Predictive Modelling of Crime in Selected Nigerian Cities

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Abstract
Using ten year police crime record (1999-2008), this study predicts future crime incidences and prevalence rates (2008-2050) for Ibadan, Zaria and Owerri. Linear Regression Analysis was used in determining the linear relationship between year and annual crime incidence. Crime incidence was taken as a quotient of projected population figure in order to establish predicted prevalence rates. The predictive models generated include y= -241278 + 123.8x (for Ibadan); y=83785.030 – 41.376x (for Zaria); y = -38897.3 + 19.727x (for Owerri) and y = 2003.128 + 0.0000537x (for the three cities as a whole). The predicted values reveals increase in crime trend in Ibadan from 7001 in 2008 to 12512 in 2050 and 903 in 2008 to 1544 in 2050 in Owerri but a decreasing crime trend in Zaria from 802 in 2008 to 5 in 2024. Between 2024 and 2025 crime trend in Zaria will reach zero point. The results further show a greater increase in Ibadan than the three cities as a whole. Between 2008 and 2050 residents of Ibadan, Zaria and Owerri will experience 108 – 258, -3 - 108 and 85 – 224 crime incidences per 1000 population, respectively. Taken the three cities as a representation of national crime situation, there will be 78 – 223 crime incidences per 1000 population in the nation between 2008 and 2050. The fact that a 'zero point – crime incidence' is a utopian situation 'talk less' of negative incidences suggested a caution in interpreting the trend of crime in Zaria. The crime situation in Ibadan and Zaria however needs urgent intervention from the residents and the government in order to avert increasing crime wave in the future.

Keywords: "crime", "incidence", "prediction", "prevalence rates"

INTRODUCTION
Prediction or forecast is defined as "statement about the way things will happen in the future; often but not always based on experience or knowledge. While there is much overlap between prediction and forecast, prediction may be a statement that some outcome is expected, while a forecast is more specific, and may cover a range of possible outcomes" (Wikipedia, The Free Encyclopedia, Accessed 16-08-2013). There could be informal prediction or informed guess or opinion; scientific; supernatural, fiction and statistical predictions which is the focus of this study. Prediction or forecast has been done for various aspects of human existence and the associated environmental elements. There is financial, sport, population and weather forecast, prediction on climate and landuse changes, city growth and expansion (Veldkamp and Lambin, 2001; Longley 2004; Adeboyejo et al 2007; Hewitt, 2013) etc. These studies or research efforts

are with multitudinous results targeted at providing information for decision makers towards policy formulation on related issues. Research work on prediction has the capability of revealing future paths or direction of the issue predicted thereby engendering actions or steps to be taken in order to accommodate, the prediction in the future.

Prediction of crime incidences is based on analysis of past trend of crime. In Nigeria there are many studies on the spatial aspect of crime in Nigeria cities (Aguda, 1994; Agbola, 1997; Afon, 2001; Agbola, 2002; Adedibu and Abodunrin, 2005; Oredein, 2006; Ahmed, 2012; Adigun 2013b). But there are limited research efforts on temporal studies (Omisakin, 1998; Agbola and Sobanjo, 2002; Abodunrin, 2004; Adeboyejo and Abodunrin, 2004; Adigun and Adedibu, 2013). It has been argued that previous research efforts by the singular act of concentrating on the spatial aspect of crime, have neglected the temporal dimension of crime occurrence thus largely incapable of tracing the trend (Adigun, 2013a). This is not to undermine the importance of spatial study but temporal analysis would provide insight into the aetiology of this monstrous social phenomenon thereby making possible simple extrapolation of the future pattern and fashioning of policies to pre-empt occurrences, which would then enhance liveability of the cities and national development in general. It was further observed that, crime research efforts in Nigeria have been significantly characterized by intensive analysis of a particular society or geographic unit rather than an extensive cross-societal study of the same problem in different geographic areas (Adigun, 2012). Cross-societal research is capable of enabling a comparison of the same social phenomenon in different societies. Such research endeavour while providing results for specific application, it is also capable of providing a generalization for the whole nation. Against this background the study examines annual crime incidences in Ibadan, Zaria and Owerri with a view to predict future crime incidences and prevalence rates. This work is a follow up of an earlier study: Adigun and Adedibu (2013). In the earlier study the trend of crime in three selected cities were examined and the prevalence rates of crime during the period of study were determined.

BRIEF ON STUDY AREAS

Ibadan is located approximately on longitude 3051 East of the Greenwich meridian and latitude 70 231 North of the equator at a distance of 145 kilometers north east of Lagos (Ayeni, 1994). The city has a population size 1,333,659 in 2006 (NPC, 2010) and eleven local government areas. This comprises of Ibadan North, Ibadan North east, Ibadan North west, Ibadan South east, Ibadan South west, Akinyele, Lagelu, Egbeda, Ona-Ara, Oluyole and Ido. Zaria is located on latitude 110101N and longitude 70391E at a height of about 670.5m above the sea level. The city has the old portion enclosed former with wall covering a total area of 16,577,670m2 or 1,658 hectares. After the British colonization of Zaria in 1902 a government station was built about 3km to the north of the old city. This lead to creation of a commercial centre, a new town or Sabon Gari and Tundun Wada in 1912 and 1914 respectively to accommodate labourers, artisans, clerks from Southern and Northern Nigeria. Owerri is a traditional Igbo city in the South eastern part of Nigeria. It is located on latitude 50291N and longitude 70021E covering 104 km^2 (40.2 sq mi). The city has a population figure of 401873 (NPC 2010) and three local government areas namely: Owerri Municipal; Owerri North and Owerri West with 15, 16 and 14 political wards respectively. The selection of the three cities is justified because they represent typical characteristics of the three major tribes in Nigeria coupled with the past and present political functions they perform.

Note: The information provided on Zaria and Owerri was substantially adopted from Schwerdtfeger, F.W. (1982) Traditional Housing in African Cities. John Wiley & Sons Singapore. pp1-2 and Wikipedia Free Encyclopedia .Owerri (Accessed 14th July 2013) respectively.

RESEARCH METHODOLOGY

Reported crime cases (1999- 2008) were reviewed from police record from Oyo; Kaduna and Imo State (s) Police Command under jurisdiction of which Ibadan; Zaria and Owerri are respectively located. Linear Regression Analysis was used in determining the linear relationship between year and annual crime incidence. The linear regression equation is written thus:

$$y = a + bx \qquad\qquad\qquad (1)$$

where: y = crime incidence
  b = constant
  x = year

In order to meet minimum data entry for linear regression analysis, crime incidence for Zaria in 1999 (which is not available) was interpolated by calculating the average of annual crime incidence for 2000, 2001, 2002 and 2003. For predictive purpose, four models were generated from the regression analyses, each for the Ibadan, Zaria, Owerri and whole study area. Crime incidences were predicted for 2008 to 2050. Population figures were projected for 2008 to 2050 using a growth rate of 3.5 percent. This is assumed based on population growth rate of 3.2 percent for Nigeria Population Census 2006 and expected population increase from 2006 - 2013. Crime incidence was taken as a quotient of population figure in order to establish the prevalence rates for the predicted crime incidences in the study areas.

RESULTS AND DISCUSSION

The results are discussed under two major headings as follows.

Predicted Crime Incidences (2008-2050)

The linear relationship between year and crime magnitude revealed an increase in crime level in Ibadan and Owerri but a decreasing trend in Zaria (r Ibadan = 0.462453; r Zaria = -0.54198 and r Owerri = 0.309615). It is observed that there is a low positive correlation of 0.05295 between year and crime incidence when the three cities were considered as a whole. This implies that crime increases steadily in the nation.

Table 1: Annual Reported Crime Incidences (1999-2008)

S/N	Year	Ibadan	Zaria	Owerri	Total Incidence
1	1999	5519	1052*	310	5829
2	2000	5735	1043	551	2443
3	2001	7023	826	964	8813
4	2002	6418	1377	671	8466
5	2003	7347	962	660	8969
6	2004	8030	652	468	9150
7	2005	7567	567	566	8700
8	2006	6079	824	544	7447
9	2007	6832	782	626	824
10	2008	7001	802	903	8706
	Total	67551	7835	6263	

Source: Adapted (with modifications) from Adigun and Adedibu, 2013

Note: *average of 2000, 2001, 2002, and 2003 crime incidences. 1052*was not included in the total reported incidences presented in the table for Zaria.

Future occurrence of crime was calculated based on data collected for a period of ten years (1999-2008). Four predictive models were generated from the result of linear regression analysis.

For Ibadan	$y= -241278 + 123.8x$	(2)
For Zaria	$y=83785.030 – 41.376x$	(3)
For Owerri	$y = -38897.3 + 19.727x$	(4)
For the 3 cities	$y = 2003.128 + 0.0000537x$	(5)

The results documented in table 2 are the predicted crime values (for 2008 to 2050) based on trend observed in each city between 1999 and 2008. Since the 10 year trend shows a consistent increase or decrease (as the case may be) with time as indicated by positive or negative r coefficient, the predicted values are the linear functions of the distribution. It is assumed that if the rate of crime incidence and level of crime reporting continues as observed between 1999 and 2008, then there is going to be a progressive increase in incidence of crime in Ibadan, Owerri and the whole study area from 2010 to 2050 but a steady decrease in crime trend in Zaria (see figure 2).

For the whole study area crime magnitude will increase from 8706 in 2008 to 7796 in 2020, 8840 in 2040 and 9362 in 2050. The increase in crime trend in Ibadan is even greater than the whole study area. Crime magnitude will rise from 7001 in 2008 to 8798 in 2020, 11273 in 2040 and 12512 in 2050. This may be premised on observation made during the data collection that the record keeping in Oyo State Police Command is highly organized and the needed data was given in already collated format such that porosity could not be clearly detected.

Even though there were observable lapses in the crime data recording and storage in Owerri but the predicted values show increase from 903 in 2008 to 951 in 2020, 1346 in 2040 to1544 in 2050. The situation in Zaria however shows a decreasing crime trend: 802 in 2008 to 178 in 2020 and 5 in 2024. Between 2024 and 2025 crime trend in Zaria will reach zero point. This is an interesting scenario as well as point of inquisition. Can there be a point when crime magnitude will be zero? If yes, then we will have a crime free city at that period of time. For how long could this be sustained? Caution must be exercised in interpreting the trend of crime in Zaria for certain observable reasons and the fact that a zero point – crime incidence is a utopian situation 'talk less' of negative incidences. One of such observed reasons is that police crime statistics are inaccurate because of dark figures (unreported crime cases), grey figures (reported but unrecorded crimes) and manipulation of records to satisfy political and or institutional interest when such is advantageous to regime in power or police force (Alemika and Chuckwuma, 2005).

Moreover the prevailing situation in the northern part of the nation featuring the destruction of lives and properties contradict this prediction. Thus percentage increase in crime rate in the nation as a whole could not be adequately fixed in this study because of crime forecasting for Zaria. But the situation in Ibadan and Zaria needs urgent intervention from the residents and the government.

Table 2: Predicted Crime Magnitude (2008 – 2050)

Year	Cities			Total
	Ibadan	**Zaria**	**Owerri**	
2008	7001	802	903	8706
2010	7560	611	755	7274
2015	8179	394	853	7535
2020	8798	178	951	7796
2024	9293	5	1030	8005
2025	9417	-38	1050	8057
2030	10036	-255	1149	8318
2035	10655	-471	1247	8579
2040	11273	-688	1346	8840
2045	11893	-904	1445	9101
2050	12512	-1121	1544	9362

Source: Author's, 2010

Predicted Prevalence Rate in Ibadan, Zaria and Owerri.
The predicted crime incidences, projected population and predicted prevalence rate for the three cities are documented in tables 3-5. Interpreting the predicted prevalence rate in the context of 1000 population, the results for the three cities are as follow. Between 2008 and 2050 residents of Ibadan, Zaria and Owerri will experience 108 – 258, -3 - 108 and 85 – 224 crime incidences per 1000 population, respectively (see table 6). On a general note there will be 78 – 223 crime incidences per 1000 population in the nation between 2008 and 2050. This result assumes a population growth rate of 3.5 and rate of crime reporting recorded between 1999 and 2008.

Table 3: Projected Population, Predicted Crime Incidence and Prevalence Rate in Ibadan

Year	Projected Population	Predicted Crime Incidence	Crime Prevalence Rate
2008	2,732,259	7,001	0.256
2010	2,926,864	7,560	0.258
2015	3,476,197	8,176	0.235
2020	4,128,631	8,798	0.213
2024	4,737,699	9,293	0.196
2025	4,903,518	9,417	0.192
2030	5,823,842	10,036	0.172

2035	6,916,877	10,655	0.154
2040	8,215,104	11,273	0.137
2045	9,756,966	11,893	0.122
2050	1,158,8215	12,512	0.108

Source: Author's, 2010

Table 4: Projected Population, Predicted Crime Incidence and Prevalence Rate in Zaria

Year	Projected Population	Predicted Crime Incidence	Crime Prevalence Rate
2008	744,575	802	0.1077
2010	797,607	611	0.0766
2015	947,307	394	0.0416
2020	1,125,104	178	0.0158
2024	1,291,083	5	0.0004
2025	1,336,271	-38	-0.0028
2030	1,587,071	-255	-0.0161
2035	1,884,942	-471	-0.0250
2040	2,238,719	-688	-0.0307
2045	2,658,896	-904	-0.0310
2050	3,157,935	-1121	-0.0355

Source: Author's, 2010

Table 5: Projected Population, Predicted Crime Incidence and Prevalence Rate in Owerri

Year	Projected Population	Predicted Crime Incidence	Crime Prevalence Rate
2008	430,497	903	0.2238
2010	461,159	755	0.1637
2015	547,712	853	0.1557
2020	650,511	951	0.1462
2024	746,475	1,030	0.1380
2025	772,602	1,050	0.1359
2030	917,609	1,149	0.1252
2035	1,089,832	1,247	0.1144
2040	1,294,379	1,346	0.1040
2045	1,537,316	1,445	0.0940
2050	1,825,849	1,544	0.0846

Source: Author's, 2010

Table 6: Projected Population, Predicted Crime Incidence and Prevalence Rate in the Three Cities

Year	Projected Population	Predicted Crime Incidence	Crime Prevalence Rate
2008	3,907,331	8,706	0.223
2010	4,185,630	8,926	0.213
2015	4,971,216	9,423	0.189
2020	5,904,246	9,927	0.168
2024	6,775,257	10,328	0.152
2025	7,012,391	10,429	0.149
2030	8,328,522	10,930	0.131
2035	9,891,651	11,431	0.116
2040	11,748,202	11,931	0.101
2045	13,953,178	12,434	0.089
2050	16,571,999	12,935	0.078

Source: Author's, 2010

CONCLUSIONS

This work is a follow up of an earlier study (Adigun and Adedibu, 2013) where the trend of crime in Ibadan, Zaria and Owerri were compared and the prevalence rates was determined. This study moves further by predicting future crime incidences and prevalence rates in the three cities. The predicted values indicate increase in crime trend in Ibadan and Owerri but a decreasing crime trend in Zaria and a greater increase in Ibadan than the three cities taken as a whole. Between 2008 and 2050 residents of Ibadan, Zaria and Owerri will experience 108 – 258, -3 - 108 and 85 – 224 crime incidences per 1000 population, respectively. Taken the three cities as a representation of national crime situation, there will be 78 – 223 crime incidences per 1000 population in the nation between 2008 and 2050. The recorded zero point – crime incidence in Zaria is a utopian situation 'not to talk' of negative incidences. Thus percentage increase in crime rate in the nation as a whole could not be adequately fixed in this study because of crime forecasting for Zaria. Moreover the prevailing situation in the northern part of the nation featuring the destruction of lives and properties contradict the zero and negative prediction recorded. This suggests that crime control or prevention interventions should not be based only on predicted data but there should be preparedness for emergency based on prevailing situations. However periodic evaluation of crime situation and projection into the future will serves as good bedrock for evolving proper control methodologies against future crime situation. The findings of this study further suggest an urgent intervention from the residents and the government in combating crime in Ibadan and Zaria. There should be increase in surveillance strategies employed in cities; residents should be involved in policing their areas and police officials should be well equipped in order to adequately combat crime.

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