Bank ATM Highway	425716.6	549665.2	1
8	ECO Bank ATM Highway	425815.2	549775.7	6
9	Standard Chartered Highway	425948.2	550233.1	1
10	WEMA Bank ATM Highway	425938.9	550306.7	1
11	Zenith Bank ATM Highway	426047.5	551022.2	4
12	Skye Bank ATM	425985.9	550988.4	2
13	Sterling Bank ATM	425816.2	551086.9	4
14	First Bank ATM MCC	426153.5	552330.2	4
15	UBA ATM In Pyramids Hotel	426235.2	553957.5	2
16	GTBank ATM At Axari Hotel	426103.0	554105.0	1
17	First Bank ATM 8miles	428214.9	559756.1	2
18	Stanbic IBTC ATM Calabar Road	424957.2	548035.5	2
19	Skye Bank ATM	424750.9	547946.6	1
20	Union Bank ATM Calabar Road	424849.8	548296.6	3
21	First Bank ATM Calabar Road	424899.1	548321.1	8
22	UBA ATM 1 Calabar Road	424933.1	548348.7	2
23	UBA ATM 2 Calabar Road Opp.	424908.5	548385.5	6
24	FCMB ATM Calabar Road	424957.7	548428.4	3
25	UBA ATM At E3 Restaurant	425013.3	548499.0	3
26	Access Bank ATM Calabar Road	425025.7	548600.4	3
27	GTBank ATM	425084.1	548538.9	3
28	Heritage Bank ATM Calabar Road	425108.8	548603.4	1
29	Eco Bank ATM Calabar Road	425173.2	548277.8	5
30	Access Bank ATM Calabar Road	425367.1	548157.9	2
31	Zenith Bank ATM Mary Slessor	425561.1	548123.8	3
32	First Bank ATM Marian Road	427227.2	551205.2	7
33	Diamond Bank ATM Marian Road	427255.2	551472.3	5
34	Unity Bank ATM	426961.3	550143.0	1
35	Stanbic IBTC Bank ATM	426843.8	549725.5	2
36	ATM Point At GLO Office	426739.4	549667.3	2
37	Eco Bank ATM Etta Agbo	426878.8	547821.6	7
38	First Bank ATM Etta Agbo	427168.1	547511.2	2
39	Fidelity Bank ATM Etta Agbo Road	426850.7	547453.2	5
40	Diamond Bank ATM Mayne Avenue/Palm Street	425362.4	546536.5	2
50	First Bank ATM Mayne Avenue	424798.4	546233.1	5
51	Zenith Bank ATM Chamley Street	424291.1	547179.4	2
52	First Bank ATM By Ambo Street	424025.0	545819.3	1
53	First Bank ATM 56 Mbukpa Street	424341.8	545416.7	2
54	Union Bank ATM	427137.2	547379.2	2
55	ECO Bank ATM Akim Area	427569.4	548432.0	3
56	FCMB ATM	426943.4	547680.3	3
57	Skye Bank ATM	426678.0	547124.8	2
58	First Bank ATM	424327.2	546252.0	1
59	UBA ATM (Ekondo Bank)	424836.6	547360.0	1

Source: Authors' fieldwork (2016)

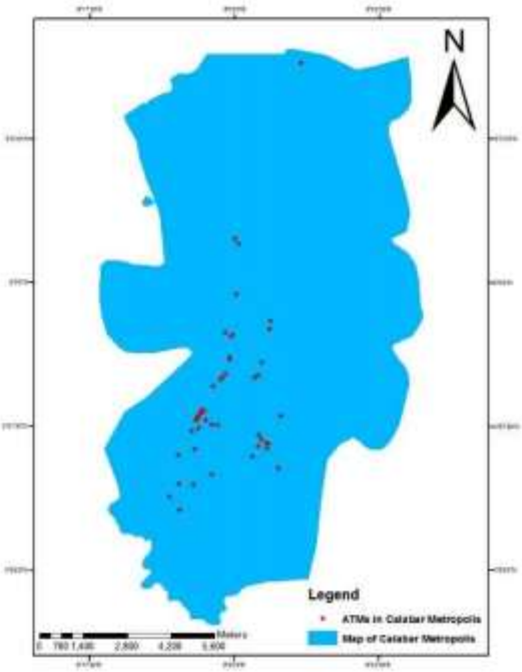

Fig-3: Spatial distribution of ATMs in Calabar Metropolis

The approximate time that respondents take to walk from their homes to the nearest ATM location is shown in Table 3. The table reveals that 62.1 per cent of respondents walk more than 30 minutes to get to the nearest ATM point while 23 per cent walk less than 10 minutes to reach the nearest station to their homes.

Table 3: Approximate distance walk to ATM

	Frequency	Percent	Cumulative Percent
<10min	77	23.0	23.0
10-20min	45	13.4	36.4
21-30min	5	1.5	37.9
>30min	208	62.1	100.0
Total	335	100.0	

Source: Authors' fieldwork (2016)

Table 4 shows some of the challenges encountered by users of ATMs in Calabar Metropolis. It reveals that 50.5 per cent of the respondents experienced long queue at ATM locations. 38.3 per cent says it is the problem of insufficient funds while 11.2 per cent complained of ATM being out of order/ non-availability of network for transmission.

Table 4: Challenges faced when using ATM

Challenge	Frequency	Percent	Cumulative Percent
Insufficient ATM stations	155	38.56	38.56
Long queue/time wasting	196	48.76	87.32
ATMs out of order/no network for transaction	51	12.68	100.0
Total	402	100.0	

Source: Authors' fieldwork (2016).

Table 5 shows a cross tabulation of the cost customers pay to locate nearest ATM to their residence across Calabar Metropolis. About 19 per cent of respondents do not need to pay for transportation to the nearest ATM station, 61 per cent pay at least ₦50 to get to the nearest station, 16 per cent pay up to ₦100 while less than 4 per cent pay up to ₦150.

Table 5: Frequency distribution of cost of transportation to locate nearest ATM in Calabar Metropolis

Cost	LGA		Total	
	Calabar Municipality	Calabar South	Frequency	Percentage
₦.00	58	20	78	19.40
₦50.00	102	143	245	60.95
₦100.00	19	47	66	16.42
₦150.00	5	8	13	3.23
Total	184	218	402	

Source: Authors' fieldwork (2016).

Distribution of ATM

The distribution of point data can be discussed under first-order and second-order effects. The discussion in this section follows this pattern.

First-order effects

In examining in possible variation of ATM point density over the Calabar Metropolis, the dot-density map (Fig. 4) reveals the stations seems to be more in the southern part than in the northern section of the study area. However, this impression is subjective. As Bailey and Gattrell [14] and O'Sullivan and Unwin [12] argue, this impression depends on the cartographic technique involved.

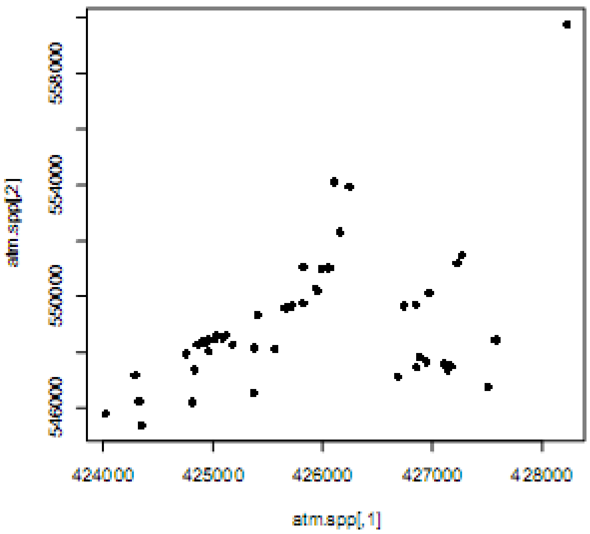

Fig-4: Dot-density map of ATM in Calabar Metropolis

Results of further examination of the first-order effect using quadrat analysis based on a 10 X 10 quadrat is shown in Fig. 5. This result has been summarized as observed frequency in Table 6. Of the total of 100 quadrats, 80 did not have any ATM station, 11 had one ATM station each,3 had two ATM stations while 1 had three stations. Again, 4 quadrats had four ATM stations each while 1 quadrat had 12 stations.

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]	[,8]	[,9]	[,10]
[1,]	1	2	1	0	0	0	0	0	0	0
[2,]	0	1	1	1	0	0	4	4	0	0
[3,]	0	0	12	4	0	0	0	0	1	0
[4,]	0	0	0	1	6	0	3	0	0	0
[5,]	0	0	0	0	2	1	0	2	0	0
[6,]	0	0	0	0	1	1	0	0	0	0
[7,]	0	0	0	0	0	0	0	0	0	0
[8,]	0	0	0	0	0	0	0	0	0	0
[9,]	0	0	0	0	0	0	0	0	0	0
[10,]	0	0	0	0	0	0	0	0	0	1

Fig-5: 10 X 10 quadrat of ATM distribution in Calabar Metropolis

It has been argued [12] that a useful model for predicting the pattern generated by a spatial process is the Poisson distribution, since it represents the distribution of the number of randomly generated points that are found in a given area. The expected frequencies of ATM based on Poisson distribution are also presented in Table 6. Fig. 6 is the modelled frequency distribution.

Table 6: Frequency distribution of ATM in Calabar Metropolis based on a 10 X 10 quadrat

No. of ATM	No. of quadrats		
	Observed frequency	**P (x)**	**Expected frequency**
0	80	0.5534	55.43
1	11	0.3271	32.71
2	3	0.0965	9.65
3	1	0.0190	1.90
4	4	0.0028	0.28
5	0	0.0003	0.03
6	0	0.0000	0.00
7	0	0.0000	0.00
8	0	0.0000	0.00
9	0	0.0000	0.00
10	0	0.0000	0.00
11	0	0.0000	0.00
12	1	0.0000	0.00

Source: Authors' analysis (2016)

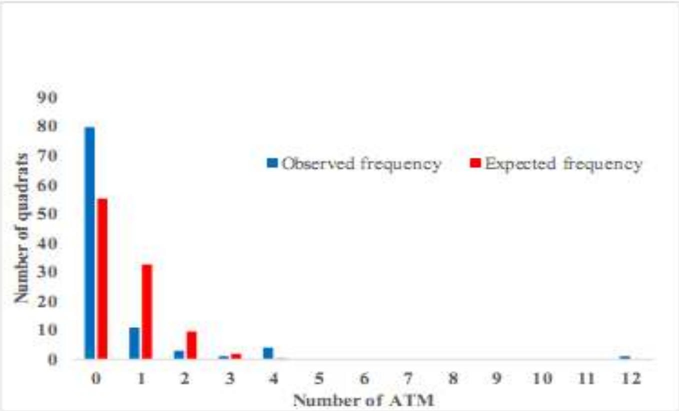

Fig-6: Modelled frequency distribution of ATM stations in Calabar Metropolis

The result of the 'goodness-of-fit' test of the distribution based on Kolmogorov-Smirnov D test reveals the observed and predicted proportions shown in Table 7. The cumulative proportions are presented in Table 8.

Table 7: The observed and predicted proportion of ATM distribution in Calabar Metropolis

K	**Number of quadrats**	**Observed proportion**	**Expected proportion**
0	80	0.80	0.5534
1	11	0.11	0.3271
2	3	0.03	0.0965
3	1	0.01	0.0190
4	4	0.04	0.0028
5	0	0.00	0.0003
6	0	0.00	0.0000
7	0	0.00	0.0000
8	0	0.00	0.0000
9	0	0.00	0.0000
10	0	0.00	0.0000
11	0	0.00	0.0000
12	1	0.01	0.0000

Source: Authors' statistical analysis (2016)

Table 8: Cumulative proportions

K	Number of quadrats	Observed proportion	Expected proportion
0	0.80	0.5543	0.2459
1	0.91	0.8814	0.0286
2	0.94	0.9779	0.0379
3	0.95	0.9969	0.0469
4	0.99	0.9997	0.0097
5	0.99	1.000	0.01
6	0.99	1.000	0.01
7	0.99	1.000	0.01
8	0.99	1.000	0.01
9	0.99	1.000	0.01
10	0.99	1.000	0.01
11	0.99	1.000	0.01
12	1.00	1.000	0.00

Source: Authors' statistical analysis (2016)

In testing hypothesis 1, Table 8 reveals that Max D =0.2459. At the 0.05 significance level,

$$\text{Critical D} = \frac{1.36}{\sqrt{N}} = \frac{1.36}{\sqrt{100}} = \frac{1.36}{10} = 0.136$$

Since Max. D of 0.2459 > critical D of 0.136, Ho was rejected.

Hence, the distribution of ATM in Calabar Metropolis is not random. There is therefore a pattern in the distribution of ATM in Calabar Metropolis.

Second-order effects

Investigation of second order effects was carried out to determine if locations of ATM form local clusters and, if so, how tightly packed the clusters are. The graph of the nearest-neighbour cumulative empirical probability distribution function G(w),is shown in 8. The nearest neighbour function allows one to model the interdependency between ATM points.

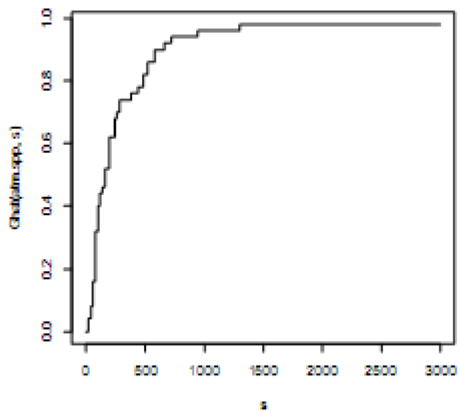

Fig-8: The G-Function for ATM distribution in Calabar Metropolis

In the present study, it can be observed that the graph in Fig. 8 climbs very steeply between the distance of 0 and about 250m. This is an indication of clustering. Between 250 and 300m, the line on the graph slows down briefly before climbing fast again at a distance of about 300m until at about 700m where it begins to remain relatively stable over the remaining distance in the study area. The implication is that there are more ATM locations that are nearer to each other than those that are afar off. But the nearest-neighbour analysis has a disadvantage that they only measure the nearest neighbour for each event in the pattern [12].

The K-function and the L-function were used to overcome the disadvantage of the G-function. A comparison of the K-function with the CSR model revealed that at a distance of about 50m, the K-function deviate from the CSR.

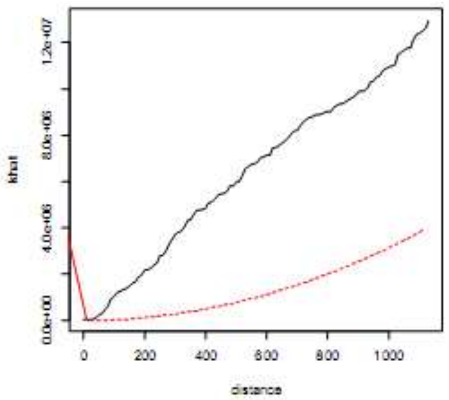

Fig-9: K-function graph (black) for ATM distribution with the estimated CSR model (red)

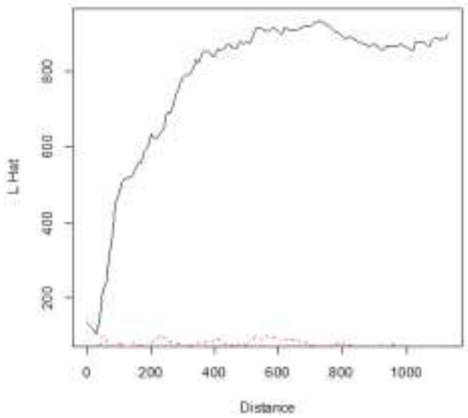

Fig-10: L-function for ATM distribution with CSR model at 99 simulations

Relationship between ATM locations and population density

Table 9 shows the result of the Spearman's Ranked-order correlation analysis (rho) between number of ATM and population density of wards in Calabar Metropolis.

Fig. 10 shows the comparison of the observed L-function with the CSR model. The random simulations was plotted using a Monte Carlo procedure which is widely used in modern statistics to locate events in a study area. From Fig. 10, it is observed that over the entire distance covered, the observed pattern is more clustered than one would expect it to be if it were generated by a CSR. This is because the L-function curve (black colour) is above the CSR curve (red colour) at all distances. This therefore confirms our decision on hypothesis 1.

Table 9: Results of Correlation analysis

			Number of ATM per ward	Population density per ward
Spearman's rho	Number of ATM per ward	Correlation Coefficient	1.000	.197
		Sig. (2-tailed)	.	.379
		N	22	22
	Population density per ward	Correlation Coefficient	.197	1.000
		Sig. (2-tailed)	.379	.
		N	22	22

Source: Authors' statistical analysis (2016)

From Table 9, the result, rho = 0.197, indicates that there is a weak positive relationship between number of ATM and population density in Calabar Metropolis. In testing hypothesis 2, the result is however not significant, since p = 0.379 which is > 0.05. The null hypothesis was therefore retained. The implication is that the available ATM stations are not commensurate with the population in the study area.

Variations in cost of transportation to ATM locations in Calabar Metropolis

The results of the one-way analysis of variance are presented in Tables 10 -12. From the results in Table 10, it was observed that there is a significant variation (since F = (d.f. = 1, 400) = 27.472, p < 0.05) in the cost of transportation to the nearest ATM location across the 22 Wards in Calabar Metropolis. Hence, we do not have enough evidence to retain hypothesis 3.

Table 10: Results of ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	31411.853	1	31411.853	27.472	.000
Within Groups	457369.241	400	1143.423		
Total	488781.095	401			

Source: Authors' statistical analysis (2016)

From the result in Table 11, it is observed that people generally pay more to be able to assess ATMs in Calabar South Local Government Area (x – 59.86) than in Calabar Municipality (X = 42.12). However, there is the need to locate more ATMs in Calabar Metropolis to alleviate the cost burden on the people. Moreover, certain wards would require more ATM locations than others if the cost of transportation must be minimized. For instance, more ATMs would be needed in Ward 3, 4 9 and 10 with a mean transport cost of in excess of N50.00 for one part of the movement. (Table 12). For Calabar South Local Government Area, except for Wards 5, 6 and 7, residents in every other Wards pay in excess of N50.00 to be able to access the nearest ATM. Hence, the need to increase the number of ATM locations in these areas. Fig. 11 shows the mean cost plots for all the wards while Fig 12 shows variations in the number of ATM across the wards in Calabar metropolis.

Table 11: Descriptive statistics on cost of transportation across the two LGA's in Calabar Metropolis

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Calabar Municipality	184	42.1196	35.53443	2.61963	36.9510	47.2881	.00	150.00
Calabar South	218	59.8624	32.29300	2.18716	55.5516	64.1732	.00	150.00
Total	402	51.7413	34.91283	1.74129	48.3181	55.1645	.00	150.00

Source: Authors' statistical analysis (2016)

Table 12: Descriptive statistics on cost of transportation across the 22 ward in Calabar Metropolis

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Cal Mun 1	55	20.9091	24.89033	3.35621	14.1803	27.6379	.00	50.00
Cal Mun 2	10	25.0000	26.35231	8.33333	6.1487	43.8513	.00	50.00
Cal Mun 3	12	58.3333	55.73204	16.08845	22.9229	93.7438	.00	150.00
Cal Mun 4	14	85.7143	30.56249	8.16817	68.0680	103.3605	50.00	150.00
Cal Mun 5	9	38.8889	22.04793	7.34931	21.9414	55.8364	.00	50.00
Cal Mun 6	22	27.2727	25.48236	5.43286	15.9745	38.5710	.00	50.00
cal Mun 7	9	44.4444	16.66667	5.55556	31.6333	57.2556	.00	50.00
cal Mun 8	27	46.2963	23.72084	4.56508	36.9126	55.6799	.00	100.00
cal Mun 9	13	57.6923	18.77669	5.20772	46.3457	69.0389	50.00	100.00
Cal Mun 10	13	84.6154	37.55338	10.41543	61.9221	107.3087	50.00	150.00
Cal S 1	12	54.1667	14.43376	4.16667	44.9959	63.3374	50.00	100.00
Cal S 2	15	53.3333	22.88689	5.90937	40.6590	66.0077	.00	100.00
Cal S 3	19	86.8421	36.67464	8.41374	69.1655	104.5187	50.00	150.00
Cal S 4	16	78.1250	31.45764	7.86441	61.3624	94.8876	50.00	150.00
Cal S 5	16	50.0000	36.51484	9.12871	30.5426	69.4574	.00	100.00
Cal S 6	22	38.6364	21.44660	4.57243	29.1275	48.1453	.00	50.00
Cal S 7	13	38.4615	21.92645	6.08130	25.2115	51.7116	.00	50.00
Cal S 8	10	75.0000	35.35534	11.18034	49.7083	100.2917	50.00	150.00
Cal S 9	32	51.5625	29.74183	5.25766	40.8394	62.2856	.00	100.00
Cal S 10	14	78.5714	46.88072	12.52940	51.5033	105.6396	.00	150.00
Cal S 11	18	66.6667	29.70443	7.00140	51.8950	81.4383	.00	100.00
Cal S 12	31	59.6774	20.08048	3.60656	52.3118	67.0430	50.00	100.00
Total	402	51.7413	34.91283	1.74129	48.3181	55.1645	.00	150.00

Source: Authors' statistical analysis (2016)

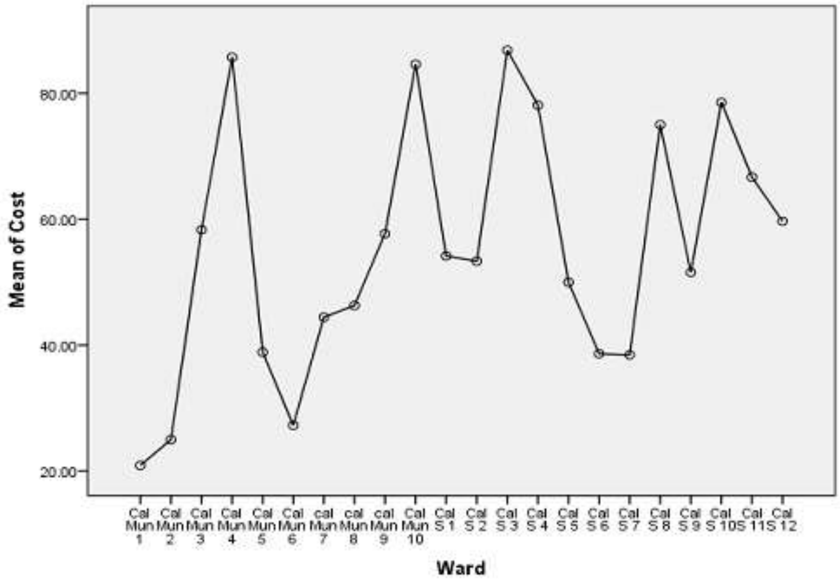

Fig-11: Mean cost plots for all the wards in Calabar Metropolis

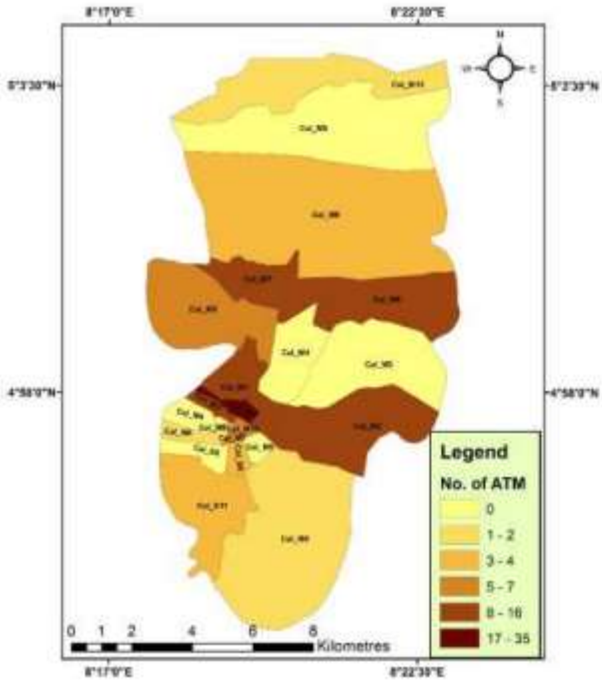

Fig-12: Variations in number of ATM across the wards in Calabar Metropolis

CONCLUSIONS

From the above results and discussions, it was concluded that ATM locations in Calabar Metropolis is significantly clustered, with some areas being over-served while other are underserved. This clustering, however, may be as a result of the clustering of bank locations themselves. Many banks would not want to locate their ATMs outside their banking premises for security reasons.

Also, there is no significant relationship between number of ATMs and population density in Calabar Metropolis. Again, significant variations exist in the cost of transportation from residence of ATM users to the nearest ATM location. In some cases, ATM users pay up to ₦150.00 to get to the nearest ATM station. This is not economical. Furthermore, ATM users experience a lot of challenges, ranging from insufficient ATM stations to long queue at ATM locations and poor network connections at ATM stations.

While the cashless policy of the CBN has come to stay, it is recommended that banks should endeavour to make ATMs available to their customers, especially at the locations (wards) identified in this study. This would ease the problems faced by users, particularly transportation cost and time wastage at ATM locations.

REFERENCES

1. Muyiwa O, Tunmibi S, John-Dewole AT; Impact of cashless economy in Nigeria. Greener Journal of Internet, Information and Communication Systems, 2013; 1(2): 040-043.
2. Munro P, Deighton J, Leong J; ATM banking + gaming theory. Chicago: A. T. Kearney, 2010.
3. Alhaffa A, Abdulal W; A Market-Base study of optimal ATMs deployment strategy. International Journal of Machine Learning and Computing, 2011; 1(1).
4. Mc Andrews J; A Model of ATM Pricing: Foreign Fees and Surcharges. Federal Reserve Bank of New York, 2001. Available: thttp://www.ny.frb.org/rmaghome/economist/mcandrews/pubs.html.
5. Charles EM; A GIS-based analysis of wastes dumpsters distribution in Calabar South Local Government Area, Cross River State. An unpublished B.Sc. Project Report, Department of Geography and Environmental Science, University of Calabar, Calabar, Nigeria, 2016.
6. Eni D, Abua M; Spatial Organization of Society. Calabar: Tabson Global Resources, 2006.
7. Christaller W; Central Place Theory. Englewood, Cliffs, N. J: Prentice-Hall, Inc., 1966.
8. King LJ; A quantitative expression of the pattern of urban settlements in selected areas of the United States. Tijdschrift voor Economische en Sociale Geografie, 1962; 53: 1–7.
9. Rogers A; A stochastic analysis of the spatial clustering of retail establishments. Journal of the American Statistical Association, 1965; 60: 1094–1102.
10. Gatrell AC, Bailey TC, Diggle P, Rowlingson BS; Spatial point pattern analysis and its application in geographical epidemiology. Transactions Institute of British Geographers, 1996; 21: 256-274.
11. Gatrell AC, Rowlingson BS; Spatial point process modelling in a geographical information systems environment. In Fotheringham, A. S. and Rogerson, P. (Eds.). Spatial analysis and GIS. London: Taylor & Francis, 1994.
12. O'Sullivan D, Unwin DJ; Geographic Information analysis. (2nd Edition). New Jersey: John Wiley & Sons, Inc., 2010.
13. Trenhaile AS; Drumlins: their distribution, orientation and morphology. Canadian Geographer, 1971; 15: 113–26.
14. Bailey T, Gatrell A; Interactive spatial data analysis. Harlow: Longman Scientific & Technical, 1995.
15. Fotheringham AS, Brunsdon C, Charlton M; Quantitative geography: perspectives on spatial data analysis. London: SAGE, 2000.
16. Mateu J, Uso JL, Montes F; The spatial pattern of a forest ecosystem. Ecological Modelling, 1998; 108: 163–174.
17. Zhang Y, Li J, Chang S, Li X, Lu J; Spatial distribution pattern of Picea schrenkiana population in Middle Tianshan Mountains and relationship with topographic attributes. Journal of Arid Land, 2012; 4(4): 457-468.
18. Eze EB, Efiong J; Morphometric parameters of the Calabar River basin: Implication for hydrologic processes. Journal of Geography and Geology, 2010; 2(1): 18-26.
19. Efiong J; Changing pattern of land use in the Calabar River catchment, Southeastern Nigeria. Journal of Sustainable Development, 2011; 4(1): 92-102.
20. Asouzu OE, Efiong J; Implication of open dumpsite on groundwater quality in Calabar Metropolis, Nigeria. Journal of Geography, Environment and Earth Science International, 2015; 2(3): 117 – 125.
21. Yamene T; Statistics: an introductory text. Second edition. New York: Harper & Row, 1967.