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COMPUTING AND INFORMATION SYSTEM

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**Assessment Title: QGIS Mini-Project**

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# 2. Abstract

This study investigates the connection between crime rates in Cardiff and Swansea and employment and economic deprivation. The major goal of the analysis is to show how increased crime rates in these cities are correlated with higher levels of socioeconomic deprivation, as measured by income and employment domain scores. The study uses QGIS for spatial data analysis and techniques like overlay and buffer analysis to produce a comprehensive geographic representation of the relationship between crime rates and deprivation. The results are intended to help policymakers better understand how socioeconomic factors affect crime and maybe direct focused actions to reduce crime in places where unemployment and poverty are most prevalent.

# 3. Introduction

Background Information:

Urban crime rates have been found to strongly correspond with several socioeconomic characteristics, such as work status and income levels. These relationships are especially noticeable in places like Cardiff and Swansea, where a variety of urban settings and economic circumstances significantly influence the dynamics of crime. Knowing these connections can help law enforcement and urban planners make important decisions, especially when creating plans that deal with the underlying causes of crime.

Purpose and Relevance:

The purpose of this analysis is to investigate the relationship between crime rates in Cardiff and Swansea and particular socioeconomic indicators, including income and unemployment. The study aims to advance knowledge of the socioeconomic factors influencing urban crime by investigating these connections. The results are meant to help public safety authorities, community planners, and legislators create interventions that successfully target and reduce crime in these communities.

Research Question:

"How do income and employment deprivation influence crime rates in Cardiff and Swansea?" is the main topic this study aims to address. To provide a quantitative foundation for socioeconomic and crime-related urban policy decisions, this research topic guides the analytical efforts towards determining the degree to which fluctuations in economic deprivation can predict changes in crime patterns.

# 4. Literature Review:

Existing Studies:

The social disorganisation and strain hypotheses corroborate the large body of data that shows socioeconomic variables have a major impact on crime rates. These ideas suggest that because social controls are less effective and citizens are more stressed and frustrated, crime rates are higher in places with high rates of poverty, unemployment, and educational gaps.

Economic distress can result in social disarray, which raises crime rates, according to studies like those by (Entorf H. S., 2000), who emphasise the impact of socioeconomic variables in urban crime. Although there is a more complicated relationship with violent crime, which frequently necessitates considering additional contextual factors, recent research in metropolitan areas has also shown a direct association between unemployment rates and property crime (Pridemore, 2012).

Although these studies offer a general grasp of the connection between crime and economic disadvantage, there is a lack of localised research that applies this understanding to urban locations, such as Cardiff and Swansea (A., 2011). By providing a targeted examination of the ways in which regional economic circumstances directly affect crime rates in these two cities, this study seeks to close this disparity.

This study applies well-established theories that link crime and socioeconomic hardship to the metropolitan settings of Cardiff and Swansea. The theoretical foundations that support the analysis are examined in this section, with a focus on the significance of examining these sites within the context of urban economy and crime theory.

# 5. Methodology:

Crime Rate Data:

With an emphasis on Wales, the study used extensive crime data from local police databases until September 2024. To align the study's geographic focus, this dataset was carefully filtered to extract information relevant to Cardiff and Swansea. The information includes thorough records of crimes committed in the two cities, broken down by nature and location.

A map of a city

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### Map 1

Since the survey lacked a predetermined 'crime rate' column, calculating crime density was necessary.

Computing Crime Count Per Area:

Each Lower Super Output Area's (LSOA) unique crime incidences were combined to determine the crime counts per area. To ensure that the overall crime occurrence in each area was appropriately depicted, this method entailed performing a spatial analysis using QGIS, where crimes were totalled up for each LSOA. After that, a CSV file with the results was exported for additional examination.

These crimes count statistics were combined with population density data from official sources to precisely evaluate the effect of population density on crime rates. The following formula was then used to determine the crime rate:

Crime Rate=( Number of Crimes/ Population​)×1000

This formula adjusts the crime count to reflect the number of crimes per 1,000 residents, thereby standardizing the measure across areas with varying population sizes and allowing for comparative analysis across different LSOAs within Cardiff and Swansea. These processed data provided the foundation for the spatial and statistical analyses undertaken in this study.

A graph of income and income

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### Bar chart 1

Data on Income and Employment Deprivation: The most recent Welsh Government reports, which provide detailed information on income and employment deprivation at the LSOA level, were carefully consulted to gather deprivation measures.

A map of the united kingdom

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### Map 2

As a crucial gauge of relative deprivation throughout different communities, these indices provide a quantitative look at the socioeconomic situations across regions.

A map of the employment domain score

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Map 3

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The extensive dataset covering all South Wales was explicitly limited to Cardiff and Swansea for the purposes of this investigation. To ensure that the study was specifically targeted, records that matched the geographic borders of these two locations were chosen as part of the filtration procedure.

Data Preparation and Exportation: To enable in-depth, city-specific analysis, the data for every city was exported independently after filtering. This method made it possible to examine and visualise deprivation indicators in connection to local crime rates in a sophisticated manner.

Visualisation Techniques:

To clearly illustrate the income and employment deprivation scores throughout Cardiff and Swansea, the filtered data was visualised using QGIS. By using graduated colour schemes to depict different degrees of deprivation, this spatial representation offered a quick visual evaluation of socioeconomic difficulties in connection to specific city sites. In addition to highlighting regions with high deprivation scores, the visualisation technique made it easier to compare the two cities and identify trends and differences in socioeconomic circumstances.

Analytical Method :-

Spatial Analysis Methods: To investigate the spatial relationships between crime rates and socioeconomic characteristics in Cardiff and Swansea, the study used a variety of spatial analysis methods.

Buffer Analysis:

The ‘spillover' impacts of crime in the vicinity of identified high-crime locales within Lower Super Output Areas (LSOAs) were extensively studied using buffer analysis. The study evaluated the potential effects of proximity to high-crime regions on crime rates in nearby neighbourhoods by establishing buffers with different radii around these crime hotspots. The geographic distribution and severity of crime in relation to regions with high and low socioeconomic deprivation were measured and visualised with the aid of this technique.

Overlay Techniques:

This analysis relied heavily on overlay techniques, which integrated several data layers, including socioeconomic deprivation indices (scores for income and employment deprivation) and crime statistics. This method made it possible to thoroughly investigate regions where there is a high crime rate and significant socioeconomic deprivation. Two overlay sets were created:

Maps displaying the overlay of high crime rates over locations with high income deprivation scores in Cardiff and Swansea demonstrated the correlation between high crime rates and places experiencing economic hardship.

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### Scatter Plot 1

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A map of a city with a red spot

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### Map 4

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Employment and Crime Overlays:

In a similar vein, regions where a dearth of job possibilities is closely associated with greater crime rates were highlighted by overlaying high employment deprivation ratings with crime data.

A map of the state of colorado

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### Map 5

These overlays were crucial in identifying spatial relationships and patterns that suggest a linkage between socioeconomic deprivation and crime occurrences, supporting a targeted analysis of how and where socio-economic challenges impact urban safety.

A graph of employment domain score

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### Scatter Plot 2

These methods collectively underscore the intricate relationships between socioeconomic variables and crime, reinforcing the need for integrated urban planning and policy interventions.

Software Tools:

QGIS:

An open-source Geographic Information System (GIS), QGIS was the main tool used in this study for manipulating, analysing, and visualising spatial data. This program was chosen because of its extensive geographical analytic features and strong support for a wide range of data formats. The development of intricate maps that depicted socioeconomic variables and criminal distributions was made easier by QGIS.

R:

To conduct in-depth statistical analysis, the R programming language was utilised separately in addition to QGIS. CSV files containing the extracted data from QGIS were exported and then imported into R for additional processing. Bar charts and scatter plots were among the statistical visualisations made in R to examine the connection between crime rates and socioeconomic characteristics. A deeper comprehension of the underlying trends and patterns was made possible by this dual-tool approach, which enabled a thorough investigation of the data's statistical and geographical aspects.

This section highlights the study's methodological diversity and analytical depth by showcasing the combined use of R for statistical analysis and QGIS for spatial exploration.

Location of the Map and First Visualisations:

The first visualisations were designed to show the geographical distribution of crime occurrences and socioeconomic deprivation scores for Cardiff and Swansea independently. These maps offer a first visual evaluation of the regions of interest, showcasing patterns and trends that guide the more in-depth spatial analyses carried out in later phases of the study.

# 6. Result

Descriptive Statistics:

The first part of this study looks at the crime and deprivation rates in Cardiff and Swansea. The number of crimes reported and the deprivation indices for employment and income were among the carefully documented data starting in September 2024. To determine the spatial distribution of crime in relation to socioeconomic situations, the descriptive analysis involved calculating crime counts per area, where crime incidents were grouped into Lower Super Output Areas (LSOAs). To provide a comparison measure of crime intensity between the two cities, these counts were then normalised against population density to provide a composite crime rate.

Spatial Analysis Outcomes:

Using overlay techniques to directly compare the geographic overlay of high crime rates with areas of high income and employment deprivation was the main component of the spatial study. These overlays were graphically displayed on QGIS-generated maps, which indicated possible hotspots influenced by socioeconomic factors by highlighting regions where high deprivation coexists with high crime rates. The usage of buffer zones around high-crime regions to further examine the spillover effect into nearby less impoverished areas provided support for these findings.

Crime and Income Deprivation:

In Cardiff, there was a discernible relationship between high crime rates and regions with more income deprivation, particularly in central metropolitan districts. Swansea, on the other hand, displayed a comparable pattern but different spatial patterns, showing that other mediating factors may be at play and that the most impoverished places may not necessarily have the greatest crime rates.

Crime and Employment Deprivation:

In certain neighbourhoods of both cities, there was a significant relationship between crime rates and employment deprivation. This was especially noticeable in places with higher unemployment rates than the city, which corresponds with higher rates of crime.  
  
Map Placement:  
To convey the results clearly and effectively:

The foundation for comprehending the baseline circumstances was laid by early maps that displayed the distribution of crime and deprivation scores independently for each city. The 'before-and-after' visual analysis was produced by combining these layers in subsequent maps. These comparative maps are essential for showing how crime hotspots and areas with different degrees of deprivation intersect.

The last set of maps include the findings from the buffer analysis and shows how crime spreads outside of places that are directly poor, maybe because of the socioeconomic circumstances of the surrounding communities.

To guarantee readability and facilitate the visual evaluation of the spatial association between crime rates and socioeconomic disadvantage throughout Cardiff and Swansea, each map is meticulously annotated with legends and scales.

The study's analytical depth is summarised in this section of the paper, which uses solid geographic data to provide complex insights into the dynamics of crime in connection to socioeconomic hardship.

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# 7. Discussion:-

Interpretation of Result:

Significant spatial links between high socioeconomic deprivation locations and high crime rates in Cardiff and Swansea are highlighted by the investigation. These trends imply that greater rates of unemployment and income inequality within LSOAs are linked to higher crime rates.

A map of a city

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### Map 5

By displaying the overall deprivation scores for Cardiff and Swansea and highlighting locations with compounded socioeconomic issues, this visual depiction [see the 'Combine Deprivation Score (Cardiff and Swansea)' map] combines the findings. Our consideration of how widespread impoverishment might affect crime rates more generally in both cities is supported by this thorough perspective.

This connection highlights the possibility of focused public policy initiatives meant to lower crime by enhancing socioeconomic conditions. To effectively reduce crime, policymakers may think about incorporating income support programs, educational possibilities, and employment programs, particularly in high-risk neighbourhoods.

Comparison with Literature:

The results of this study are consistent with previous research that suggests socioeconomic deprivation can raise crime rates because of things like diminished social cohesiveness, elevated stress levels, and restricted access to economic possibilities (J, 2023). But by delivering a thorough spatial analysis of how these elements interact locally in Cardiff and Swansea, this work adds to the body of literature and provides a more sophisticated picture of urban crime dynamics than was previously possible.  
  
Limitations and Challenges:

This study had several issues that might affect how the findings are interpreted. First, since not all crimes are reported to the police, depending solely on official crime statistics may understate true crime rates. Second, the deprivation scores might not reflect current shifts in employment rates or economic situations because they were derived from publicly available data. In terms of methodology, the study's dependence on overlay and buffer studies assumes that crime rates and socioeconomic characteristics are spatially homogeneous, which may not be the case in various metropolitan environments.

Further Research Suggestions:

This study could be expanded upon in the future by using longitudinal data to evaluate patterns over time and offer insights into the effectiveness of policy interventions. To evaluate urban dynamics and validate the results across various socioeconomic circumstances, comparable research could also be carried out in other areas or abroad. The quantitative analysis could be enhanced and greater insights into the causal mechanisms connecting impoverishment and crime could be gained by further integrating qualitative data, such as community surveys or interviews.

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# 8. Conclusion:-

Using a thorough geographical analysis technique with QGIS and additional statistical analysis in R, the study thoroughly examined the relationship between income and employment deprivation and crime rates in Cardiff and Swansea. According to the data, there are notable spatial correlations between higher socioeconomic deprivation levels—more especially, those related to income and employment—and higher crime rates in the same areas.

These trends highlight how important it is to implement focused socioeconomic interventions to reduce crime in communities that have been classified as extremely impoverished. To put into practice more successful community support and crime prevention methods, urban design and public policy must take these relationships into account.

More research is required to look at these relationships over time using longitudinal data to present a dynamic picture of how community development programs and economic policies impact crime rates. Such study might also be extended to other domains to validate the coherence of these findings and enhance the implications for the formulation of national policy.

# 9. References:-

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