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THE SPATIAL PATTERN OF ANTI-SOCIAL BEHAVIOUR IN SHEFFIELD, UK

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ABSTRACT

This study underpinned the use of GIS in investigating the spatial pattern of Anti-Social Behaviour (ASB) in Sheffield with a view to carrying out exploration as to whether there is a significant relationship between the pattern of ASB and population density. Two hypotheses were formulated that: values associated with features are randomly distributed across the study area and there is no significant relationship between population density and Anti-Social Behaviour. The study made use of secondary data from infusemimas.co.uk and crimestat.co.uk as well as journal articles. The analyses employed global and local autocorrelation as well as linear regression analyses. The Global Moran's I shows a statistically significant relationship and proof that there is less than 1% likelihood that the clustered pattern of ASB could be the result of random choice and the optimized hot spot analysis (Local Autocorrelation) shows a high degree of association. This however, rejected the null hypothesis. The linear regression analysis was also run to test the second hypothesis and the results show a statistically significant relationship between population density and ASB and the overall model fit was $R^2 = 0.905$. This could mean that density is a causal factor and the proportion in the population causing ASB is constant and as such more people equals more ASB.

1. INTRODUCTION.

Anti- Social Behaviour henceforth, in this paper will be referred to as ASB. Some concerns have been made upon the prevailing circumstances of ASB in our contemporary society which brought about several legislative procedures as measures to tackle the menace. The UK government in September 10, 2003 introduced a new legislation which defined certain behaviours and activities as ASB – these include "litter/rubbish, criminal damage/vandalism, vehicle related nuisance, nuisance behaviour, noise, rowdy behaviour, abandoned vehicle, street drinking and begging, drugs/substance misuse and drug dealing, animal related problem, hoax call, prostitution, kerb crawling, and sexual acts" (Home Office, 2003).

Similarly, Bannister and Scott (2000) also pointed out other behaviours likely to be labelled as ASB to include: incivilities within neighbourhood public spaces, neighbour's disputes, and crimes of all forms. Harradine et al., (2004) added environmental damage, negative acts directed at people, misuse of public spaces and disregard for community personal wellbeing. ASB is basically a new lexicon from psychological literature that is expressed as a label for an unwanted behaviour owing to personality disorder normally seen as the opposite of pro-social behaviour (Lane, 1987; Fanington, 1995; Millon et al., 1998).

The prevalence of ASB all over the world appears to be alarming in densely populated and deprived urban areas characterized by high level of unemployment (Millie, 2006; Kitchen, 2007). This is glaring in global and major cities of the world like London in the UK, Washington DC and Chicago in USA, Ottawa and Saskatoon in Canada, Beijing in China, Tokyo in Japan, Johannesburg in South Africa and Lagos in Nigeria, which are undoubtedly affected by the menace of ASB with the marginalized and deprived young people in focus (Millie et al., 2005; Jacobson et al., 2005). In the UK for example, political and media attention have been given to ASB. This was evidenced in the survey conducted by the Home Office (2003) with “fundamentally lack of respect” as the prime cause of ASB with other factors such as no education, unemployment, family issues, and social freedom (leading to drugs and alcohol misuse).

The “Respect Action Plan” was launched in January 2006 by the British government as a strategy to eradicate ASB (Millie, 2009). In his work, Millie (2009) added that lack of respect as a fundamental cause of ASB is unacceptable rather, lack of respect could be traced from unsound education in schools, homes and the society in general which predicated ASB. In London for example, certain factors like size, population density, cultural diversity of the city and level of deprivation in some neighbourhoods adjoining other areas with great wealth, substantial number of visitors, and high level of unemployment and underemployment have all influenced the rate of crime as well as ASB (Crawford, 1999; Cook, 2006).

Blunkett (2003) asserts that social development such as illicit drugs use and binge drinking have a negative impact on the society. Similarly, in a study conducted by Thorpe and Wood (2004), found that ASB is higher in the inner-city areas, low income and social housing areas where the very poor, and socially excluded families live with majority of the young people involved are mainly from single mothers. Certain factors are observed to be major indicators of ASB in urban areas, these are; population concentration and overcrowded living (Ferrel, 2006), deprivation (Rae, 2011), lack of education (Millie, 2009), lack of respect, unemployment, social freedom, family disengagement (Home Office, 2003). Population density and overcrowded living are associated with social housing where different categories of individuals inhabit and often make a living out of nothing other than engaged in drugs misuse, heavy drinking and smoking, assault and rape. Unemployment isolates individuals particularly, the young people and propels them into several vices with majority involving in ASB. In the same vein, Rae (2011) identified Sheffield as the most deprived former industrial city of England. His measurement of deprivation was based on sectorial areas such as health and disability, education, skills and training which are observed to have some impacts on ASB. Disengaged youth from their families and sometimes from the larger society which is a widespread practice in the UK has often manifested into senseless, incoherent, and malicious behaviours often known as ASB (Millie, 2005).

The Police in Sheffield have always monitored ASB through CCTV cameras and phone contacts. About 60% of ASB cases reported to the Police through non – emergency contact numbers are about rowdy behaviour, youth nuisance and problem individuals (Garrett, 2010). Several interventions are usually put in place to tackle the menace of ASB like letters to inform parents of their children's misbehaviours, acceptance behaviour contract, court orders and other diversionary activities. Criminal damage such as damage to buildings and property and anti-social fires are also measured as nuisance which usually start from litter or refuse and affect people's safety and surroundings. To this regard, the Sheffield City Council have achieved a great deal in reduction of deliberate anti-social fires over a decade (McManus and Bayley, 2007).

The Sheffield City Council introduced the restorative justice which is a method of eradicating ASB and low-level offending behaviours in Sheffield. The method has yielded positive results by reducing the likelihood of reoccurrence of such offences and empowering neighbourhoods to be directly involved in the restorative justice process which is a partnership project aimed at completely eradicating ASB in Sheffield (Zehr and Mika, 1997).

AIM: The aim of this study is to investigate the spatial pattern of ASB in Sheffield with a view to carrying out an exploration as to whether there is a significant relationship between the spatial pattern of ASB and population density.

OBJECTIVES: The objectives are:

(i) To run a spatial autocorrelation (global and local analyses) in GIS using the spatial element (ASB).

(ii) To run a linear regression analysis in SPSS using ASB as dependent variable and population density as an explanatory variable.

2. METHODOLOGY

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This study employed secondary data from the UK census of population, 2011, crime data (ASB), and boundary data as well as journal articles. The 2011 population census data were selected since it is the most recent population census conducted in the UK and this exercise was conducted near perfection as all individual's resident in the UK at the time of the census were counted, thereafter, projected to 2018 using growth rate of 3.0. The ASB data were sourced from http://www.ukcrimestat.com/AboutData/ for November 2018 since crime data is collected on monthly basis and the population data available at https://infuse.mimas.ac.uk/2011census. The reason for using the 2018 ASB data was to carry out justifiable analysis by comparing the pattern and occurrences of ASB with the population density obtained from the same year. The justification for selecting population was based on published literature, the assumptions as perceived influence on ASB, and its level of significance in the analyses.

Another essential element in this research is the choice of selecting Sheffield Census Wards in measuring ASB. According to the Office of the National Statistics (2012), census wards are delineated as neighbourhoods that shared similar geographical, political, infrastructural facilities, and socio-economic characteristics hence, census wards were used to measure the pattern of ASB in each ward and thereafter, predict which wards that are likely to experience more of ASB in the nearest future following the analyses and results (see Figure 1 below).

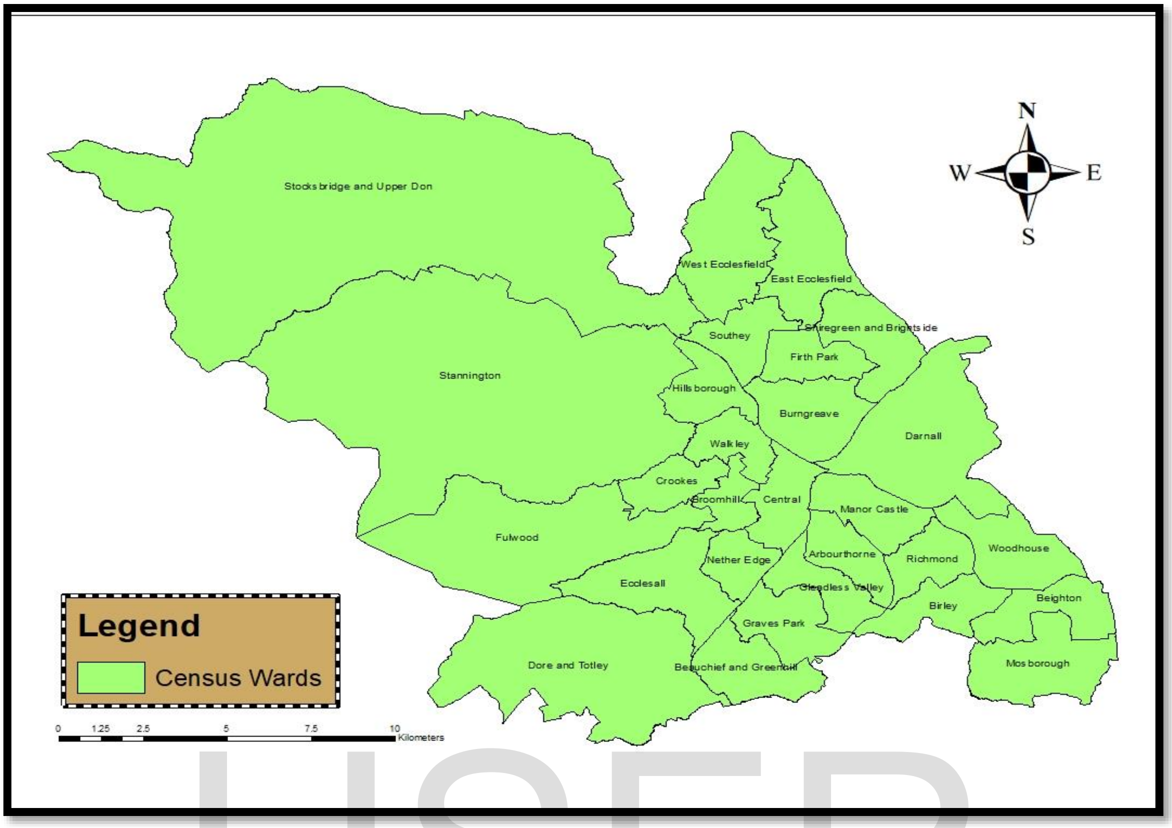

Figure 1: Map of Sheffield showing the delineation of Census Wards

The study adopted quantitative approach in the analysis of the dependent variable (ASB) using spatial autocorrelation in Arc GIS 10.3.1 which shows the spatial pattern of ASB around the neighbourhoods as well as the analysis of linear regression using the independent (population density) and dependent (ASB) variables in SPSS 24. Both analyses were however, compared in making predictions about future scenarios.

3. ANALYSES AND RESULTS

The analyses of this report were in two parts: the first part measured autocorrelation analysis of the spatial element (ASB) in Arc GIS 10.3.1. The second part measured linear regression analysis in SPSS 24 using the dependent and independent variables.

3.1 SPATIAL AUTOCORRELATION ANALYSIS

Literally, if a variable is correlated with itself, it is termed autocorrelation which means that autocorrelation has one variable. A pair of spatial element or pattern that are very close to each other are more likely to have similar values, and a pair of pattern or elements further apart from each other are more likely to have dissimilar values (Haining, 1980; Arbia, 1989; Griffith, 1992). Crime pattern are examples of spatial structures that are useful in autocorrelation analysis. In this paper, the spatial element is ASB that was auto correlated because of the spatial properties that are attributed to it (see Figure 2 below).

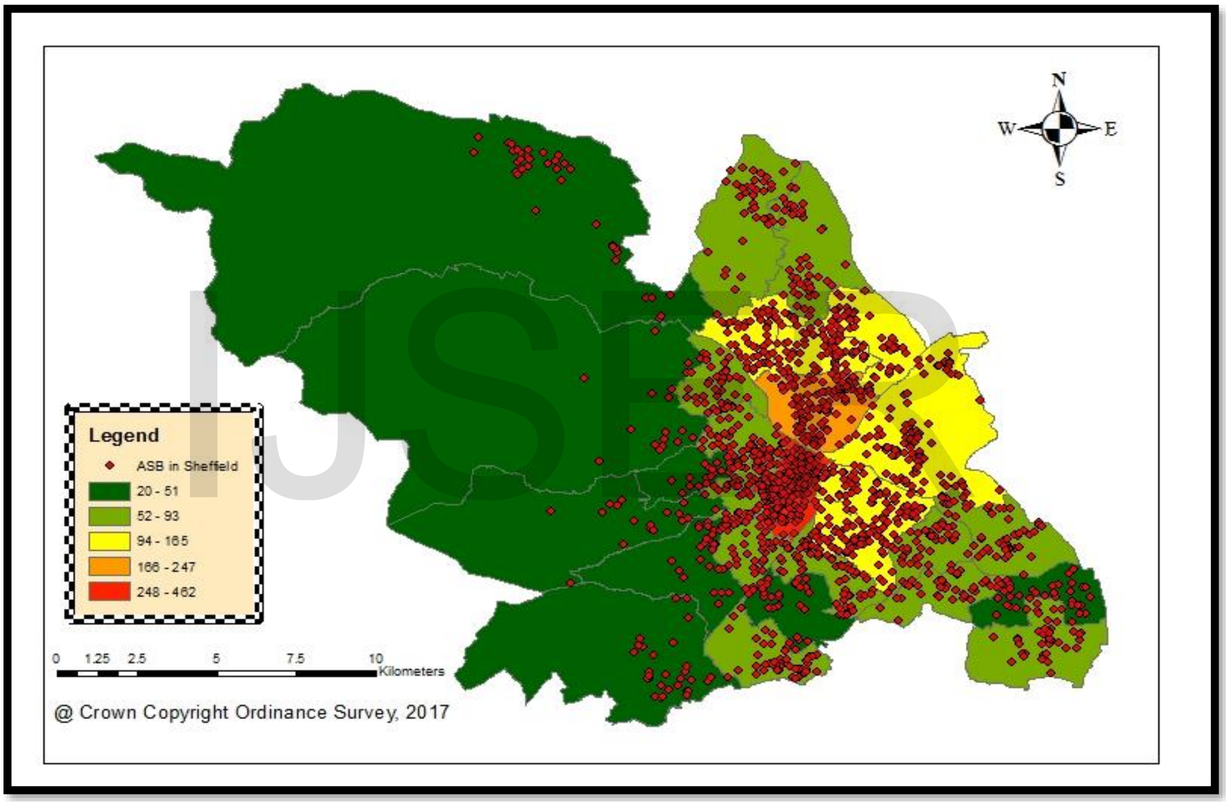

***Figure 2: The Distribution of ASB in Sheffield*.**

The Figure 2 above shows the distribution of ASB in Sheffield. Spatial Autocorrelation in GIS expresses the degree to which an object is similar to the other objects that are nearby. According to the first law of Geography, "everything is related to everything else, but near things are more related than distant things". From the Figure 2 above, a positive spatial autocorrelation has been illustrated as similar values of ASB cluster together in the map. The ASB values are represented by points and colour ramps within the wards under investigation ranging from low values of 20 points to high values of 462 points of ASB in the center. Interestingly, the Figure 3 has also demonstrated that the wards with high values of ASB are close to each other and shared geographical boundaries. For example, wards with high values of ASB like Central, Burngreave, Darnall, Manor Castle, Firth Park, Arbourthorne, Southey, and Shiregreen and Brightside are all located from the center toward the north/east of Sheffield. Whereas, those with lower values of ASB like Graves Park, Fulwood, Dore and Totley, Crookes, and Eclesall are farther away. Autocorrelation is important because statistics relies on observation being independent from one another but this is however, violated if autocorrelation exists in a map. The figure 3 below shows the concentration of activities of ASB in the study area.

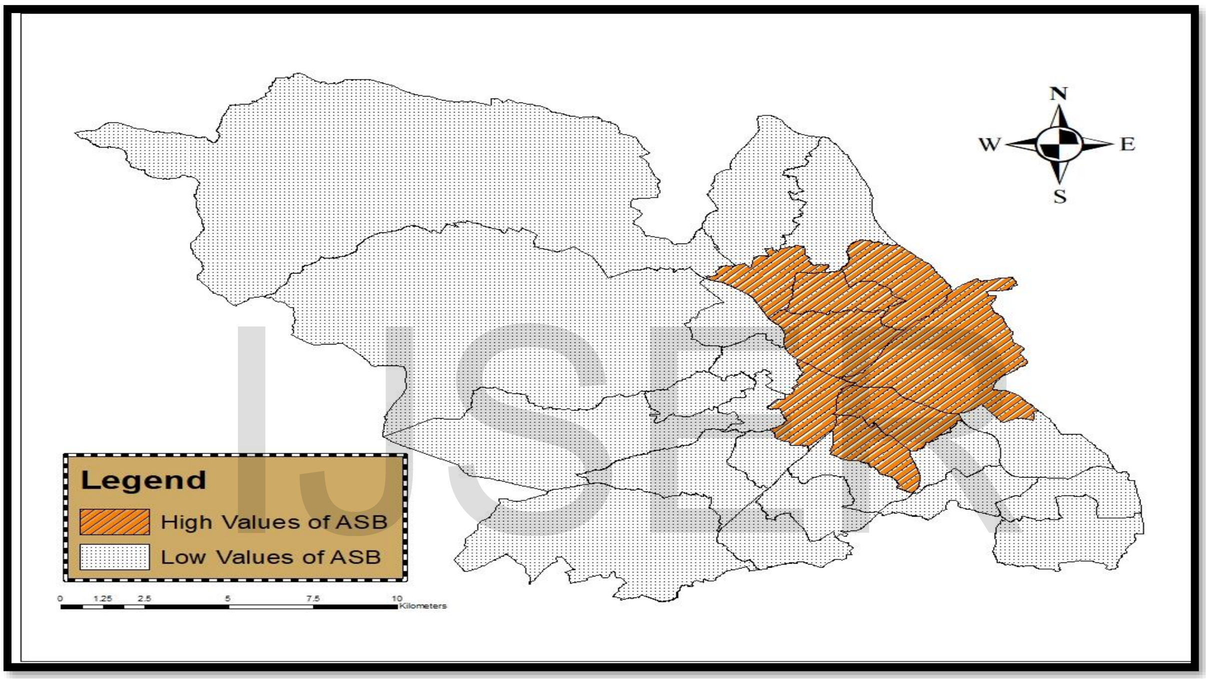

Figure 3: The Distribution of High and Low Values of ASB.

Global Moran's I Summary

Moran's Index:	0.080814
Expected Index:	-0.037037
Variance:	0.002831
z-score:	2.215060
p-value:	0.026756

Table 1: Global Moran's I Summary

Autocorrelation – Global Moran's I measures whether the pattern is clustered, dispersed, or random. If the analysis of the Z-score and P-value indicates statistical significance, a positive Moran's Index value shows tendency towards clustering, while negative value shows dispersion and zero value shows random. In spatial autocorrelation, the null hypothesis states that values associated with features are randomly distributed across the study area.

The z-score and p-value are the statistical tools that measures the level of significance which indicate whether to reject or accept the stated null hypothesis. However, from the Global Moran's I summary in the Table 1 above, I>0 which indicates clustering (similar values found together) hence, the null hypothesis is rejected. A positive spatial autocorrelation has been analyzed as Moran's I>0 (ie values are clustered together). This clustered pattern of ASB generates a Moran's I of 0.080814 and z-score of 2.215060 which is statistically significant and proof that there is less than 1% likelihood that this clustered pattern could be the result of random choice.

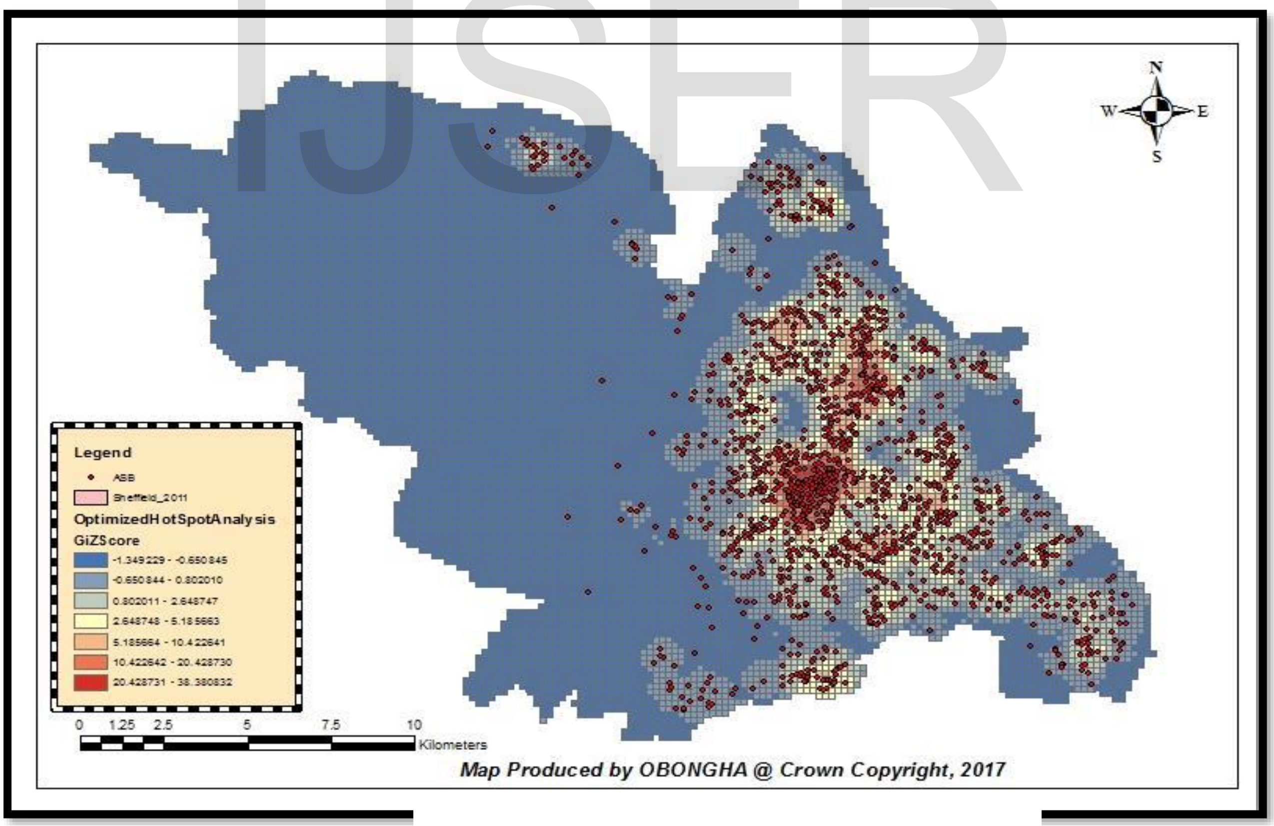

Figure 4: Optimized Hot Spot Analysis (Getis Ord Gi*)

The optimized hot spot analysis identified statistically significant spatial clusters of high values (hot spot) and low values (cold spot) and as well represented with different colour ramps as shown in the Legend above. It gives an appropriate scale of analysis and correct for both multiple testing and spatial dependence. The incidents data are points which in this case are ASB with measurement of its presence or absence as well as attributes of its cluster. The analysis in Figure 4 above shows: Min =0.0000; Max = 25.0000; Mean = 0.2478 and Standard Deviation = 1.1191. The GiP-value ranges from high = 0.390385 to low = 0.183252 and GiZ-score also ranges from high = -1.33081 to low = -0.966045. Again, the z-score values shows a high degree of association.

3.2 LINEAR REGRESSION ANALYSIS

The Linear Regression analysis was run to predict ASB, the dependent variable (Y) from the explanatory or independent variables (x_1) - population density in Sheffield using census data. The null hypothesis which states that: there is no significant relationship between the explanatory variable (population density) and ASB. This null hypothesis spurs up the analysis.

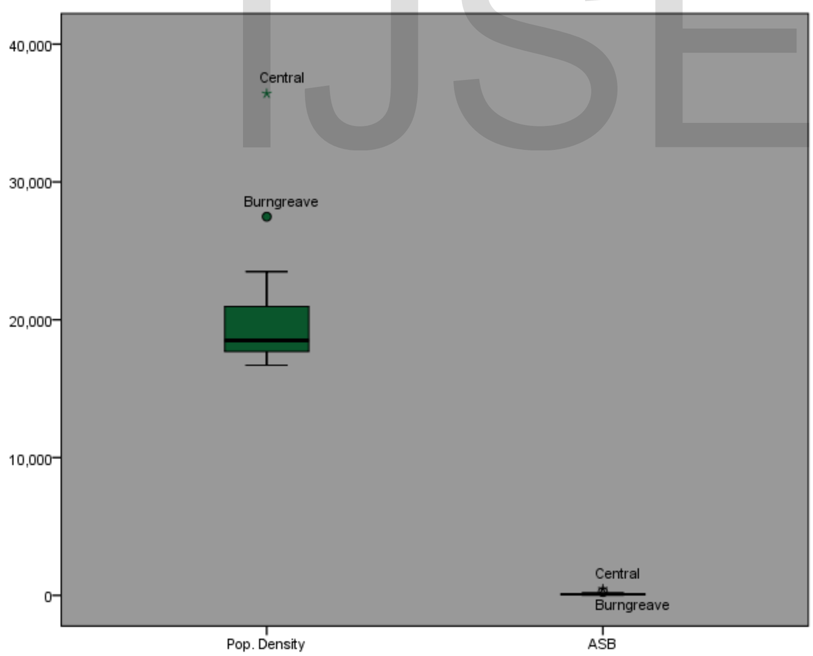

Figure 5: Box and Whisker Plot

The box and whisker plot is an explanatory graphic used in showing or representing the distribution of pattern or phenomena. It is a statistical tool useful in illustrating outliers in terms of minimum, median and maximum. In the Figure 5 above, the dependent variable (ASB) and the other predictor (independent variable) are illustrated showing high values of ASB in the Central and Burngreave. The Figure also displayed high values of population density within the Central and Burngreave wards and this has been represented in the combined bar and line graph in the Figure 6 below.

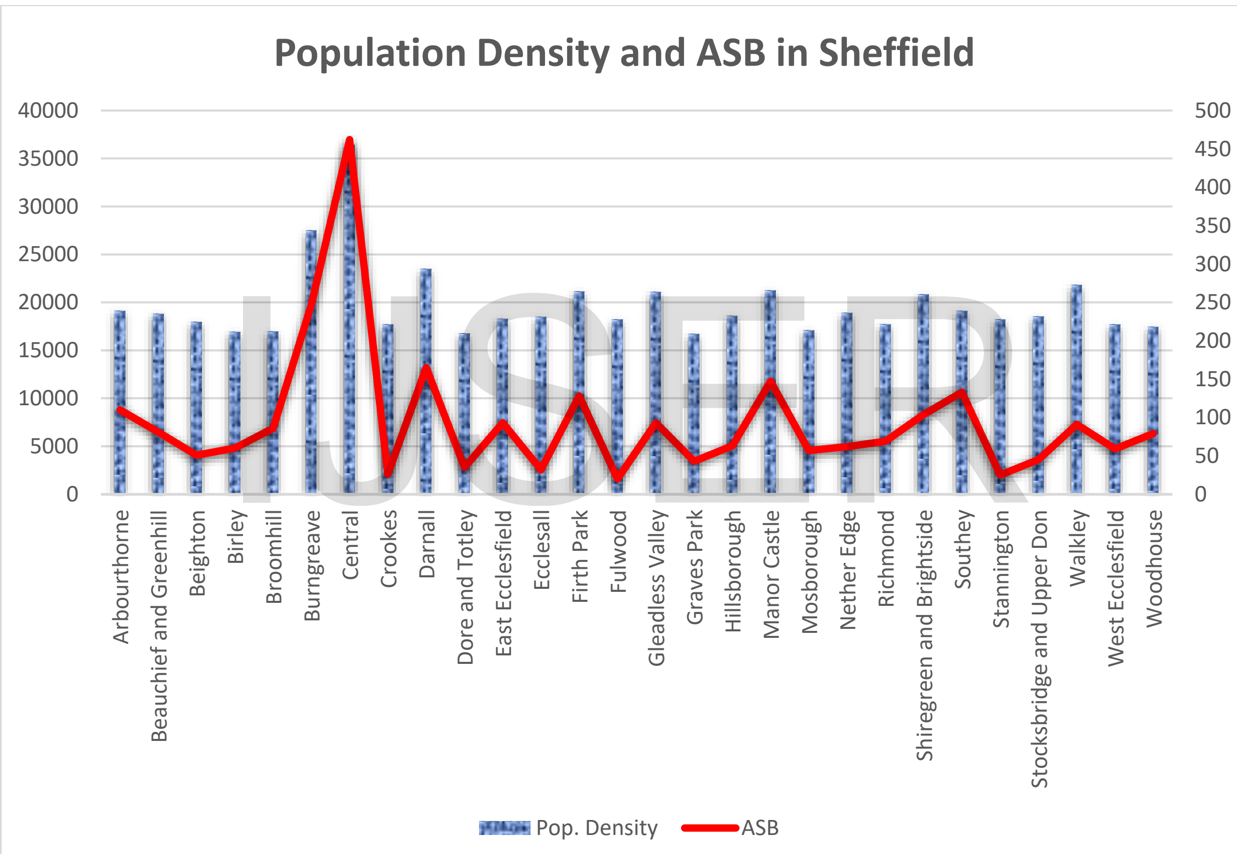

Figure 6: Combined Bar and Line Graph showing Population Density and ASB

The Figure 6 above is a representation of combined population density and ASB. It explained that the more people live in a neighbourhood the more ASB will occur. This could mean that density is a causal factor and the proportion in the population causing ASB is constant and as such more people equals more ASB (see Central, Burngreave, Darnall, Manor Castle, and Firth Park in Figure 6).

Table 2: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.951[a]	.905	.901	27.399	.905	247.791	1	26	.000

a. Predictor: (Constant), Pop. Density
b. Dependent Variable: ASB

The Table 2 above shows an explanation of 90.1% of the variation in ASB with the linear explanatory variable of one predictor. 90.5% is the coefficient of determination (this means that it is the proportion of variance in ASB that is explained by the predictor). However, the Adjusted R square penalizes the addition of extraneous predictors into the model. This explains a strong relationship.

Table 3: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	186021.946	1	186021.946	247.791	.000[b]
	Residual	19518.768	26	750.722		
	Total	205540.714	27			

a. Dependent Variable: ASB
b. Predictor: (Constant), Pop. Density

The Table 4 above explains that the independent variable (one predictor) statistically significantly predicted the dependent variable (ASB). The $F(247.791) > 1$ and the significant value $p = 0.000 < 0.05$. This means that the regression model has satisfied its goodness of fit in the data and as such there is a relationship.

Table 4: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-311.439	26.347		-11.821	.000
	Pop. Density	.021	.001	.951	15.741	.000

a. Dependent Variable: ASB

From the Table 4 above, it was observed that:

- Population density was statistically significant.
- The slope of the coefficient of population density is positive. This means that wards with high population density tends to be associated with high values of ASB which demonstrates a statistically significant relationship.
- This could mean that density is a causal factor and the proportion in the population causing ASB is constant and as such more people equals more ASB.
- The result of the output of population density fulfilled all conditions of the assumptions and in published literature. By this, it is agreed that population density contributed significantly to the activities of ASB in the study area. This is however, demonstrated in Figure 5 where high values of population density and ASB are shown in Central and Burngreave wards.
- The overall model fit was $R^2 = 0.905$

The assumptions of the linear regression analysis were checked clearly by producing the following plots and graphs with a predictor against ASB.

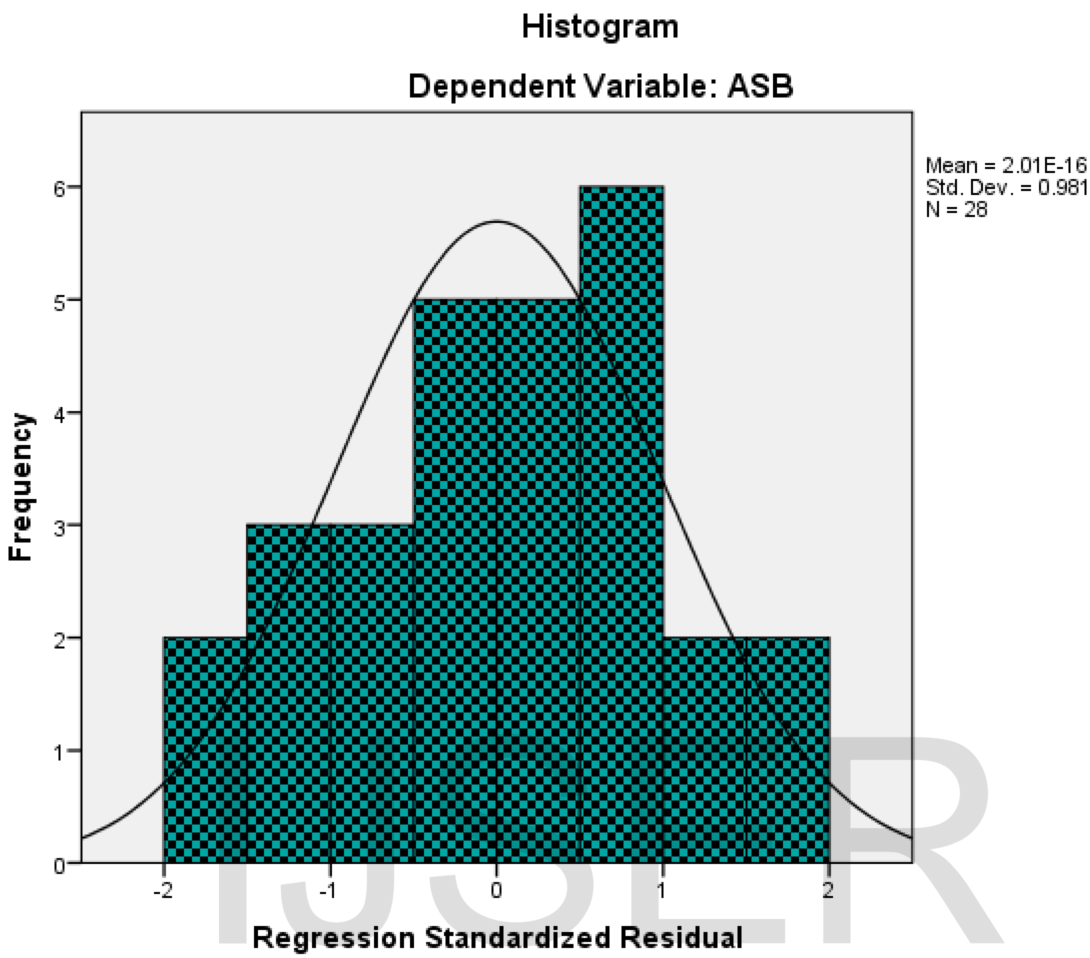

Figure 7: The histogram showing the plots of residuals versus predicted Y

A histogram of the residuals with a normal curve superimposed and the residuals are approximately normal. The histogram is a frequency of plots showing the distribution of variables in regularly spaced cells. The pattern shown above is a normal distribution which indicates a no problem with the assumption of the residuals.

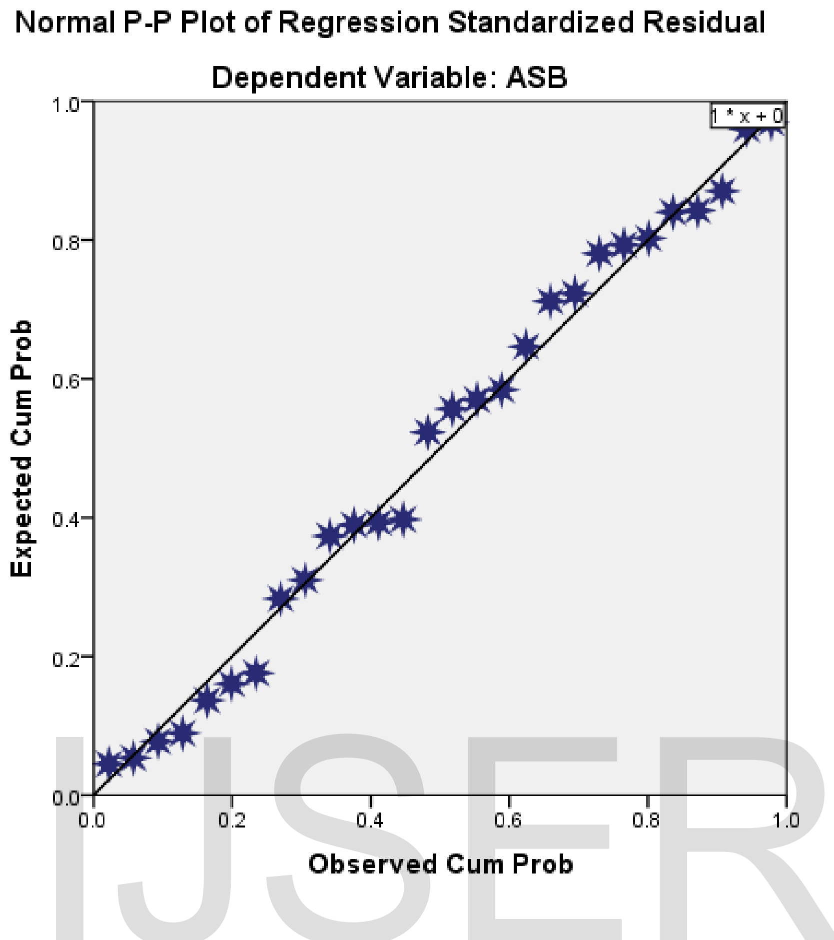

Figure 8: Normal Plot of Regression Standardized Residual

The assumption in the plot above shows that the residuals are not related to the explanatory variable and hence the slope of the regression equation demonstrated a gradual downward movement from right to the left which is normal. It also shows a straight-line relationship between the residuals and the predicted responses.

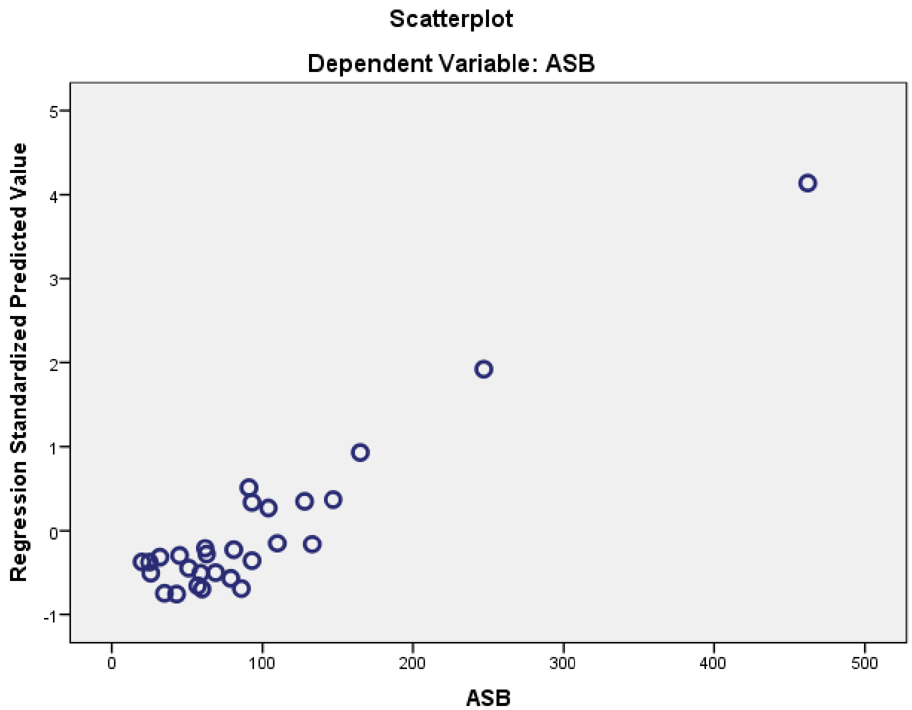

Figure 9: Scatter Plot of ASB Predicted by Population Density

The plot above shows a positive slope of the coefficient indicating a significant relationship between population density and ASB. This means that wards with high population density are associated with high values of ASB.

4. CONCLUSION

This paper investigated the spatial pattern of ASB in Sheffield using two statistical techniques: firstly, the spatial autocorrelation (global and local analyses) with Arc GIS 10.3.1 and the analysis indicated a positive Global Moran's Index showing a statistically significant relationship of the distribution because the p-value = 0.026756 and z-score = 2.215060 are positive and greater than zero and the result expressed clustering of ASB in the Central, Burngreave, and Darnall etc. This however, showed that neighbourhoods with high values of ASB are geographically located close to one another (the Figure 3 shows their location around central towards north/east of Sheffield). The analysis however, illustrated that the clustered pattern of ASB generated a Moran's I of 0.080 and z-score of 2.22 which is statistically significant and proofs that there is less than 1% likelihood that this clustered pattern could be the result of random choice. The local autocorrelation was also applied using the optimized hot spot analysis and result showed a high degree of association.

The second part of the analysis was carried out using SPSS 24 in running a linear regression analysis with ASB as the dependent variable and population density as independent (explanatory) variable from the census data as predictor used in predicting the spatial pattern of ASB in Sheffield as well as testing the stated null hypothesis. The overall model was explained by $R^2=0.905$ while the predictor (population density) was statistically significant with a positive slope of the coefficient.

The implication of the result is that population density contributed significantly to the pattern of ASB in Sheffield. This means that wards with high population density tends to be associated with increased activities of ASB. The Figures 2, 5, and 6 have proven this to be true where population density is high in Central, Burngreave, Darnall etc, values of ASB also tends to be higher in the same wards. This could mean that density is a factor that causes ASB and the proportion in the population causing ASB is constant, as such more people will lead to more ASB. Finally, from the published literature, it has been shown that factors of population density, unemployment, no educational qualification, lack of respect, family disengagement, deprivation, cultural diversity, increased number of visitors and size of the city are responsible for ASB, but the pattern of ASB in Sheffield has proven that population density contributes greatly to it. By this it is obvious that wards with dense population are associated with activities of ASB. Tables, plots and graphs were also used to buttress the assumptions from the analysis and all indicated normal distribution of the residuals and curves, the results therefore, proved the assumptions to be correct.

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