Methods of Disclosure Control: The UKDS approach to review

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Methods of Disclosure Control
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Acknowledgement

To our ingest team for contributions to this presentation

• Sharon Bolton and Kay Eastaugh – survey data curation gurus
Our approach to Input Disclosure Review

• **Advice:** help data depositors make decisions about the relative risk in microdata they wish to share, and document these

• **Work:** undertake in-house disclosure review checks

• **Outcome:** data can be made available under various conditions, so sharing channels can be tailored to relative disclosure risk
Our responsibility

Help meet ethical and legal obligations

- **Obtain informed consent for** data sharing and long-term preservation

- **Protect identities** when promised

- **Regulate access** where needed (all or part of data) e.g. by group, use, time period
Protecting confidentiality: the ‘5 Safes’

- **Safe data** - treat the data to protect respondent confidentiality
- **Safe people** - educate researchers to use data safely
- **Safe projects** - research projects for ‘public good’
- **Safe settings** - SecureLab system for sensitive data
- **Safe outputs** - SecureLab projects outputs screened

5 Safes Video
Access spectrum

Open
• available for download/online access under open licence

Safeguarded
• available for download/online access to registered authenticated users - agreed to an End User Licence

Controlled
• available for remote/ safe room access - registered users with approved research proposal who have been specially trained
What data goes into which category?

• Most producers use own techniques for assessing ‘risk’ of identification - based on their acceptable thresholds.

• Some use formal Statistical Disclosure Control (SDC) techniques to reduce the risk of disclosure to an ‘acceptable level’.

• Most we speak to SDC takes an ‘intruder’ view, so that it is presumed that the intruder does cannot recognise anyone of the sample (e.g. family).
Not an exact science

- No magic formula to help us judge ‘objective’ risk
- We cannot give a one-size-fits-all rule book
- Recommend existing best practice for surveys

Front line guidance: ONS

- Disclosure Control Guidance for Microdata Produced from Social Surveys (Oct 2014) with case studies
- United Nations Economic Commission for Europe: Managing statistical confidentiality and microdata access
- ICO data privacy guidance: Conducting Privacy Impact Assessments: Code of Practice
We follow ONS Guidance on SDC

Assess disclosure risk based on three groups of potentially disclosive or **Classifying variables**

- **Direct identifiers**
- **Key variables**
  - variables that, in combination, can be linked to external information to re-identify respondents in the released dataset. “Implicit identifiers” or “quasi-identifiers”
- **Non-identifying variables**
- **Sensitive variables**
Direct identifiers

Not usually found (on purpose) in data we receive

- Names; addresses; telephone numbers; email addresses; photos; (perhaps) IP addresses

- Unless explicit consent obtained for sharing, remove direct identifiers from data

- Securely store personal or sensitive data (separately)

- Store longitudinal linkage keys separately (to link admin/personal data and anonymised files)
Indirect identifiers

- Sensitive information: health information/medical conditions; illegal behaviour, drug/alcohol use etc.
- ‘Less sensitive’ information: age/birth date, specialist employment, religious affiliation, large household size, unusual health condition, geographic area
- Local specific characteristics
  - Household or community level e.g. flushing toilets, glazed windows
- Other text/string variables – too detailed
- Linked information - demographics in combination (e.g. demographics + geographies)
What we expect

- Treatment process to be as well documented as possible
- Which variables have been treated and how

- Good information through data documentation reduces user queries! **Documentation is king!**

- Examples:
  - Opinions and Lifestyle final check spreadsheet – reduces errors
  - Documentation to show variables included in different versions
  - Short report on disclosure treatment
Good documentation

- OLS – sent with the data

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Module no.</th>
<th>Client</th>
<th>Archiv e type</th>
<th>vars deleted/amended</th>
<th>Serial number anonymised</th>
<th>Rage and DVSize top coded</th>
<th>Cases removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan, Feb, April 2015 merged dataset</td>
<td>MAZ</td>
<td>ONS</td>
<td>EUL</td>
<td>DVAge3</td>
<td>Yes</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NumPass citizen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AZ_25 topcoded for purchases over 5k</td>
<td>Yes</td>
<td>Yes</td>
<td>None</td>
</tr>
</tbody>
</table>

- Change in survey managers? Need procedures!
Checking - common techniques we use

**Qualitative**
- Look at univariate frequencies – low values for ‘risky’ variables
- Cross tabulate ‘risky’ variables to find small cell counts
- Choose thresholds, e.g. may be no cell counts <10 (ONS) or 30 (others)

**Treatment**
- Common: variable(s) – banding, top coding, reducing precision, remove variable, microaggregation
- Less common: adding noise. record swapping, simulation
Examples 1: ONS Wealth and Assets Survey

ONS longitudinal survey - Great Britain

- Wave 1 (July 2006 – June 2008)
- Follow-up wave 2 (July 2008 – June 2010)

Looks at change in household assets change over the life course

- Data released in 2012 to UK Data Service for use under Special Licence
- Due to demand EUL also created
Risk Assessment

• Sample size
  • Wave 1: 30,000 household interviews
  • Wave 2: 20,000 household interviews
• Survey is a longitudinal, household survey
• Potential for extreme outliers on wealth variables

This information used when determining key variables:
where a combination might enable identification of an individual or household or an attribute relating to the individual or household

• Geography
• Country of Birth
• Ethnicity
• Religion
• Sexual identity
• Age
• Household Size
• Occupation
Applying Disclosure Control - EUL

- Remove households of size 10 and above
- **Top code Individual Age** at 80
- Give special consideration to the **Wealth** variable
  - all variables relating to wealth and finance top-coded
  - compromise - variables of lesser research importance removed to reduce the risk of identification
  - to retain full detail of the financial variables some rounding at the top level was still required
Additional disclosure control - EUL

As longitudinal dataset:

- Remove Geography from the EUL dataset
- Remove sensitive and 'observable' socio-demographic variables - country of birth, ethnic group, religion and sexual identity
- Recode combined age (HRP + spouse) Age into 5 year age bands
- Limit SOC (Occupation) to 2 digits
- Remove any flags that can identify births
- Suppress Wealth to three significant figures
- Top code Number of cars 4+
Reflection

• Removal of geography **significantly** reduces risk
• Data longitudinal but **not pre-linked**
  • Analysts need to link Waves themselves - extra step likely to reduce the likelihood of identifying split households and disclosing information about new household members
• Disclosure risk decreased due to **age of the data**
  • Wave 1 up to 6 years old; Wave 2 up to 4 years old.
  • Difficult to positively identify an individual from 10 year old data
• Data reviewed on a **wave-by-wave basis** to ensure the rules are still appropriate with 'evolving' data
Our recommendations

- Aggregate categories to reduce precision
- Top/bottom code or band ages continuous variables e.g., incomes, expenditure to disguise outliers
- Generalise meaning of detailed text, e.g. occupation
- Use standard coding frames – e.g. SOC2010
- Document changes made
- Talk to other data producers

Attempt to apply optimal SDC techniques that reduce disclosure risks with minimal information loss, and preserve data utility
Semi automating input SDC

- In-house use of ‘intruder’ algorithms to detect identifying ‘risk’ in data - individual cases that might stand out
- SDC Micro and ARX
- Computation and estimation of sample and population frequency counts to identify unique observations violating chosen thresh-holds
- Example principle: if frequencies of cases violating 2-anonymity exceed 5% of all observations the key variables used in combinations may present high risk of disclosure
Example 2: versions of ONS QLFS

- Joint review by UKDS & ONS of QLFS Special Licence data
- Assess potential for wider release of more detailed data at EUL
- How can SL data be treated to reduce risk to suit wider release without unacceptable loss of detail?
- Mitigate increased demand for Secure Access

- UKDS - data analytical risk assessment
  - Excludes external information
  - Examination of key variables and unique records against data intrusion simulation (DIS)
  - ARX software used
- ONS - penetration/intruder testing
Variables of interest - LFS

- Instances of several variables that **cover the same concept at different levels of detail**
- **EUL** - include only the least detailed categories rather than much banding/topcoding
- **Birthdate**
  - **EUL** - year of birth
  - **Secure** - month, day and year
- **Industry code**
  - **Secure** - 5-digit subclass for main, second, and last job
  - **EUL** - 4-digit industry class for main job only in EUL
  - **EUL** - 1, 2 and 3-digit for second and last jobs
- **Geography**
  - **EUL** - Region level
  - **Secure** - LA, NUTS3/4, Census Output Areas, Wards, parliamentary constituencies, Travel-To-Work-Areas etc.
Example 3: Health and Demographic Surveillance Systems (HDSS)

- Field sites observing the life events of 3 million+ people in 20 LMICs in Africa, Asia and Oceania
- Eg INDEPTH Wellcome Trust, NIH, and EC-funded
- UKDS collaborative work:
  - Ghana Millennium Villages study - DFID
  - Agincourt HDSS site, ZA. UKDS-DataFirst project
    (87,000+ people, 14,000+ households, 26 villages in semi-arid rural NE, since 1992)
HDSS Challenges

- Huge investments, multiple stakeholders
- HDSS face challenges in providing timely data
- Data sharing mandated…
- Often only summary demographics released
- But little other data available for social and economic researchers to exploit, without personal request
- Issue: disclosure risk and undocumented files
- Often no longer-term solutions for data access

- More capacity needed in data management and data preparation

https://discover.ukdataservice.ac.uk/catalogue?sn=7734

- Millennium Villages Project (MVP) 'proof of concept' project to support African rural communities in meeting the Millennium Development Goals (MDGs)
- UK Department for International Development (DFID) provided a grant of £11.5 million to implement a new Millennium Village in northern Ghana
- GhanaMV - 2012 to 2017 with interventions targeting a cluster of communities with a total population of 26,000
Ghana MV data sharing

- Prospective data collection put at risk as no data shared
- PIs worked with UKDA to solve stalemate
- Disclosure risk assessment; post-hoc US IRB approval
- Difficult to gain trust in our data sharing procedures by data collectors/owners...
- Formats hard to review, process & analyse – 130 separate Stata files
- Little metadata in files; complex subfolder structures; poor documentation; little cross-referencing
Disclosure Review

- Identified potentially disclosive variables within each dataset as well as between groups of datasets.
- Initial screening of data files for:
  - direct identifiers
  - key variables to identify individual units
- Frequency analyses of all variables across all data files to determine:
  - low-frequency responses and extreme outliers
Assessment: semi-automated help

- Aim: ensure risk of linking confidential information with individual respondents was significantly lower whilst retaining utility
- \textit{R sdcMicro} used to compute the sample and population frequency counts
- Frequency analysis tested whether responses to the combination of \textit{selected key variables} were unique for any observation
- 162 observations identified where the combination of key variables was unique for those individuals
Variables assessed

• Granular and direct identifiers:
  • raw age, community and village names had very small frequency counts - excluded from dataset
• Those for which local knowledge is essential to indicate risk - implicit or quasi-identifiers
  • ethnicity, fuel type use, toilet facilities with flushing mechanisms, house wall material – recoded/grouped
• See UKDS-ESPA Guide: Sharing social data in multidisciplinary, multi-stakeholder research
## Household survey variables assessed

<table>
<thead>
<tr>
<th>Variables</th>
<th>Disclosure risk</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community</td>
<td>Low frequency counts for all named communities, respondents who gave answers very easily identifiable (especially in combination with other variables)</td>
<td>Exclude variable from dataset</td>
</tr>
<tr>
<td>Age</td>
<td>Low counts of older respondents over 75 years old</td>
<td>Top-code age &gt;= 75 as '75 and over'</td>
</tr>
<tr>
<td>Main occupation during last 12 months</td>
<td>Low counts of very specific occupations</td>
<td>Occupations aggregated into standard occupation codes</td>
</tr>
<tr>
<td>Ethnicity of the Household Head</td>
<td>Low counts of specific ethnicities.</td>
<td>Recode the low-frequency responses (all responses but 'Mamprusi' and 'Builsa') into 'Other'.</td>
</tr>
<tr>
<td>Household’s primary type or energy/fuel used for cooking</td>
<td>Very low counts for 'Gas/LPG' and 'Electricity-solar panel' responses may lead to household identification (especially if combined with other datasets)</td>
<td>Recode all responses into the following main categories: 1 - 'Firewood'; 2 - 'Electricity-based'; 3 - 'Charcoal'; 4 - 'Other', 5 - 'Don't know'; 6 - 'NA/missing'.</td>
</tr>
<tr>
<td>Main material of the wall of the house</td>
<td>A number of low-frequency responses; exterior features (households/buildings easily identifiable)</td>
<td>As the main material of the wall refers to the exterior of a building, it may be advisable to recode the low-frequency and 'Other' variables into 'Other (incl. wood-based and stone-based)' and retain the remaining groups</td>
</tr>
<tr>
<td>Crops grown on plots</td>
<td>A number of low-frequency specific responses for each variable</td>
<td>Variables are recoded into crop categories</td>
</tr>
</tbody>
</table>
UKDS access solution

• Release 1: Household data only
• Special Licence condition
• Proposed Data Access Committee and procedures for decision making about applicants
• And how access to more than one dataset is to be judged (e.g. household data plus bloods)
• For ease of access administration, each conditional Special Licence (bloods, anthropometrics), is held under a separate study number, especially if access to one of the data collections precludes access to another
New life for HDSS data: beyond demography

- Recent complete restructuring of unavailable Agincourt HDSS data to meet social science needs:
- Linked panel data format (long form) at 3 levels:

<table>
<thead>
<tr>
<th>Individual level data (N=200,000)</th>
<th>Life events from 1992 - every person</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Educational events from 2000 - most people</td>
</tr>
<tr>
<td></td>
<td>Labour force events from 2000 - most people</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household level data</th>
<th>Size by year from 1992</th>
</tr>
</thead>
<tbody>
<tr>
<td>link to Person ID</td>
<td>Assets and consumption from 2000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Village level information</th>
</tr>
</thead>
</table>

- Secure access only
- Exemplary showcase for release of complex data
Summary: review and access control

• Balance between protecting respondents’ confidentiality and maintaining research utility of data
• Open where possible, closed when necessary
• Combine anonymisation with access control to preserve usability - create multiple versions of data
• Accept that some research can only be done with identifying data e.g. research on patients with specific diseases
• Go back to the 5 Safes – consider sharing via an accredited Secure Lab or Secure Research Data Centre (ISO27001)
• Producers benefit from providing clear documentation on disclosure review and treatment!
Contact

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