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and Policymaking

**Beyond 'Mansplanning': exploring the link between Feminist Urban Planning
and Violence Against Women in Scotland**

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Abstract

Violence against women is a deep-rooted issue which has been often defined as an epidemic. Although most episodes occur in domestic settings, urban areas also represent unsafe spaces with women experiencing different forms of sexual assault daily. Cities represent dangerous spaces for women and feminist urban planning emerged as a critique of traditional planning which is gender-blind and neglects women's needs in the design of urban spaces. Feminist urban planning scholars advocate for cities better designed for women. Efficient and affordable transport networks are often cited as a measure to reduce feelings of insecurity and improve access to the city for women. However, both the literature and policymaking still lack consistent methods to assess the effectiveness of feminist urban policies, including public transport, in increasing safety. By estimating two Poisson regression models using secondary data, this research aims to explore the relationship between public transport availability and instances of violence against women in Scotland's local authorities. The results show that public transport availability alone does not prevent occurrences of rape and sexual assault, highlighting the need for a more comprehensive assessment of urban policy to better inform urban planning and increase women's safety in urban areas.

Introduction

Violence against women continues to be a persistent problem in the United Kingdom and around the globe. Sarah Everard, Sabina Nessa, and Ashling Murphy are only three of the UK victims of femicide in 2021. Sarah, Sabina, and Ashling were all murdered in public areas, while they were returning home or walking in a park. This commonality sparked nationwide outrage, with the majority of women identifying with the victims as having experienced instances of sexual assault and harassment in public areas at some point in their lives (Government Equalities Office, 2020). Protests were organised all over UK cities to highlight how urban areas do not represent safe spaces for women (BBC News, 2022). Feminist urban planning proposals have been put forward by feminist scholars as a way to make cities a safer place for women and reduce violence (Sweet and Escalante, 2010). In the feminist urban planning literature, a strong emphasis is placed on public transport solutions to improve

accessibility and safety in cities (Sweet and Escalante, 2010; Buiten, 2007). While feminist urban planning scholars propose solutions to improve safety in several policy areas besides transport, further research focus is needed to extensively study the effectiveness of the interventions (Loukaitou-Sideris, 2009). This research will explore the link between transport availability and sexual violence in Scotland's Council Areas.

Violence against women is a deeply rooted phenomenon in our society. The UN defines violence against women as 'any act of gender-based violence that results in, or is likely to result in physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life' (1993: 2). Gender-based violence can be viewed as a continuum on which different acts of violence are placed and interact with each other (Kelly, 1988). Although most episodes of violence against women occur in domestic settings, data and surveys show that violence in public areas is also dangerously widespread (Vera-Gray and Kelly, 2020; Government Equalities Office, 2020). The shocking feminicides in 2021 and 2022 reopened the debate on women's safety in public areas, with thousands of women marching against violence against women. This led to the renewed establishment of the movement #ReclaimTheseStreets, which initially emerged as Reclaim the Night marches in the 1970s in the UK (Mackay, 2014). The movement organised vigils following the feminicides and aims to educate men and boys to take responsibility for violence against women, rather than asking women to behave differently in response to violence (Reclaim These Streets, 2022). Additionally, a recent UK-wide survey shows that violence such as sexual harassment is extensively perpetrated in public areas such as streets, clubs, and public transport (Government Equalities Office, 2020). Therefore, it is clear that violence against women in public areas must be tackled and more research is needed to explore the mechanisms through which violence against women occurs and to understand the policy intervention required to prevent it (Vera-Gray and Kelly, 2020).

Feminist scholars strongly criticise traditional urban planning for its lack of inclusion of women's experiences in designing urban spaces. Cities have been historically designed for men by men, neglecting the habits, needs, and lived experiences of women such as needing to use public transport more frequently than men and needing to use cars less, making shorter, more

frequent trips due to their care responsibilities, and often organising trips into more complex trip chains than men, thus achieving more efficient travelling (Scheiner and Holz-Rau, 2017; Perez, 2019). Failing to accommodate these needs leads to the emergence of feelings of insecurity and fear in urban spaces, preventing women from fully participating in as well as benefiting from city life (Beebeejaun, 2017). For these reasons, women must undertake daily 'safety work' to avoid harassment, violence, rape, and sexual assault (Vera-Gray and Kelly, 2020: 222).

Feminist urban planning emerged as a response to cities being unsafe spaces for women and as a new way to approach urban planning to design cities that can effectively accommodate women's needs (Fainstein and Servon, 2005). Affordable, frequent, and accessible public transport is central in feminist urban planning proposals, which guarantees access to the city and can help tackle feelings of insecurity in urban areas (Sweet and Escalante, 2010; Buiten, 2007). Particularly, women-only public transport, despite its controversies, has been both proposed and implemented around the globe (Loukaitou-Sideris, 2009). Increased street lighting, more accessible housing, and better surveillance in train stations and bus stops are further examples of the proposals put forward in the feminist urban planning literature (Sweet and Escalante, 2010). Failing to include women's perspectives stems from the underrepresentation of women in policymaking (Escalante and Valdivia, 2015). Aside from suggesting increased participation of women in policymaking, feminist scholars have proposed safety audits as a way to assess the safety of different urban spaces and to directly include women's input in their design (Whitzman, 2007). Nonetheless, these are considered timely and costly and have not been systematically adopted by urban planners (Whitzman and Perkovic, 2010). Therefore, there are very few examples in the literature assessing how the current urban policy provisions can help tackle violence against women in cities. This research explores this link by testing whether transport availability can help reduce violence against women in Scotland's 32 local authorities.

To do so, a dataset using secondary data is built. Violence against women data is extrapolated from the Scottish Government Statistics repository and Public Transport Availability information is obtained from the Urban Big Data Centre at the University of Glasgow. Two regression models

are built using Poisson regression. The first model's response variable is rape and attempted rape, whereas sexual assault represents the response variable for the second model. In both estimates, the Public Transport Availability Indicator is the predictor. Population size and socio-economic status, measured through the Scottish Index of Multiple Deprivation are controlled for in the two estimates.

In Chapter One, I will provide a review of the existing literature on violence against women, feminist urban planning, and the current feminist urban policy provisions in Scotland. The research questions and the hypotheses will also be introduced in Chapter One. Chapter Two will offer a description of the methodology, the data, and the methods used. The results obtained from the data analysis will be presented in Chapter Three. Chapter Four will offer a discussion and an interpretation of the results. Overall, I will argue that, given the emphasis that feminist urban planning scholars place on public transport, the latter is significant in preventing the occurrence of crimes of violence against women.

Chapter One: Literature Review

This chapter will provide a review of the literature on violence against women in public areas. I will provide an overview of the existing scholarship on feminist urban planning as a policy approach to make women feel safer in urban areas, with a particular focus on transport policy, and I will identify the gaps in the systematic assessment of urban planning provision. Finally, in this chapter, I will focus on violence against women in Scotland and the policy provisions in place to mitigate episodes of violence in the country before introducing the research questions and the hypotheses explored in this project.

Gender-Based Violence and Violence Against Women

Given that this research focuses on how violence against women can be mitigated by feminist urban planning, I will first examine the literature that defines the nature and scope of the problem of gender-based violence and violence against women. This section will define the two terms, alongside different types of violence. While gender-based violence and violence against women and girls may be used interchangeably, they have different definitions. The UN defines violence against women as 'any act of gender-based violence that results in, or is likely to result

in physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life' (1993: 2). Gender-based violence is a multifaceted issue deriving from the power imbalances and inequalities between men and women in the economic, political, cultural, and social spheres (Sweet and Escalante, 2010). Gender-based violence is a deep-rooted phenomenon and refers to acts of physical, psychological, and sexual violence intended to target women specifically or that disproportionately affect women (Krantz and Garcia-Moreno, 2005). While men can in some circumstances be victims of gender-based violence, women are predominantly targeted on the basis of their gender (Office for National Statistics, 2021). In what follows, I will be focusing specifically on the violence faced by women.

The feminist literature highlights two key dimensions of the complexity of this issue. First, violence against women is a continuum, taking many different forms that are linked and feed into each other. Kelly (1988) usefully and influentially deployed the notion of a continuum to describe the wide range of male behaviours which are considered as different forms of what she calls sexual violence. For instance, rape, attempted rape, sexual assault, and harassment can all be considered instances of sexual violence and may be linked to each other. At the same time, women's individual experiences of violence are complex and diverse. Women experience violence differently at different times in their lives and differently from each other (Kelly, 1988). Kelly (1988) highlights that, while we may think of a continuum as a line, its use to define sexual violence does not imply ranking degrees of gravity of the different forms of attack that women may face – that is, crimes at one end of the spectrum such as rape are should not be considered as more serious than verbal harassment. The author refuses to create a hierarchy of abuse with the use of the word continuum to describe sexual violence because 'the degree of impact cannot be simplistically inferred from the form of sexual violence women experience or its place within a continuum' (Kelly, 1988: 76) which can lead to minimising and dismissing types of violence that are considered less serious. Rather, the use of the continuum metaphor is intended to draw attention to how the different forms of violence can lead to one another. Secondly, gender-based violence is an intersectional phenomenon. Survivors from marginalised ethnic, health, economic, religious, and sexual backgrounds often experience heightened

consequences of sexual violence (Gill, 2018). Notably, poverty and deprivation are strongly linked to violence against women, and they can be a cause and a consequence of violence (Terry, 2004). Violence may be harder to escape for deprived women. Deprived women may not be able to afford housing in safer areas of the city, better linked with public transport. It is thus important for any research focusing on this issue to take into account how women's experience of violence intersects with economic factors.

Linking Violence Against Women and Urban Planning

Research on gender-based violence mostly focuses on domestic violence, that is, violence in the home, rather than on episodes occurring in public areas (Vera-Gray and Kelly, 2020). Nonetheless, the mass participation in the 2021 protests as well as the experiences of violence and harassment in public areas shared by women demonstrate how widespread and serious the issue remains (Government Equalities Office, 2020). Given its salience, more research is needed to explore the mechanisms through which violence against women occurs in public areas (Vera-Gray and Kelly, 2020). While it is important to research the specific mechanisms through which domestic violence occurs, the artificial and ideological character of the public/private violence divide has been criticised by feminist scholars (Sweet and Escalante, 2010; Neupane and Chesney-Lind, 2014). This juxtaposition influences policymaking, with policies aimed to address either domestic or public violence, rather than providing solutions to eradicate violence against women altogether (Sweet and Escalante, 2010). Feminist scholars suggest that policymaking should be aimed not only at physical safety, but also at community safety, rendering cities places where women can participate fully, by eliminating the barriers created by fear of violence, both at home and in public areas (Whitzman, 2007). The next sections will illustrate how policymaking can help increase safety in public areas.

Feminist critics have pointed out that the failure of urban planning to make cities a safe space shifts the responsibility onto women who undertake daily 'safety work' to avoid harassment, violence, rape, and sexual assault (Vera-Gray and Kelly, 2020: 222). The aforementioned movement #ReclaimTheseStreets aims to remove the responsibility of avoiding violence from women (Reclaim These Streets, 2022). However, women must still undertake safety work to feel safe. Examples of these self-preservation mechanisms include constantly being aware of one's

surroundings, carefully choosing clothes and appearance, avoiding certain neighbourhoods or streets deemed unsafe, changing routes, or attempting to make themselves invisible by wearing sunglasses or headphones (Vera-Gray and Kelly, 2020). Feminist urban planning provides solutions to make cities safer for women and reduce the amount of safety work they must undertake when navigating urban areas.

The Fundamentals of Feminist Urban Planning

Feminist urban planning emerged as an alternative way to approach urban planning to design cities that do not solely take into account men's needs (Fainstein and Servon, 2005). Mainstream urban planning has been criticised by feminist scholars for its lack of inclusion of women's experiences in designing urban spaces. 'Gender-blind' transport policy led to the emergence of feminist critiques of transport network design, which is traditionally based on the archaic notion of working man and stay-at-home woman (Law, 1999: 567). As shown by feminist scholars, cities have been designed for men by men, neglecting the habits, needs, and lived experiences of women. For instance, while men generally travel to and from work, mostly by car, women make shorter, more frequent trips due to their work and care responsibilities and travel mostly by foot or public transport (Perez, 2019). Additionally, transport accessibility is also affected by socio-economic status. Research has shown that public transport often fails to accommodate the needs of lower-income households (Sanchez, 2008). Consequently, since women are more likely to use public transport, women from marginalised socio-economic status are worse affected by inefficient public transport, which causes heightened feelings of insecurity (Perez, 2019). City plans rarely accommodate these complex needs, with the design of transport networks reflecting this issue. This is a result of the historical absence and significant underrepresentation of women in policymaking in general, and urban planning in particular, which leads to the neglect of women's perspectives in the design of the city (Escalante and Valdivia, 2015). The lack of gendered data is also the cause of the city being built mainly to accommodate men's needs (Perez, 2019). As a consequence, the lack of these provisions makes cities inaccessible and importantly, creates fears and feelings of unsafety among women attempting to navigate urban spaces (Sweet and Escalante, 2010). It also represents a violation of their right to the city, preventing them from fully taking part in the

social and economic life of urban areas as well as enjoying the opportunities the city has to offer (Beebejaun, 2017).

Feminist urban planning emerged to advocate for cities built for women. Increased street lighting, more accessible transport and housing, and better surveillance in stations and bus stops are, among others, examples of the proposals put forward in the feminist urban planning literature (Sweet and Escalante, 2010). Feminist urban planning scholars strongly emphasise the importance of inclusive, affordable and efficient public transport as a measure to increase women's feelings of safety (Buiten, 2007). Leslie Kern provides a comprehensive guide on how to build a feminist city and her suggestions include 'accessible transportation, plowed sidewalks, affordable housing, safe and clean public bathrooms, access to a community garden, a liveable minimum wage, and shared spaces for things like meal preparation would relieve burdens on many kinds of households, not to mention contribute to other important goals such as environmental sustainability.' (2019: 54). Therefore, feminist urban planning emerges as both a critique of mainstream planning approaches as well as a concrete set of planning proposals aimed to increase women's safety and participation in urban spaces.

Feminist urban planning in practice

While the majority of cities around the globe neglect women's experiences in their planning proposals, there are few exceptions of cities where feminist urban planning has been put into practice. The first is Barcelona, which is considered a contemporary example of feminist urban planning (Horelli, 2017). The city's administration strategy to design Barcelona to respond to women's needs was carried out between 2016 and 2020. It focuses on lived daily experiences, especially those of women, who travel on foot and by public transport more than anyone else (Women4Climate, 2019). The strategy includes the replacement of car routes with green spaces, the introduction of accessible facilities such as toilets and playgrounds around the city, a better transport network, and safer public areas (Women4Climate, 2019). Austria's capital Vienna has been praised for its commitment to gender quality since the 1990s (Horelli, 2017). Eva Kail, Vienna's planning expert, implemented feminist urban planning ideas to redesign the city. The plan includes more accessible public areas, with more parks, larger pavements, and

accessible public transport (Bauer, 2009). These examples show that feminist urban planning can be applied by policymakers to make cities safer and more accessible places for women.

In addition to the aforementioned implementations, a possible measure to increase women's safety and reduce instances of rape, assault, and other types of violence is the introduction of women-only transportation (Dunckel-Graglia, 2013). Several cities in the world such as Mumbai, Mexico City, and Rio de Janeiro introduced some form of women-only transportation (Loukaitou-Sideris, 2009). Between 2001 and 2004 women-only train cars were introduced in Tokyo. There is little data assessing the impact of these solutions (Loukaitou-Sideris, 2009). However, a report shows that harassment had fallen by only 3% in Japan, a year after the implementation of women-only train cars, while arrests linked to harassment increased by 15-20% on two of the lines where the policy was introduced. This may be due to more instances of violence or higher reporting rates from women (Loukaitou-Sideris, 2009). Women-only carriages have been criticised, with claims that this policy normalises harassment and violence against women by introducing the need to segregate women to protect them, rather than tackling the underlying causes of violence and assault, namely political, economic, social, and cultural inequalities (Dunckel-Graglia, 2013). On the other hand, women agree that women-only carriages would make them feel safer in public areas (Thomson Reuters Foundation, 2014). Nonetheless, more data is needed to assess the impact of these policies in mitigating violence and assault (Loukaitou-Sideris, 2009).

Measuring feminist urban planning success

Clarifying the objective of feminist urban planning policies is fundamental to assess their effectiveness. The feminist urban planning literature calls for measures to increase women's safety. Safety audits have been put forward as a way to evaluate safety in cities and as a bottom-up planning initiative, which directly includes women's input in the design of the city (Whitzman, 2007). Safety audits were initially introduced in Canada in the 1980s but have since spread to different regions in the world. Safety audits involve participants walking through physical spaces, assessing how safe these environments make them feel and identifying ways to improve safety in those areas (Whitzman et al, 2009). Safety audits are a powerful tool to inform urban planning and allow women to be empowered in the design of physical

environments. Despite their adoption around the globe, safety audits are still considered a radical measure and need further implementation in cities around the world (Whitzman and Perkovic, 2010). Moreover, while the feminist urban planning literature provides useful solutions to increase women's safety in cities, the scholarship fails to provide a systematic measurement of how effective these policies are at making urban areas safer for women. Thus, finding ways to evaluate the effect of urban planning on women's safety remains a key frontier for feminist urban planning research and is likely to have important policy implications, and represents the core aim of this research.

Violence Against Women in Scotland

This research will explore the link between transport availability and violence against women in Scotland's council areas. The Scottish government displays a commitment to ending gender inequality. The government's 'Equally Safe' strategy sets out a clear framework and action plan to tackle violence against women and girls (Scottish Government, 2022a). While the Scottish Government aims to end gender-based violence both in domestic settings and in public areas, gender-based violence legislation mainly focuses on domestic abuse and, while there is sexual crimes legislation – such as the Sexual Offences (Scotland) Act 2009 – it is not gender-specific (UK Legislation, 2022). Despite Scotland's commitment to tackling gender inequality, Scottish cities still represent unsafe spaces for women. Third-sector organisation Wise Women, in partnership with Glasgow Girls Club, Commonplace and Glasgow Violence Against Women Partnership, developed an app to consult women about their lived experiences of harassment and violence in Glasgow (Wise Women, 2022a). Their report revealed that infrequent public transport represents, among others, a factor in women's fears and feelings of insecurity in the city (Wise Women, 2022b). Assessing whether the current transport availability helps mitigate instances of violence against women can help inform future policymaking on making urban areas safer for women.

Policymakers in Scotland display a commitment towards increasing safety for women in urban areas. The Glasgow City Council administration recently announced its intention to adopt feminist urban planning for city provisions. The latter include increasing safety at bus stops and on buses as well as increasing lighting and security in parks at night-time (Cities Today, 2021).

Additionally, Scotland's transport minister Jenny Gilruth stated that, with the nationalisation of the Scottish railway service, the attention should focus on making women feel safer while travelling (BBC News, 2022). Despite recent proposals to increase women's safety in cities, city plans across Scotland still fail to include gender aspects in their urban planning and there are no policy initiatives introduced specifically to increase women's safety in urban areas. Therefore, due to the lack of feminist urban planning solutions, the research will assess current policy, to shed light on the relationship between urban planning and violence against women, aiming to uncover areas where further policy intervention is needed and feminist urban planning provisions that should be implemented.

In order to assess whether the current urban planning provisions in Scotland are accommodating women's needs and whether Scottish council areas are safe for women in accordance with feminist urban planning recommendations, data on different aspects of urban life are needed (Sweet and Escalante, 2010). For instance, police presence and better street lighting are mentioned by interviewees in the Wise Women report as solutions to increase safety in Glasgow (Wise Women, 2022b). However, these data are not collected systemically across the nation and across different council areas. For instance, information about streetlamps is only available on the Glasgow City Council open data repository (Glasgow City Council, 2022). Additionally, the Scottish Labour 2021 Women's Manifesto called for the introduction of women's safety audits as a pilot programme (Scottish Labour, 2021). This is the only mention of safety audits in the context of Scottish policy. They are not common practice in Scotland and there are currently no alternative methods to systematically assess feelings of safety across the nation's council areas.

Due to the lack of data needed to paint a comprehensive picture of feminist urban policy provisions across Scotland the focus of the research will be on exploring the link between public transport availability and sexual violence. The unavailability of the data and the arbitrary disaggregation of violence data affect the formulation of the research questions and hypotheses and will be addressed in more depth in Chapter Two. Nonetheless, this research represents the first attempt in the literature to quantify the relationship between violence against women and transport policy, which will help identify areas in which urban policy interventions are needed to

increase women's safety. Therefore, the research questions explored in this dissertation can be formulated as follows:

RQ1. How does transport availability affect the prevalence of rape and attempted rape in Scotland?

RQ2. How does transport availability affect the prevalence of sexual assault in Scotland?

RQ3. How does the effect of transport availability on levels of rape and sexual assault differ?

Following the research questions, the following hypotheses will be tested through the methods described in the following Chapter:

H_1^0 : Public transport availability has no effect on rape and attempted rape in Scotland.

H_1 : Higher public transport availability reduces the likelihood of rape and attempted rape in Scotland.

H_2^0 : Public transport availability has no effect on sexual assault in Scotland.

H_2 : Higher public transport availability reduces the likelihood of sexual assault in Scotland.

Chapter Two: Methodology and Methods

This chapter will provide an overview of the methodology and the dataset employed for the research as well as the methods through which the data has been analysed.

Methodology

In order to answer the research questions and test the hypotheses introduced in the previous chapter, a quantitative analysis will be conducted. Quantitative methods have been criticised by feminist scholars for often assuming that society is homogenous and for ignoring fundamental differences between men and women (Spierings, 2012). This is due to the lack of gendered data, which will be highlighted as a limitation in the following section. Additionally, quantitative

techniques have been criticised in the feminist literature for creating a division between the researcher and the research subjects, and for ignoring individuals' unique lived experience, which leads to over-generalisation (Westmarland, 2001). Given the subjective nature of qualitative research, the latter is regarded as better aligned with the aims of feminist research, allowing for a more equal relationship between researchers and subjects, and for this reason, it is largely preferred within feminist research (Westmarland, 2001; Spierings, 2012).

However, it is important to clarify that, as there is no one feminist perspective, there is no one feminist methodology, and the choice of methodology and methods depends on the type of research that is being conducted (Ramazanoglu, 1992). Quantitative methods are appropriate for this research for two reasons. Firstly, as was shown in Chapter One, feminist urban planning provisions are rarely evaluated and there has only been one instance of evaluation of feminist transport policy (Loukaitou-Sideris, 2009). So, this research would represent one of the few attempts to understand how transport affects violence against women in urban settings. Secondly, while safety audits have been proposed as the appropriate method to evaluate urban planning provisions, they are considered a radical measure, they are costly, and require time and resources. Therefore, quantitative methods, although they do not provide an in-depth report of individual experiences, allow for an initial exploration of the phenomenon, which can then be combined with mixed methods for a more exhaustive account of the relationship between transport planning and violence against women (Spierings, 2012). The following section will provide a description of the data used for this analysis.

Data

To explore correlations between transport availability and violence against women in Scotland, a tailored dataset is built using secondary data. Violence data is extrapolated from the Scottish Government Statistics online repository (Scottish Government, 2022b). The website refers to Recorded Crime and Offences recorded by Police Scotland and includes the number and rate of crime and offences per 10,000 population. The time period chosen for this analysis is 2020/2021 as the most recent data available. The data description specifies that the crimes have been recorded by the police but may not have been committed during that time period. The crimes and offences selected for this analysis appear under the section 'Sexual Crimes'. The

ones selected for this analysis are 'Rape & Attempted Rape' and 'Sexual assault'. The dataset provides numbers and rates for each Council Area in Scotland. Data for the two types of crimes represents the response variables for the models built.

Transport availability is measured using the Public Transport Availability Index (PTAI) dataset produced by the Urban Big Data Centre at the University of Glasgow (Urban Big Data Centre, 2022). I was granted access to the dataset for this analysis after submitting a user request. The dataset has been developed by UBDC by pooling data from ferry, train, bus, and transport providers in Great Britain. The data for Scotland's PTAI is selected for this analysis. By using public transport availability information for the year 2016 and by aggregating stop-level and lower-level availability indicators, a score is assigned to each of Scotland's Intermediate Zones. As the data for sexual crime and offences refers to council areas, each intermediate zone PTAI is aggregated to council-area level according to population size. PTAI is used as the predictor for sexual crimes.

The dataset also contains two control variables. The first is population size by council area which is extrapolated from the National Records of Scotland online repository (National Records of Scotland, 2021). The data refers to population size in 2020. The population size for each council area is entered in a CSV file and added to the model as a control variable. The second variable which is controlled for is socio-economic profiles of each council area. The Scottish Index of Multiple Deprivation (SIMD) is employed for socio-economic data. The SIMD measures deprivation across seven areas: income, employment, education, health, access to services, crime and housing (Scottish Government, 2020). It measures deprivation levels in Scottish data zones. However, I will aggregate the ranking to council-area level to adapt it for correlation with crime statistics.

Before describing the methods through which the data has been analysed, several limitations of the dataset can be identified. One, which is a common cause of the invisibility of gender violence, is that sexual crimes are not disaggregated by gender (Sweet and Escalante, 2010). Nonetheless, it is clear that women are overwhelmingly more likely to experience sexual violence than men. The Office for National Statistics reported that 84% of sexual violence

episodes were experienced by women in England and Wales in the year ending in March 2020 (Office for National Statistics, 2021). In 2020-2021, 80% of reported domestic abuse incidents in Scotland had a male perpetrator and a female survivor (Zero Tolerance, 2022). Due to the highly gendered nature of sexual crimes, it will be assumed that data for rape and attempted rape and sexual assault refer to violence experienced by women. Moreover, the reports lack data on sexual harassment, which is one of the most common types of violence perpetrated against women (Government Equalities Office, 2020). The data also does not specify where episodes of harassment and violence occur, which could mean that increasing public transport availability also increases the instances of harassment as perhaps more episodes occur on public transportation (Gardner et al, 2017). Moreover, while data specific to domestic violence is available, it is unclear whether the sexual crimes considered for this research occur exclusively in public areas. Additionally, public transport availability data refers to the year 2016 which may not represent more recent public transport availability rates therefore, more recent assessments are needed. Nonetheless, the dataset represents a valid starting point for assessing one aspect of feminist urban planning, that is public transport and its effect on violence against women in Scotland.

Methods

The dataset used for this analysis is created by combining the secondary data, which is then analysed using R software. Information about the software environment, the version used, as well as the code used for the analysis will be provided in the Appendix. Prior to the data analysis, both the PTAI and SIMD are aggregated to council area levels, as the former refers to Scotland's intermediate zones and the latter refers to Scotland's data zones, while crime statistics refer to Scotland's 32 council areas. The new scores are obtained by aggregating the existing scores by population size to council area levels, using the weighted mean function in R.

Rape and sexual assault reports are used to build two different statistical models in order to explore the influence of transport availability on different types of crime. Linear regression would be the preferred choice to test the direct influence of the predictor on the response variables. However, the two response variables do not follow normal distribution, as it will be shown in Chapter Three. Additionally, the response variables represent the count of events that

occur independently of each other in the form of discrete, positive numbers, there is no clear upper limit to the number of events that can occur, or the upper limit is clearly greater than the actual counts. For these reasons, Poisson regression is the most suitable model for the analysis (Monogan III, 2015; Hayat and Higgins, 2014). Using Poisson regression helps establish how PTAI influences occurrences of rape and attempted rape and sexual assault in Scottish local authorities. Therefore, two generalised linear models using Poisson regression are estimated (Monogan III, 2015).

Poisson distribution is used for the estimation and the probability mass function for Poisson regression can be formulated as follows:

$$P(y; \mu) = \frac{\exp(-\mu)\mu^y}{y!}$$

1: Poisson probability mass function

for $y = 0, 1, 2, \dots$, with expected counts $\mu > 0$ (Dunn and Smyth, 2018: 371).

A logarithmic link function was used in the model, as the canonical link function for Poisson models, which ensures $\mu > 0$ and helps interpret the regression parameters as having multiplicative effects. The general form, which is applied in R to estimate the models is:

$$\{y \sim \text{Pois}(\mu) \log \log \mu = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p\}$$

2: Poisson estimation

(Dunn and Smyth, 2018: 372). In this model, the mean equals the variance, however, when the variance is larger than the mean, overdispersion occurs. The problem is more frequent with a limited amount of data which is the case for this model and can lead to an underestimation of the standard errors and overestimation of the significance of the explanatory variables. Therefore, before interpreting the results, the model is tested for overdispersion by conducting goodness-of-fit tests. If the result is much greater than one, this indicates lack of fit for the model (Dunn and Smyth, 2018). This is tested in R by dividing the residual deviance by the degrees of freedom for each model.

Therefore, quantitative methods are employed to estimate two Poisson regression models using secondary data. The models test the hypotheses introduced in Chapter One and explore how

Public Transport Availability affects the occurrence of rape and attempted rape and sexual assault in Scotland. The results will be offered in the following Chapter.

Chapter Three: Results

This chapter will provide an overview of the results obtained by analysing the data and estimating the two regression models described in Chapter Two. Initial data analysis has been conducted to check for the appropriateness of linear regression and to assess the suitability of the Poisson regression model with the data. Firstly, the distribution of rape and attempted rape as well as sexual assault is reported in Figure 1 and Figure 2 respectively.

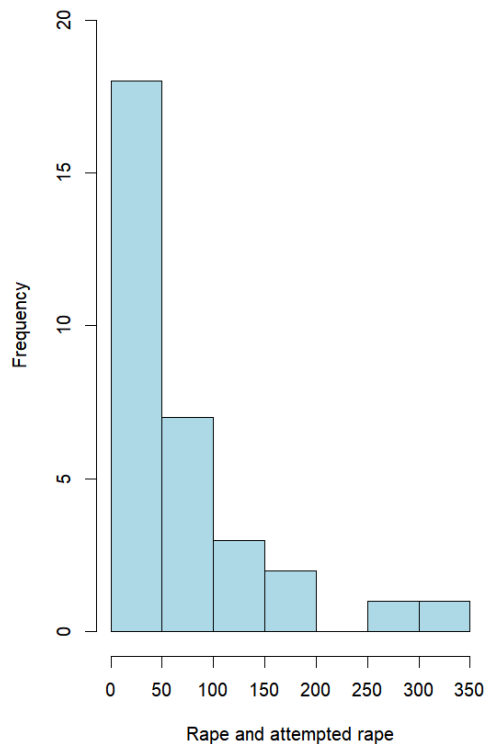


Figure 1: Rape and attempted rape distribution

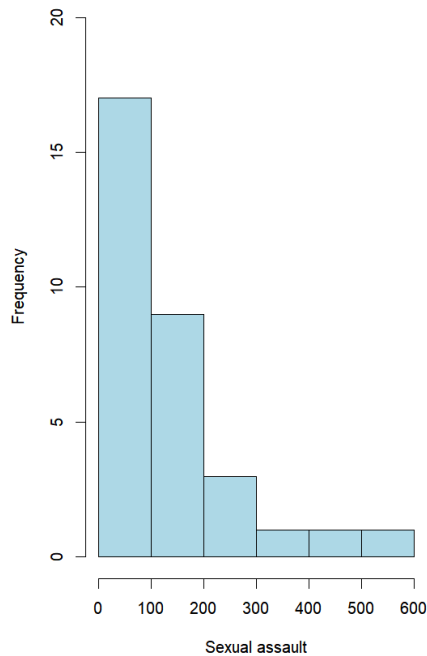


Figure 2: Sexual assault distribution

The figures show the number of crimes reported – represented on the x -axis – and the number of times each level of crime occurs in the data – with frequency represented by the y -axis. Both rape and attempted rape and sexual assault do not follow normal distribution and the data is highly skewed. The distribution is positively skewed indicating that lower crime rates are more frequent for council areas in Scotland, with only two local authorities reporting rape and attempted rape counts higher than 250, namely Glasgow and Edinburgh LAs, and three reporting sexual assault rates higher than 300, Glasgow, Edinburgh, and Fife.

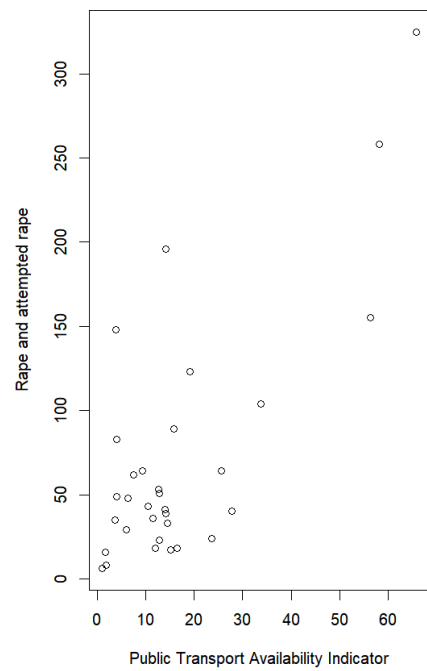


Figure 3: PTAI and rape correlation

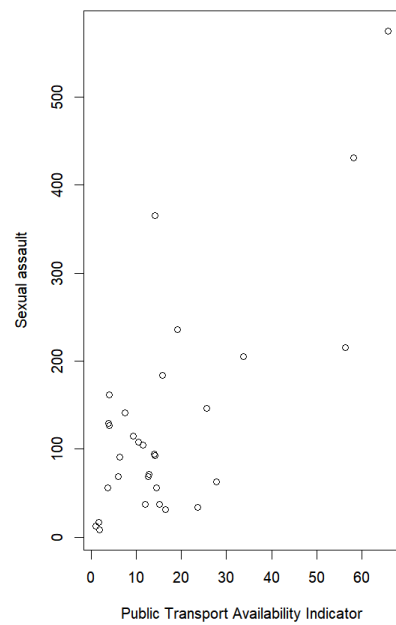


Figure 4: PTAI and sexual assault correlation

Additionally, initial data exploration revealed slightly positive correlations between PTAI and rape and attempted rape and PTAI and sexual assault, which can be observed in Figures 3 and 4. The graphs reflect the positive skew observed in the distribution analysis with data points clustered in the bottom left corner and a few outliers in the top right area for both variables. The presence of outliers reflects the heterogeneity of Scotland's different council areas: prevalently rural local authorities may have lower transport availability and given a smaller population size, crime incidence is lower. Mainly urban local authorities such as Glasgow and Edinburgh council areas may have higher transport availability scores and higher crime rates, given the larger population size. This relationship is surprising as it was hypothesised that the crimes and the PTAI would be negatively correlated. Because the dependent variables in question represent even counts, and because of the characteristics of the data illustrated above, two Poisson Generalised Linear Models have been estimated. Population size and deprivation have been added as control variables to each model. The output of the model estimation can be observed in Tables 1 and 2 which will be described in turn. The chosen significance level for the p-value is 5% as the conventionally accepted statistical significance level (Kim, 2015).

Table 1: Rape and attempted rape model output

	Estimate	Std. Error	Z value	P-value
(intercept)	3.456e+00	1.123e-01	30.773	<2e-16
PTAI	4.100e-03	1.685e-03	2.433	0.015
Population	3.733e-06	1.902e-07	19.625	<2e-16
SIMD	-3.159e-05	2.779e-05	-1.137	0.256
Null deviance	1813.12 on 31 degrees of freedom			
Residual deviance	414.04 on 28 degrees of freedom			
AIC	604.55			

The coefficients for Public Transport Availability Indicator and for council area population are statistically significant with p-values lower than 5%. The null hypothesis H_1^0 , stating that Public

Transport Availability has no effect on rape and attempted rape, can be rejected. The coefficient for deprivation is not significant at the 5% level. These results interestingly reject hypothesis H_1 , which maintains that PTAI reduces the likelihood of rape and attempted rape. Instead, Public Transport Availability is found to have a positive correlation with rape and attempted rape, confirming the initial observation represented in Figure 3. However, in order to correctly interpret the effect of transport availability on rape and attempted rape, the coefficients are exponentiated, resulting in a count ratio, which helps retrieve the percentage change in the expected count for a change in the independent variable (Monogan III, 2015). For a point increase in PTAI, rape and attempted rape increase by 0.4%, all else equal, whereas the effect of changes in population size is much smaller.

Table 2: Sexual assault model output

	Estimate	Std. Error	Z value	P-value
(intercept)	4.138e+00	8.446e-02	48.993	<2e-16
PTAI	6.193e-04	1.262e-03	0.491	0.6237
Population	3.961e-06	1.428e-07	27.745	<2e-16
SIMD	-4.852e-05	2.095e-05	-2.317	0.0205
Null deviance	2973.70 on 31 degrees of freedom			
Residual deviance	587.88 on 28 degrees of freedom			
AIC	797.72			

The output of the second model measuring the effect of public transport availability on sexual assault rates shows that the coefficient for the PTAI is not statistically significant at the 5% level. The coefficient for population size is statistically significant at the 5% level. Therefore, the null hypothesis H_2^0 , stating that PTAI does not affect sexual assault in Scotland, cannot be rejected. Interestingly, the coefficient for the Scottish Index of Multiple Deprivation is significant at the chosen level as its p-value is lower than 0.05 and it displays a negative correlation with sexual assault. As the SIMD assigns higher values to least deprived areas, a point increase in SIMD

results in a 0.005% decrease in the occurrences of sexual assault, all else equal. Therefore, more deprived areas are likely to experience higher levels of sexual assault.

The models will be tested for overdispersion by dividing the deviance by the degrees of freedom. The first generalised linear model produces a goodness-of-fit score of 14.8 while the score for the second model is 21. The two scores are significantly higher than one which signifies overdispersion. This phenomenon is more likely to occur with smaller datasets as the one used for this analysis. Negative binomial regression models are a valid alternative to Poisson regression when overdispersion occurs (Dunn and Smyth, 2018). However, the latter yields similar results and, for ease of interpretation, the estimates for the Poisson regression models are considered. Nonetheless, overdispersion is taken into account when interpreting the results, and represents one of the limitations of this study.

To summarise, the initial data exploration showed a slight positive correlation between PTAI and sexual violence in the form of rape and attempted rape and sexual assault. The first model tested the influence of public transport availability on rape and attempted rape, controlling for population size and deprivation index for the 32 council areas in Scotland. The results showed that public transport availability is statistically significant and positively correlated with the occurrence of rape and attempted rape, confirming the initial findings. It was found that a point increase in public transport availability leads to a 0.4% increase in the likelihood of rape and attempted rape, all else equal. While the null hypothesis can be rejected, this result does not support Hypothesis 1 as higher public transport availability does not reduce the likelihood of rape and attempted rape in Scotland. The second model explored the relationship between public transport availability and sexual assault while controlling for population size and deprivation. The coefficient for the PTAI is not statistically significant at the level chosen therefore, the null hypothesis formulated for this model cannot be rejected. On the other hand, the coefficient for the Scottish Index of Multiple Deprivation was found to be statistically significant in this model and positively correlated with sexual assault crimes. An interpretation of the results will be provided in the following chapter.

Chapter Four: Discussion

In this chapter, I will interpret the results reported in Chapter Three and contextualise the outcomes within the wider feminist urban planning research framework. This research aimed to explore the relationship between urban provisions, particularly transport availability, and violence against women in Scottish local authorities. To do so, the research questions set out in Chapter One aimed to understand how transport availability affects rape and sexual assault in Scotland. To answer those questions, two hypotheses were tested. The latter stated that higher transport availability reduces the likelihood of rape and attempted rape and sexual assault respectively. Two generalised linear models for Poisson regression were estimated to test the hypotheses. The results showed that higher PTAI increases the likelihood of rape and attempted rape by 0.4% but it does not have a direct effect on occurrences of sexual assault, when controlling for population size and socio-economic status. The latter is found to be statistically significant in the second estimation and, with a point increase in deprivation, there is a 0.005% increase in the likelihood of sexual assault.

Violence Against Women on Public Transport

These results generate interesting outcomes. To answer the first research question, the first model estimated shows that an increase in public transport availability leads to a slight increase in the occurrence of rape and attempted rape. While these outcomes may suggest that reducing public transport availability may reduce occurrences of rape and attempted rape, they must be interpreted carefully. The positive relationship is not completely unexpected. This correlation between transport availability and sexual crimes can be attributed to the fact that sexual violence occurs on public transport and so, increasing transport links can lead to an increase in occurrences, where public transport is not a safe space for women as it was previously observed in the literature (Gardner, 2017). Violence against women occurs on public transport, as well as in other public areas, as a violation of their freedom to be in that public space. This is a consequence of the traditional relegation of women to the private sphere, with their spatial mobility and use of public spaces seen as defiant and deviant (Neupane and Chesney-Lind, 2014). Male power and privilege are reinforced in public areas when sexual violence occurs, as women must defend their right to be and use that public space (Neupane and Chesney-Lind,

2014). Therefore, merely increasing transport availability does little to ensure that violence against women is not perpetrated if these policy interventions are not accompanied by education on gender inequality as well as a comprehensive urban planning approach, as it will be shown in the following section.

Comprehensive Urban Planning

While feminist urban planning scholars suggest that increasing transport availability may help make cities safer spaces for women, the literature importantly highlights how availability must be paired with affordability and accessibility of public transport in order for it to be effective in making cities less dangerous (Buiten, 2007). However, the data employed for this analysis solely takes into account the availability of public transportation, neglecting the other factors. The positive correlation between rape and PTAI does not signify that public transport is not a valid option for women and that we should encourage women to use alternative transport modes such as cars in order to be safer. The relation could be attributed to the inadequate public transport provision which does not effectively prevent occurrences of sexual crimes in Scottish Council Areas. In order to measure the effectiveness of public transport in preventing sexual crimes and making cities safer, factors such as accessibility and affordability should be taken into account (Buiten, 2007). Measuring not only the occurrence of transport but also the experiences of women on means of transportation is fundamental to understand how public transport and sexual crimes intertwine and to inform policy interventions needed to increase safety. Additionally, as women mostly travel on foot, the journey to and from the closest transport link may represent dangerous routes. When train stations and bus stops are still unsafe, increasing public transport availability does little to ensure lower crime rates (Smith, 2008). Thus, tackling public transport alone cannot effectively make urban spaces safer. Examples of feminist urban planning implementations in Barcelona and Vienna show that, in order for them to be successful, policy interventions must be comprehensive and not limited to tackling only one aspect of urban policy. The two cities introduced accessible facilities, better transport networks, and more green areas that led to safer public spaces (Women4Climate, 2019; Horelli, 2017). While feminist urban planning measures must be comprehensive to be

effective, there is no one-size-fits-all and women's experiences must be considered when designing urban policy interventions.

Categorising Violence Against Women

The outcomes of the second model estimated can be interpreted to answer the second research question. The model shows that public transport availability does not affect occurrences of sexual assault. This is surprising given the positive correlation between the two variables found in the initial analysis. Comparing the outcomes of the two models can also help answer the third research question. Public transport availability seems to only affect crimes of rape and attempted rape, while it has no statistically significant effect on crimes of sexual assault. This result is unexpected because as the two types of crimes can be found on the gender-based violence continuum, it would be expected for them to be affected by transport availability in a similar way (Kelly, 1988). This divergence could be due to the Scottish Government's definition of sexual crimes. Sexual assault can be used as an umbrella term to define all acts of non-consensual sexual activities, which can include rape and attempted rape (Kilpatrick et al, 1989). The Scottish Government's published user guide to crimes and offences suggests that crimes of sexual assault include a wide range of sexual crimes, including rape and attempted rape, similarly using sexual assault as an umbrella term (Scottish Government, 2022c). This distinction between rape and attempted rape appears arbitrary and can influence the analysis conducted with these data. Muehlenhard and colleagues (1992) illustrate how adopting narrow definitions of rape and attempted rape can reinforce existing power relations, determine how these offences are perceived and judged, and negatively affect the experiences of survivors. Additionally, categorising crimes in terms of the hierarchy of abuse can be detrimental to the survivors and can contribute to the justification of crimes when they are considered not serious enough, as illustrated in the literature (Kelly, 1988). Therefore, clarifying their definition is fundamental when reporting sexual crimes and offences since it can strongly influence both research and policymaking employing these data.

The Intersectionality of Violence

The coefficient for multiple deprivation is found to be statistically significant in the second model estimated. The results show that deprived areas are more likely to experience an increase in occurrences of sexual assault. Although the influence is minimal, these results support the idea that gender-based violence is an intersectional phenomenon (Gill, 2018). The results show that women in deprived areas are more vulnerable to violence and public transport and targeted urban policy proposals can be implemented to improve safety in those areas and should be aimed at preventing violence (Sanchez, 2008). However, this analysis utilised deprivation data which has been aggregated to the council area level, more granular analysis is needed since there are important differences within city councils with respect to deprivation (Scottish Government, 2020). Further research could focus on exploring how deprivation affects the influence of urban policy on violence against women.

These results can be summarised into three key conclusions. Firstly, public spaces are still highly gendered and violence against women can be seen as a consequence of male privilege being propagated in urban areas. Secondly, in order to make cities safer, tackling one policy area is not sufficient and systematic assessments of women's experiences are needed to inform policy intervention, which must take into account intersectional aspects of violence. Finally, violence against women must not be categorised arbitrarily and better data on these crimes are needed.

Conclusion

This research explored the relationship between transport availability and violence against women in Scotland's council areas. Violence against women is a persistent phenomenon and the recent #ReclaimTheseStreets protests in 2021 highlighted the urgency for policymakers to make urban areas safer environments for women (Reclaim These Streets, 2022). There are different ways in which urban planning can tackle unsafety in cities. Feminist urban planning advocates suggest, among other proposals, to increase transport availability and affordability in order to help women – who are more likely than men to use public transportation – better access and navigate the city (Sweet and Escalante, 2010). Nonetheless, there have been few attempts both in the literature and in policymaking to assess how effective transport policy is in

tackling violence against women. While scholars have introduced ways to assess the safety of cities, their implementations have been sporadic, and the literature still lacks a common and systematic way to measure how policy can tackle violence against women (Whitzman and Perkovic, 2010).

This research represents an attempt to quantitatively measure the effect of transport availability on sexual crimes. After estimating two regression models, the results show interesting correlations between the variables. Public transport availability positively affects the occurrence of rape and attempted rape in Scotland, although its effect is minimal. However, the solution should not be to encourage women to seek modes of transport different from public provisions. Feminist urban planning proposes a range of urban interventions which can reduce feelings of insecurity in cities, which are not limited to increasing public transport networks. A better understanding of the mechanisms through which transport policy affects sexual violence is needed and can be achieved by measuring not only availability but also accessibility and affordability of public transport as well as all the other urban provisions proposed by feminist urban planning advocates (Sweet and Escalante, 2010). Additionally, it was found that public transport availability does not affect sexual assault although the latter is positively affected by deprivation. This result supports the idea that sexual violence is an intersectional phenomenon and factors such as socioeconomic status, ethnicity, housing, health status, religion, and sexuality should always be taken into account when designing policies aimed at tackling gender-based violence (Terry, 2004). The divergence of outcomes between the two models can be due to the way sexual crimes are categorised and measured. Rape and attempted rape are often found under the umbrella term of sexual assault (Muehlenhard et al, 1992) whereas the Scottish Government considers these as separate categories. Arbitrary categorisation of rape and sexual assault affects the way these crimes are classified and judged, as well as survivors' understanding of the crimes (Muehlenhard et al, 1992). Therefore, adopting clear definitions is fundamental when reporting crimes of violence against women.

This research has some limitations. Firstly, the data used to measure Public Transport Availability is outdated as it refers to the year 2016 while sexual crime data refers to the 2020-2021 timeframe. More recent measurements are needed for more accurate research. An

additional limitation of this study is that it refers to reported crimes of violence against women. Only 1 in 100 rapes were reported to the police in England and Wales (Rape Crisis, 2022). Similarly, in Scotland, only 12% of rapes were prosecuted and only 6% resulted in a conviction in 2015-16 (Public Health Scotland, 2021). Thirdly, the statistical limitations of the regression model estimated prevent us from making straightforward conclusions about these results, as explained in Chapter Three.

Despite the limitations, this study represents the first attempt to quantify the relationship between transport policy with violence against women, drawing from the proposals of feminist urban planning scholars. Further research should focus on proposing a common method for assessing the impact of urban policy on violence against women and to inform future feminist urban planning proposals. Nonetheless, this research does not aim to argue that safety can solely be measured in terms of episodes of reported violence but it is a starting point for monitoring urban planning success in increasing women's safety, since other methods such as safety audits are costly and timely. Additionally, as deprivation was found to be a statistically significant factor in this project, further research should explore how feminist urban planning can benefit marginalised racial, sexual, religious and socioeconomic groups. Violence against women in urban areas is an alarmingly widespread phenomenon and cities are currently unsafe spaces for women. Feminist urban planning interventions, as well as educating people on gender-based violence, are needed to tackle violence against women and to make cities safer.

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Appendix

PTAI aggregation

```
#choose file
file.choose()

#read file
data =
read.csv("C:\\Users\\sabri\\OneDrive\\Desktop\\MSc\\semester2\\diss\\aggre
gation_df.csv")

#convert to dataframe
df = data.frame(data)

#split data by local authority
your_data_groups <- split(df, list(df$LA_id))

#apply weighing function by population
weight<-sapply(your_data_groups, function(y) weighted.mean(x=y$PTAI,
w=y$pop))

#convert result into dataframe for download
new_ptai = data.frame(weight)

#export dataframe to file
write.csv(new_ptai,"C:\\Users\\sabri\\OneDrive\\Desktop\\MSc\\semester2\\d
iss\\IZ_PTAI.csv", row.names = FALSE)
```

The same function was used to aggregate the Scottish Index of Multiple Deprivation first to Intermediate Zone level and then to Local Authority level.

Poisson Regression Estimation

```
#glm estimation
glm1<-glm(rape~ptai+pop+simd,family=poisson(link=log),data=data)

#summary of glm
glm1s <- summary(glm1)
glm1s

#check for over dispersion
glm1s$deviance/glm1s$df.residual
```

The same function was used to estimate the second regression model.