



## Introduction

The aim of this study is to investigate if there is a relationship between certain factors and the rate of crime in the UK using data and statistical analysis. These potential relationships we will be investigating are: Unemployment and crime figures, shotgun ownership and attempted murder rates, pupil exclusion rates and youth crime rates and drug and general crime rates.

It is of great importance to be able to identify the causes of crime and the factors that affect crime. This study will focus on factors that are expected to have an affect crime rates in a positive sense, i.e. the factors we investigate are expected to increase crime as they increase.

In order to investigate our hypotheses, two main statistical tests will be carried out on a variety of data. These tests are the test for Pearson correlation and the test for Spearman's rank correlation. Both of these statistical tests are test for correlation between variables.

## Unemployment

The possible existence of a relationship between unemployment and crime levels is an issue of great political, criminological and economic importance. Various analyses have been carried out in recent years in order to establish if such a correlation exists which which has lead to numerous debates over the issue.

The data set used to examine this correlation contains the yearly total recorded crime all across The UK for the period of 2003-2015 and the yearly unemployment figures for this period. The unemployment figures contains the number of unemployed citizens aged 16 and over across The UK. The null hypothesis for our analysis is that there is no correlation between criminal incidents and unemployment ( $\rho = 0$ ). Whereas the alternative hypothesis that there is a correlation between them ( $\rho \neq 0$ ).

It can be perceived from the scatter plot that our data follow a decreasing trend. The natural assumption to make, indicates that a close to zero or a negative correlation will exist which means that more criminal incidents occur when unemployment is higher, but according to our figure more criminal incidents tend to occur frequently when the number of unemployed citizens is low. From the visualization of our data we can imply that a negative linear relationship may exist between the criminal incidents and unemployment.

Correlations				
Spearman's rho	Criminal Incidents	Crimes per 1000	Unemployment	
		1.000	-0.863	
	Unemployment	-0.863	1.000	
		35	35	

Figure 2: Spearman's correlation output table between criminal incidents and unemployment indicating a strong negative linear correlation

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The strong negative correlation here could be said to indicate a decreasing trend between unemployment and crime. Therefore, according to the results it could be said that a high unemployment rate would mean less crime and that low unemployment means high crime. There is, however, not sufficient evidence to conclude this definitively and as such, more investigation into the matter is required.

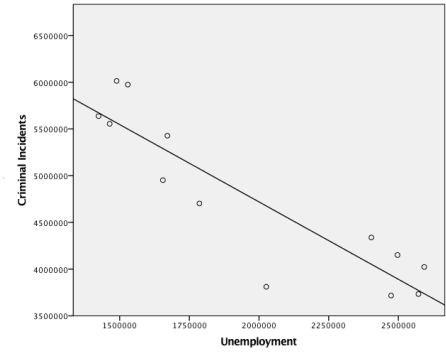


Figure 1: Graph plotting yearly unemployment figures against yearly criminal incidents in The UK for the years 2003-2015 with line of best fit

## Drug Crime

The question of whether there is a relationship between drug crime and crime as a whole is a heavily debated one. The question is also of great socio-economic importance and so this statistical study aims to deduce whether there is any sort of relationship between drug crime and crime as a whole.

The data used in this statistical study contains crime figures for all types of offences (excluding fraud offences) across all areas of England and Wales in the 12 months up to June 2017 and the 12 months up to June 2016. The dataset also provides population figures for each area of England and Wales in 2016 and 2017. The data was obtained from individual police forces across England and Wales and accumulated into one data set by the Office of National Statistics (ONS). Using the crime and population figures it was possible to deduce a crime rate(excluding drugs and fraud)(per 1000 people) and a drug crime rate for each individual area of England and Wales. The purpose of this statistical analysis is to assess whether there is any relationship between the rate of drug offences in England and Wales and the rate of overall criminal offences excluding drugs and fraud. For the purposes of this analysis we will refer to total crime excluding drug and fraud offences as general crime.

Initially it was hypothesised that the data would reveal a positive correlation between the rate of drug crime and the rate of general crime. Therefore it was assumed that, in general, areas which had high rates of recorded drug offences would also have high rates of recorded general crime and areas which had low rates of recorded drug offences would also have low rates of recorded general crime.

For this statistical analysis it was deemed appropriate to check for outliers in the dataset and remove these outliers before carrying out any statistical tests for correlation. This is so that it could confidently be said that any potential relationship found in our statistical analysis would not be affected by the presence of outliers in our data. The method of Tukey's Fences was used in order to identify outliers in the data and these outliers were then removed from the data that was eventually tested for correlation. This method, proposed by John Tukey, identifies outliers using the interquartile range of the data. Let us say that  $Q_L$  is the lower quartile,  $Q_U$  is the upper quartile and that  $IQR$  is the interquartile range, then any data point that lies outside the range of  $[(Q_L - k(IQR), Q_U + k(IQR)]$  where  $k = 1.5$  is deemed to be an outlier of the data. As outliers are removed from the data, this process is repeated until no more data points lie outside the range. This process was carried out to remove outliers for both 2016 and 2017 and it was decided that if a data point was an outlier for either drug crime rate, general crime rate or both then it was removed. The police force areas removed for the 2016 data were: City of London, S. Wales, Dyfed-Powys, Metropolitan Police, Hertfordshire, Leicestershire, Merseyside, West Yorkshire. The police force areas removed for the 2017 data were: City of London, West Yorkshire, Greater Manchester, Metropolitan Police, Merseyside, Dyfed-Powys.

In both Figure 3 and Figure 4 it can be seen, by observing the line of best fit, that there appears to be a slight negative correlation between general crime rates and drug crime rates. Whilst it appears that, both in 2016 and 2017, the slight negative correlation is not very significant, it clearly doesn't support the initial hypothesis of our investigation that there would be a positive correlation. This could imply that in fact there is not a positive relationship between drug crime and general crime as hypothesised.

In order to investigate whether this perceived lack correlation is the case we carried out a Spearman's rank statistical test of correlation between drug crime and general crime. The Spearman's rank test requires that the pairs of observations are independent of each other, i.e. the drug crime and general crime rates of one area is independent of any other area. The test also requires that the observations can be ranked. Since both of the conditions are satisfied by our dataset we carried out a Spearman's rank correlation test. For the 2016 data we observed a value for the Spearman's rank correlation of  $-0.149$ , as shown in Figure 5, which supports what we saw in the line of best fit in Figure 3. For the 2017 data we observed a value for the Spearman's rank correlation of  $-0.183$  which supports that we saw in the line of best fit in Figure 4. Neither of these values are significant at the 1% level and thus we can reject the initial hypothesis that there is a positive correlation between drug crime rates and general crime rates.

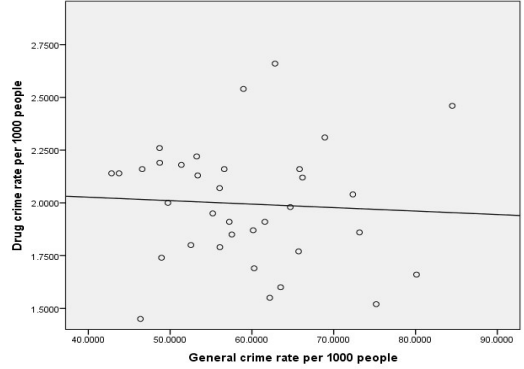


Figure 3: Graph plotting general crime rate per 1000 people against drug crime rate per 1000 people for year ending June 2016 with line of best fit

Correlations				
Spearman's rho	CrimeRatePer1000	Correlation Coefficient	Significance	N
		-0.149	0.000	35
	DrugRatePer1000	-0.183	0.000	35
		35	35	

Figure 4: Graph plotting general crime rate per 1000 people against drug crime rate per 1000 people for year ending June 2017 with line of best fit

Figure 5: Table of results for Spearman's rank correlation for drug rates and general crime rates in 2016

## Conclusion

For this statistical study, we observed significant positive correlations between shotgun ownership and attempted murder rates in The UK as well as between youth crime and pupil exclusion rates. In the case shotgun ownership and attempted murder rates we cannot necessarily conclude that a higher rate of gun ownership affects the attempted murder rate in The UK. This is due to the fact that this investigation does not take into account the number of illegally owned firearms in the country, however these figures are not easily obtainable. It could be argued that since these guns are illegally owned then it is more likely that they will be used for illegal activity. Ultimately, the strong positive correlation we found between shotgun ownership and attempted murder rates does suggest that more gun ownership does increase the number of attempted murders however more investigation would be needed to conclusively determine this.

In the case of pupil exclusion rates and youth crime, there is clearly a strong correlation between the two.

This almost certainly suggests that the two are linked however it does not definitively prove that higher exclusion rates cause more youth crime.

In this study we did find results that went against what we initially hypothesised. We found that, contrary to our initial expectations, there is in fact a strong negative correlation between unemployment figures and crime figures. This is not to say conclusively that "higher unemployment means less crime" however. This is because we chose to compare crime and unemployment numbers as opposed to the crime and unemployment rates which would take into account the amount of unemployed people and crime relative to the population. This could potentially yield a different result from ours and so it is appropriate to say that this is something that should be investigate before any definite conclusion is drawn.

Finally, in our investigation into a relationship between drug crime and general crime we found that there

was no significant correlation between the two in England and Wales. This did not support our initial hypothesis and could be due to a variety of different reasons. For example, a large proportion of low level drug crime, like possession of small amounts and low level dealing, is not reported and so this would not reflect in our crime figures. Ultimately we cannot conclude that drug crime does affect general crime, however, were there more data regarding low level drug crime, we could carry out a more accurate investigation.

In conclusion, it is clear from our study that one of the greatest problems in attempting to discover relationships between certain socio-economic factors and crime is that many crime goes unreported. Because of this, a large proportion of the data we could use is not a true reflection of the actual crime levels in The UK. However, what we can conclude is that a variety of factors could be said to affect crime in The UK but that statistical analysis of data can only go so far as to discovering these factors.

## Gun Crime

In 2013, a researcher David Hemenway made the statement "Generally, if you live in a civilized society, more guns mean more death." In this analysis, it will be checked whether there is a correlation between the attempted murder rate and the number of shotgun certificates to see if the statement made by David Hemenway is true in The UK.

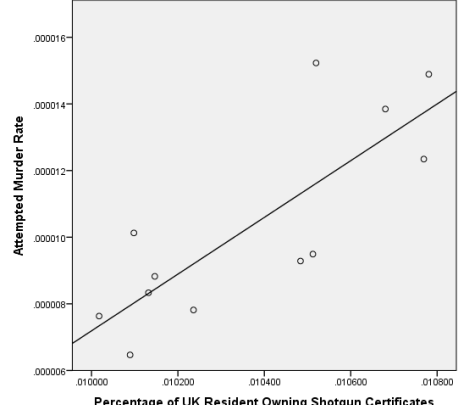


Figure 6: Graph plotting shotgun certificate ownership rates against attempted murder rates in The UK yearly between 2003 and 2015 with a line of west fit

The null hypothesis for our analysis is there is no relationship between percentage of UK resident owning shotgun certificates and attempted murder rate. The datasets are collected from Office for National Statistics, which includes the murder rate and the percentage residents owning shotgun certificates in UK for the period 2003 to 2015 yearly.

To test for the possibility of a relationship, we will test for Pearson correlation. This requires that the data is bivariately normal and continuous. Since our dataset is small, we use the Shapiro-Wilk test to test for normality and find that both variables are distributed normally. This however does not mean they are certainly bivariately normal and so we shall proceed with caution.

The Pearson correlation for this test is  $+0.808$ , which shows that there is likely to be a positive relationship between attempted murder rate and the shotgun ownership rate. Whilst the results do not conclusively say that "more guns mean more death" in The UK, it does support the claim based on the apparent correlation between the two.

## Pupil Exclusion Rates and Youth Crime

The data analysed was sourced from the Department of Education and Ministry of Justice via Gov.UK website, the figures are permanent pupil exclusion rates and youth crime rates between 2002/3 to 2012/13. The youth crime rates were calculated using both the recorded crimes figures and the population figures for ages 10-17 for each year.

The results are anticipated to be a positive correlation as it is predicted that those pupils excluded would have more time to be involved in criminal activity due to not attending school. A study by the Audit Commission found that 42% of offenders of school age who were sentenced in the youth court had been excluded from school (Audit Commission, 1996).

A test for Pearson correlation was run to determine the strength of the relationship between pupil exclusion rates and youth crime rates between 2002/03 to 2012/13. The dataset is first tested for normality using the Shapiro-Wilk test, as the dataset is small. The results of this test indicate that the each variable is normally distributed but not necessarily that they are bivariately normal and thus we shall exercise caution when moving forward. The results of the test for correlation are ( $r=0.945$ ,  $n=11$ ,  $p<0.01$ ). The results show a very strong positive correlation between the two variables, as pupil exclusion rates increase so does youth crime rate in England. This suggests that higher exclusion rates do cause higher youth crime rates and points towards further investigation.

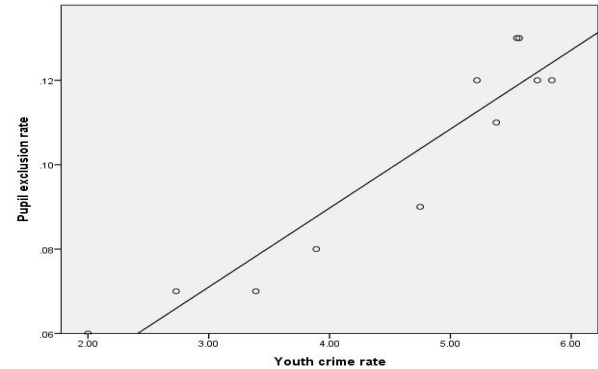


Figure 7: Graph plotting youth crime rates against pupil exclusion rates yearly in The UK between 2002 and 2013 with line of best fit

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