Consumer Data Research Centre

An ESRC Data Investment

CONSUMER DATA RESEARCH CENTRE

Controlled Data
Project Proposal Form

For office use: Ref

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INTRODUCTION

This form should be completed by those wishing to access the Consumer Data Research Centre's (CDRC) controlled data collections and for those who wish to access both controlled and safeguarded data for the same project. You should consult the ***CDRC Data Service User Guide*** before completing the form. A CDRC data scientist will be assigned to you who can provide support in the application process.

Once submitted your proposal will be forwarded to the CDRC Research Approvals Group (RAG) for independent assessment. Projects will be assessed based on the criteria listed in Appendix 1. Please note this process generally takes 6-8 weeks.

Approval to access data will not be granted without evidence that the applicant has acquired ethical approval for the research through their institution, or supplied evidence that this is not applicable. For non-academic projects, where there is no approval process in place, the CDRC will assist the applicant in acquiring this.

PART A. PROJECT DETAILS

1. Contact Details

1.1. **Lead applicant:** Hyesop Shin
Department and Institution: MRC/CSO Social and Public Health Sciences Unit
Address: 90 Byres Road, Glasgow, UK, G12 8TB
Email: hyesop.shin@glasgow.ac.uk
Telephone: 07565 201773

1.2. **Initial Proposal Form Reference:** LEEDS144_EXT

1.3. **Title of Project**

Simulating Vehicles in the Glasgow Low Emission Zone and their Impact on Pedestrian Health

2. Project Proposal Details

2.1. **Abstract**. Appropriate for a general audience. This may be used by the CDRC for reporting and publicity purposes as well as selecting RAG academic reviewers (max 150 words).

Glasgow faces significant traffic congestion as well as high levels of air pollution. In response, Glasgow City Council plans to introduce a low emission zone (LEZ) in June 2023. This research project aims to assess the current traffic and emission levels in central Glasgow, explore the impact of the LEZ on traffic patterns, mobility behaviour, and exposure levels, and investigate the potential health benefits resulting from reduced air pollution exposure and increased physical activity.

To accomplish these objectives, the project will utilize the SUMO (Simulation of Urban MObility) traffic simulator, which incorporates human and vehicular agents to capture the intricate dynamics of traffic and individual behaviours. The project seeks to develop a comprehensive and open-source traffic simulation framework by inviting feedback during the initial stage. Real-time traffic calibration will be achieved using the Wejo mobility dataset. Once calibration is complete, a detailed case study will be conducted to examine the association between traffic patterns and human health, with implications for policy scenarios. This research will contribute to understanding the effectiveness of the LEZ in improving air quality and public health in Glasgow.

2.2. Project description. A detailed description of the project, documenting the motivation, scope and aims of the intended research as well as the methods you will use in the proposed research. Please indicate whether you currently possess expertise in these methods, or whether the methodological expertise will be provided by a member of your research team (max 1500 words).

1. Project Rationale and Aim

Glasgow, a major city in the UK, faces significant challenges due to high traffic volume, including private vehicles and Heavy Goods Vehicles (HGVs). The latest Scottish Transport Statistics report of 2022 revealed that Glasgow had the highest number of licensed vehicles among Scottish cities in 2021, reaching nearly 3 million. This escalating number of cars and lorries has resulted in severe congestion, contributing to excessive levels of nitrogen oxides from vehicle emissions, as well as particulates from brake wear, tire wear, and road abrasion. Compounding the issue, the majority of traffic congestion and emissions are concentrated in the city centre, where it intersects with the busiest pedestrian area in Glasgow, housing a population of over 60,000 people. Urgent action is necessary to tackle congestion in Glasgow, reducing its detrimental impact on air pollution, safeguarding residents' health, and promoting the adoption of active transportation.

In response to these traffic-related challenges and the associated health risks, Glasgow is set to become the first city in Scotland to enforce a low emission zone (LEZ) starting from June 1st, 2023. The LEZ will restrict entry to vehicles that meet specific emission standards. The Glasgow City Council anticipates that the implementation of the LEZ will lead to an overall reduction in emissions, following successful precedents such as London's city-wide Ultra-Low Emission Zone (ULEZ).

Although various approaches, including Multi-Agent Systems (MAS) and agent-based modelling (ABM), have been employed to simulate traffic flow, emissions, and atmospheric dispersion, previous studies have primarily focused on analysing changes in air quality levels without investigating their impact on human health. However, understanding the effects on human health is crucial for informing public health policies, such as improving life expectancy and reducing rates of low-weight full-term births.

In light of these research gaps, the aim of this study is to develop an agent-based traffic simulation that accounts for changes in traffic flows, emission levels, and pedestrians' exposure levels following the implementation of Glasgow's low emission zone (LEZ). The study seeks to answer the following research questions:

1. What is the current status of traffic flow and emission levels in the vicinity of Glasgow City Centre?
2. How can agent-based modelling be utilised to simulate changes in traffic flow resulting from the new LEZ scheme?
3. How will individuals' mobility patterns and exposure levels change when commercial and private vehicle traffic is reduced?
4. What are the health impacts of reduced air pollution exposure and increased physical activity resulting from the LEZ implementation?

2. Method

Study Area

The study will focus on the city center of Glasgow, bordered by the M8 motorway to the north and west, the River Clyde to the south, and High St and Saltmarket to the east.

SUMO (Simulation of Urban Mobility)

The study will utilise SUMO, an open-source simulation platform designed to handle large road networks in a continuous geographic space. SUMO offers several advantages, including its user-friendly graphical interface, compatibility with other models, and the ability to calculate vehicle emissions using High-Performance Computing. The software is freely available and can be downloaded and used on various operating systems. Additionally, the study team is considering using GRAL (Graz Lagrangian Model), which incorporates meteorological conditions and city morphology.

Integration of Wejo in SUMO

To accurately model mobility patterns and emission levels in SUMO, it is crucial to track the movement of people and vehicles. The study will use Wejo Traffic Mobility Data to calibrate the traffic flow, examining hourly, daily, and weekly trends. By analysing this data, the team can generate vehicles of different types, including private vehicles, vans, HGVs, and buses. Once the traffic exploration is complete, it will be integrated into SUMO.

3. Subsequent Stages

The study will generate emissions from individual vehicles using SUMO's PHEM model and apply either the iTETRIS or GRAL dispersion model. A human exposure metric will then be employed to estimate potential exposure levels at the individual or small group levels, considering relative risk.

4. The Expert Team

The research team consists of interdisciplinary experts in agent-based modeling, public health science, geography, and traffic simulation. Dr. Hyesop Shin and Dr. Eric Silverman will lead the project, overseeing the research design, dissemination, and SUMO coding. Dr. Andreas Keler and Mr. Mario Illic, experienced traffic simulation experts, will assist with the SUMO coding. Professor Nicolas Malleson and Professor Alison Heppenstall, experts in agent-based modelling, will provide advisory and technical support.

2.3. Research Category:

2.3.1. Is this request for an Undergraduate, Masters project? U'grad ☐ Masters ☐

2.3.2. Is this request for a PhD project? PhD ☐

2.3.3. Is your project funded, commissioned or sponsored by a funding body or any other organisation? Yes ☒ No ☐ Funding application in progress ☐

Please include the name, postal and web address of your current or prospective funder, and your grant/project reference number (if applicable).

This work has been supported is funded by the UK Medical Research Council (MRC) Places and Health Programme, Grant/Award Number: MC_UU_00022/4; Chief Scientist Office (CSO), Grant/Award Number: SPHSU19

2.4. Project Impact. Please describe the anticipated scientific and societal benefits of the project and the ways in which you intend to maximise those benefits (max 500 words).

This research project has significant implications for both public health interventions and the scientific advancement of agent-based traffic models for policy intervention.

Public Health Impact:
By examining the effects of the low emission zone (LEZ) implementation in Glasgow, this project will contribute valuable insights into the potential health benefits associated with reduced air pollution exposure and increased physical activity. The findings can inform public health interventions and policy decisions aimed at improving air quality and promoting healthier lifestyles. With fewer vehicles on the roads, individuals may be encouraged to engage in active modes of transport such as walking or cycling, leading to increased physical activity levels. This, in turn, can have positive effects on cardiovascular health, respiratory function, and overall well-being. By quantifying these health benefits, this research can support evidence-based decision-making and help prioritise sustainable transport strategies that prioritise public health.

Scientific Impact:
This project also has scientific implications for the utilization of agent-based traffic models in policy interventions. By developing and applying an agent-based traffic simulation framework using the SUMO (Simulation of Urban MObility) platform, this research expands the use case of such models in studying the effects of traffic interventions on a city's dynamics. The project aims to create a comprehensive and open-source traffic simulation framework that can be

utilized by researchers and policymakers in assessing the impacts of various transportation policies and interventions. By demonstrating the effectiveness and applicability of agent-based models in understanding traffic patterns, mobility behaviours, and health outcomes, this research contributes to the advancement of scientific knowledge in the field of transportation planning and policy. The findings can inform future research endeavours, enhance policy evaluation capabilities, and provide a foundation for evidence-based decision-making in urban planning and sustainable transport initiatives.

2.5. **End Users.** Who are the main end users of this research (academic research, central government, consultancy, industry, local government, NHS, public sector, third sector? List all that are applicable.)

academic research, government, local government

2.6. **Outputs and Publications.** What are the intended outputs or publications arising from the use of these data? (For example, journal articles, PhD thesis, report for government department, policy documents for a local authority, White Papers, new software or other tools, etc.)

The calibration work will be published as part of a broader paper that outlines the methods and preliminary results that will be submitted to a high-ranking geography journal such as Computers Environment and Urban Studies.
The project will also produce associated open-source code (published using GitHub) and, if appropriate, a policy document describing the modelling scenarios.

2.7. **Research Team**

Please list the names, affiliation and email addresses of all known members of your research team and all co-authors on any publication/presentation who will make use of the CDRC data. If you are a student please include your academic supervisor.

Applicants seeking access to controlled CDRC data are required to have safe researcher training, as offered by the Administrative Data Research Network (ADRN), HM Revenue and Customs (HMRC), Office of National Statistics (ONS) or the UK Data Service (UKDS) and maintain their accreditation throughout the period of access. If you have not previously completed such training, the CDRC will help you to access a course. Please state whether you are currently accredited.

Please attach the lead applicant's CV.

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Research Team *(add more rows if required)*

Title, Name	Department / Institution	Institutional email address	Will be accessing controlled data: Yes/No	Will be accessing safeguarded data: Yes/No	Completed a safe researcher training course. If yes, please specify course and date of completion.
Dr, Hyesop Shin	MRC/CSO Social and Public Health Sciences Unit, University of Glasgow	hyesop.shin@glasgow.ac.uk	Yes	Yes	
Dr, Eric Silverman	MRC/CSO Social and Public Health Sciences Unit, University of Glasgow	eric.silverman@glasgow.ac.uk	No	No	
Professor, Nick Malleson	Department of Geography, University of Leeds	n.s.malleson@leeds.ac.uk	Yes	Yes	
Professor, Alison Heppenstall	MRC/CSO Social and Public Health Sciences Unit, University of Glasgow	alison.heppenstall@glasgow.ac.uk	Yes	Yes	
Dr, Andreas Keler	Applied Geoinformatics, Institute of Geography, Augsburg University	andreas.keler@uni-a.de	No	No	
Mr, Mario Illic	TUM School of Engineering and Design, Technical University of Munich (TUM)	mario.ilic@tum.de	No	No	
Ms. Sonali Abeysinghe	TUM School of Engineering and Design, Technical University of Munich (TUM)	sonali.abeysinghe@tum.de	Yes	Yes	

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PART B. DATA REQUEST

1.1. Data Required. Please provide the following information for each dataset requested. If a variable required is not currently held by CDRC then a Data Case for Support[1] may be submitted. Please add more lines if required.

Data Partner	Data Set	Controlled / Safeguarded	Access to Full Data Set requested or specific variables (list)	Geographic Extent	Temporal Extent
Wejo	Wejo Connected Vehicle Trajectories	Secure	Full	Scotland	2022

[1] If data not currently available please contact info@ucl.ac.uk for a CDRC Data Case for Support form.

1.2. **Justification** Why do you need access to this data and how will it be used in your project? Briefly explain why access to the proposed controlled/safeguarded data is needed for your research and why less detailed or disclosive versions of the data sources are not sufficient for your purposes. **Please provide, in the case of controlled data, a description of the data outputs you will want to take from the secure lab, what they will be used for and why they are safe.** Please note that outputs should be 'finished outputs' (see Appendix 3). An example of such an output is given below.

LSOA11CD	No. Customers	No. Male	No. Female	Average Basket Spend	Total Basket Spend 2016	Average Income
E01000054	30	15	15	23	70000	32000
E01000055	***	***	***	8	32000	27000
E01000056	12	###	###	2	10000	18000

*** - any count with a value less than 10 should be supressed
- any paired variable where the counts of less than 10 could be revealed should all be supressed

As stated in the project description, Wejo data is needed to calibrate the vehicle count throughout the simulation. Wejo, which has traffic counts for various vehicle types every few seconds for July 2022, will provide a wealth of information for understanding traffic flow at various temporal scales.

We aim to extract data for each street at the minute, hourly, and weekly (Tue-Thu, Weekends) levels. For example, July 12th, 2022, Tuesday 10-11am High Street - 480 private vehicles, 20 HGVs, and 137 vans.

We would be delighted to extract some plots by vehicle type for visual purposes, such as Figure 1.

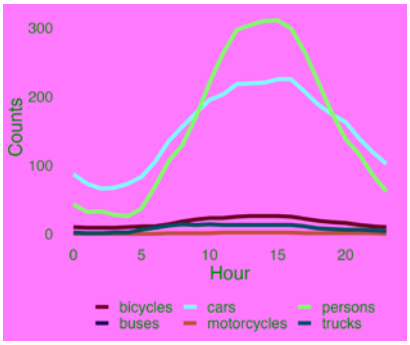

Figure 1 Hourly averaged CCTV transport data during 2020-2021 period

2. Data Linkage

2.1. **Data Linkage.** If your project will be linking more than one data source, describe which data sources will be linked and how the linkage will be done, including any specific variables that need to be linked (if known). If any of the data to be linked has identifying information as defined in the Data Protection Act 1998 or General Data Protection Regulations please provide details and if you are bringing this data with you please provide brief details of the data, source, method of collection and information about consent required to link (e.g. Data Owner or Controller's name, any documentation available or previous contact; if consent has already been achieved). Please note that no project that has the potential to re-identify individuals through data linkage will be approved.

Not applicable (other data sources will be used, but only for simulation calibration, no direct linkages will be done)

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PART C: ACCESS REQUIREMENTS

This section considers resource requirements. Once a project is approved and the secure facility site allocated you will be sent a site specific user guide detailing lab facilities and conditions. A summary of these can be found in Appendix 2.

1. Duration of Access

Progress of a CDRC project will be affected by the amount of time taken to secure access to datasets; you may need to be flexible with your research timetable. In order to help us assess the likelihood of your project being feasible please provide information about the following:

- Preferred project start date[2]: 19/06/2023
- Estimated duration of the project (remember to factor in time for peer review): 6 months
- Expected time you will spend on data analysis (in no. of days): 90 days (including re-analysis)
- Any known publication or other deadlines you are looking to meet: Not at the moment

2. Access to Secure Service

2.1 Secure Facility Site. Please specify which CDRC secure lab you would prefer to undertake your data analysis. While we will attempt to facilitate your requests, we cannot guarantee that data will be made available at your preferred site.

Leeds ☒ UCL ☐ Liverpool ☐

2.2. Software. Please specify if you have any software requirements not already provided by the CDRC. A list of available software can be found in Appendix 2.

SUMO (free software https://www.eclipse.org/sumo/)

Do you have a licence for this software?

Yes ☐ No ☒

2.3. Commercial Software licence. Would you require a commercial licence for any CDRC owned software? If yes, please note you will be required to purchase this licence.

Yes ☐ No ☒

[2] RAG review process generally takes 6-8 weeks.

2.4. Hardware Configuration. If you think you will require significant computing power please specify your specific hardware configuration requirements here. Examples of a typical hardware requirement: 50GB storage, with 8GB of RAM and 4 processors (or quad-core).

50GB Storage with at least 16GB RAM and quadcore processors

2.5. Concurrent Access Requirements. Will more than one researcher require access to the data at the same time? Please specify here any requirements you may have to enable multiple researchers access to the data at the same time including dates when multiple access would be applicable. If multiple researchers require access to the data but at different times (i.e. so that only *one* researcher accesses the data at a time) then this question can be left blank.

3. Data Security Requirements for Data Being Brought to Centre

If you are bringing in external data, please be aware of the data security requirements stipulated by the licensor and list below. Please specify any specialist data security requirements that are required from the CDRC for the duration of the project. *Please note that these requirements may be stipulated in the licence terms and conditions of the original data.*

We anticipate bringing in GIS road and building files for mapping purposes. All of this external data will be open access i.e., OpenStreetMap.

4. Technical Support Requirements

4.1. Please specify if you will have substantial storage requirements for any additional data that you would be importing into the secure lab.

Click here to enter text.

4.2. Please specify any specialist support you anticipate requiring for the duration of the project. For example: training, support with data cleaning, GIS / mapping support. Please be as detailed as possible.

> ***Please note:*** *The CDRC has limited support services available and these are only offered at* ***CDRC Leeds****. We may need to discuss your requirements in more detail with you before we forward your application to the RAG along with our own assessment of the feasibility of your project in light of current resourcing. In some cases where your support exceeds CDRC resource capabilities, the RAG may return your application requesting you re-submit with support requirements factored into your own project's resourcing. Projects which receive approval from the RAG will do so on the basis of the support requirements initially agreed. If*

additional support requirements emerge during the lifetime of the project, additional permission will be required from the RAG, which will necessarily impact the timeline of the project even if approved.

Click here to enter text.

5. Ethical Approval

5.1. Have you sought or are you seeking **ethical approval from an institutional ethical approvals panel** or any other appropriate body?

Yes ☐ No ☒

3.2. If *Yes*, please provide **evidence** of the status of the application or the outcome of the ruling issued. Please list what evidence you are enclosing below and return it as a separate attachment in PDF format when you return this application form. Feel free to add any comments below.

Click here to enter text.

3.3. If *No*, please bring this to the attention of the CDRC as soon as possible so that routes for ethical approval may be discussed.

3.4. If you believe that ethical approval is not required for your research, please provide justification for this below.

Since the project seeks vehicle movement patterns and emission per street, we will not require any individual (sensitive) data.

6. Supporting Documentation

Please select which of the following supporting documentation are included with application:

☒ Lead applicant CV *(required)*

☐ Data Case for Support form *(if applicable)*

☐ Extra data *(if applicable)*

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PART D: DECLARATION

By completing this declaration I hereby declare that the information included in this application form is true and correct to the best of my knowledge. I understand that any false or misleading information given by me in connection with my application may result in termination of the application process and/or other sanctions.

I also agree that I will be the single point of contact for progress updates and communication regarding the progress of the application.

I agree for my personal information to be used for the purposes of processing this application in accordance with the relevant data laws of the UK.

☒ I consent to my contact details being added to the CDRC contacts database so that the CDRC can send me notifications of CDRC related activities.

☒ I understand that forwarding this form by email constitutes an electronic signature.

☒ I understand that final approval for this project may require the additional submission of project approval forms.

Name: Hyesop Shin

Date: 13/06/2023

For office use: Ref

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APPENDIX 1: RAG CRITERIA FOR ASSESSMENT

The role of the RAG is to provide independent and transparent assessments of applications by researchers for access to data through both the CDRC Safeguarded and CDRC Secure services based on a set of standard evaluation criteria. RAG is independent to the CDRC and will include representation from the academic, big data, industrial sectors as well as the data partners concerned. For full Terms of Reference and membership see https://www.cdrc.ac.uk/data-services/using-our-data/

Criteria for Approval

- **Scientific advancement –** how the project has the potential to advance scientific knowledge, understanding and/or methods using consumer data;
- **Public good** – how the project has the potential to provide insight and/or solutions that could benefit society;
- **Privacy and ethics –** the potential privacy impacts or risks, and wider ethical considerations relating to the project
- **Project Design and Methods –** how the project will be conducted and who will be involved with a focus on demonstrating project feasibility.
- **Cost and resources issues –** what impact the project is likely to have on CDRC resources**,** including CDRC staff time and use of infrastructure, as well as any data acquisition costs. Resource requirements should be justified.

APPENDIX 2: CDRC SECURE DATA SERVICES & TOOLS AVAILABLE

JDI Research Lab

The CDRC have access to the Department of Security and Crime Science Jill Dando Institute Research Lab (JDI Research Lab) - a high-security computer facility where research using highly confidential data is undertaken. The JDI Research Lab hosts datasets on behalf of CDRC, providing access to these data for CDRC researchers, via workstations in a secure work area. To enter this secure work area users must attain clearance to meet the HMG Baseline Personnel Security Standard (BPSS).

The facility comprises a swipe card controlled windowless but air conditioned lab with workstations with twin 27" screens. These all run a virtualised windows operating system with each terminal providing the following software:

- ArcGIS
- CrimeStat
- MATLAB
- Office
- GeoDa
- MinGW

- NetLogo
- Notepad ++
- R
- Sophos
- QGIS
- Psycopg
- Python
- Enthought Canopy
- SQL 2014 Enterprise

University of Liverpool Secure Facility

The facility at the University of Liverpool comprises a swipe card controlled windowless but air conditioned lab with ten 27" all in one computers. These all run a virtualised windows operating system with each terminal providing connectivity to the CDRC secure database and to the following software:

- R and R Studio
- Python
- Anaconda
- Sublime Text Editor

On each desktop, there are some example scripts that can be used to access data, and help get you started on your research project.

University of Leeds Analytic Secure Environment for Research (LASER)

The CDRC have access to the University of Leeds Analytic Secure Environment for Research (LASER). LASER is a platform upon which secure virtual research environments are built, enabling research to take place using highly confidential data. LASER hosts datasets on behalf of CDRC, providing access to these data for CDRC researchers, via thin clients in a number of safe rooms. In certain cases, LASER may also enable researchers to access the data via a secure remote connection, although this depends on the data sharing agreement made with the data provider.

The safe rooms are air-conditioned and are accessed by an individually-assigned electronic fob, which will give access to the circulation corridors, the safe room area and the specific room assigned. Each room contains 2 thin clients with dual 24" monitors attached. A 1 person room and a 4 person room are also available. One of the thin clients in the 4 person room has dual 28" monitors attached. These all run a virtual desktop system which requires a two-factor authentication token to access. Either Windows or CentOS Linux can be provided as required. Each desktop can be pre-configured with the software required. The following software packages are generally available but please discuss with us if you want to use other software packages or programming environments:

- Office
- Notepad ++
- R (with RStudio)
- QGIS
- Python
- Java
- SQL Server Management Studio

All analysis and outputs are completed in the virtual research environment, and as such, **no data will enter or leave any of the CDRC facilities on the day of your visit**.

APPENDIX 3: STATISTICAL DISCLOSURE CONTROL - OUTPUT REQUIREMENTS

Outputs

Outputs requested should be 'finished outputs' i.e. the finished statistical analyses that you intend to present to the public. If requiring intermediate outputs for a particular reason e.g. to present initial findings then these may be considered if clearly presented and clearly explained. All outputs must be easy to read and interpret and how they are to be used explained.

Non-Disclosive Data

Taken from GSS/GSR Disclosure Control Guidance for Tables Produced from Surveys, October 2014

Social Surveys

- For the majority of surveys, outputs should be for large geographical areas, e.g. Country or Government Office Region, or in some cases Local Authority District (or equivalent). The level of geography should reflect survey design.
- Suppress or combine unsafe cells, i.e. where there are one or two units contributing to the cell.
- Where the sample size of a total or sub-total is one or two, suppress the whole row or column to which the total refers, including any zero cells (or combine neighbouring categories).
- In unweighted tables, cell suppression does not provide sufficient protection. Unsafe cells should only be combined with other cells.
- If unweighted sample base numbers are essential they should be conventionally rounded to base 10.
- Percentages may be released, provided it is not possible to deduce where only one or two units have contributed to the cell.
- Units may be individuals, families or households, communal establishments or any other unit whose confidentiality should be protected.

Subsamples

- For the majority of surveys, outputs should be for large geographical areas, e.g. regions, or in some cases Local Authority District (or equivalent). The level of geography should reflect survey design.
- Table design should be used to remove all unsafe cells, i.e. where there is one unit contributing to a cell. Variable categories should be combined or variables removed until only safe cells remain.
- Percentages may be released, provided it is not possible to deduce where only one unit has contributed to the cell.
- Units may be individuals, families or households or any other unit whose confidentiality should be protected.

Business Surveys: Magnitude tables

- A cell meeting both the following criteria is safe (otherwise the cell is unsafe):
  - there must be at least *n* enterprise groups in a cell (threshold rule)
  - the total of the cell minus the largest *m* reporting unit(s) must be greater than or equal to p% of the value of the largest reporting unit (p% rule)

Note that the values of the p% and minimum threshold parameter *n* and m should remain confidential, since knowledge of these values reduces the protection. The choice of p, n and m would usually be decided by the Responsible Statistician. Typical examples would be 2,3,4,5 (for n), and 2,3 (for m) and 5% 10% ,15%, 20% (for p).

- Table design should be used first to reduce the number of unsafe cells in a table where this is consistent with the main uses of the data.
- Cell suppression is the standard method used to protect tables with unsafe cells. The unsafe cells are suppressed, known as *primary suppressions*. Other cells must be suppressed to prevent the values of the unsafe cells being calculated by subtraction from the marginal totals of the table. These are known as *secondary suppressions*.
- Cell suppression does not generally provide protection from disclosure by differencing. Tables should be published using fixed categories to avoid disclosure by differencing. For example the same geographies and SIC codes should always be used.

Business Surveys: Count data

- Tables of count data are to be protected by redesign of the table to protect sensitive cells. If further protection is required other techniques such as controlled rounding to base 5 should be considered.
- Percentages or rates must be derived from rounded values.