Wetenschappelijk Onderzoek- en Documentatiecentrum

A review of Frequency Table Disclosure Control from a Microdata Perspective

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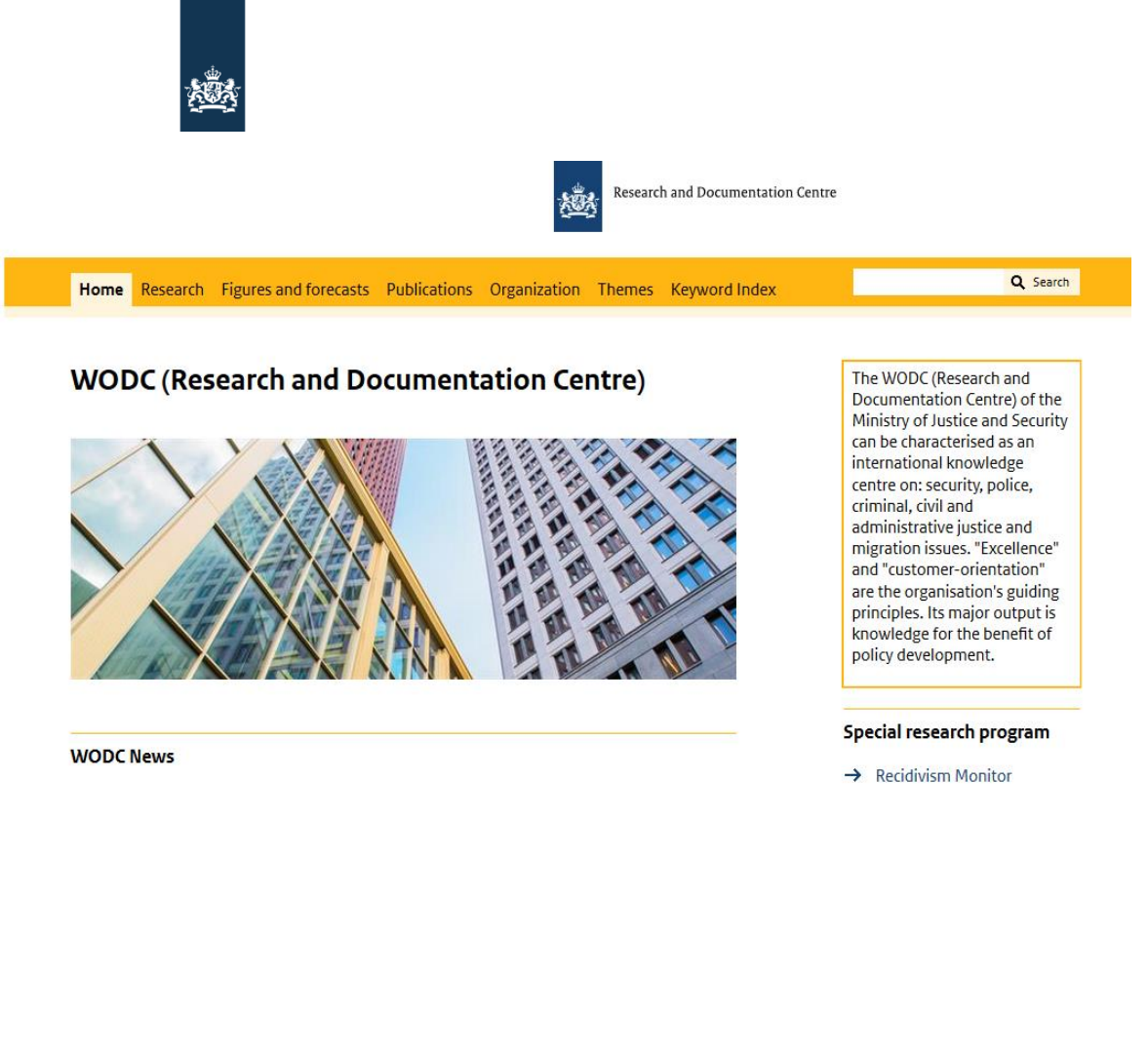
About me

- Background in computer science
- Algorithmic fairness
- Privacy
- Security

The Research and Documentation Centre

- Ministry of Justice and Security
- Social impact
- Applied Research
- One of multiple research departments
- Topics:
  - Big data
  - Machine learning
  - Data management
  - Privacy
  - Other topics



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2. Statistical Disclosure Control (SDC)
3. Microdata
4. Tabular data
5. Practical differences
6. Sources of disclosure
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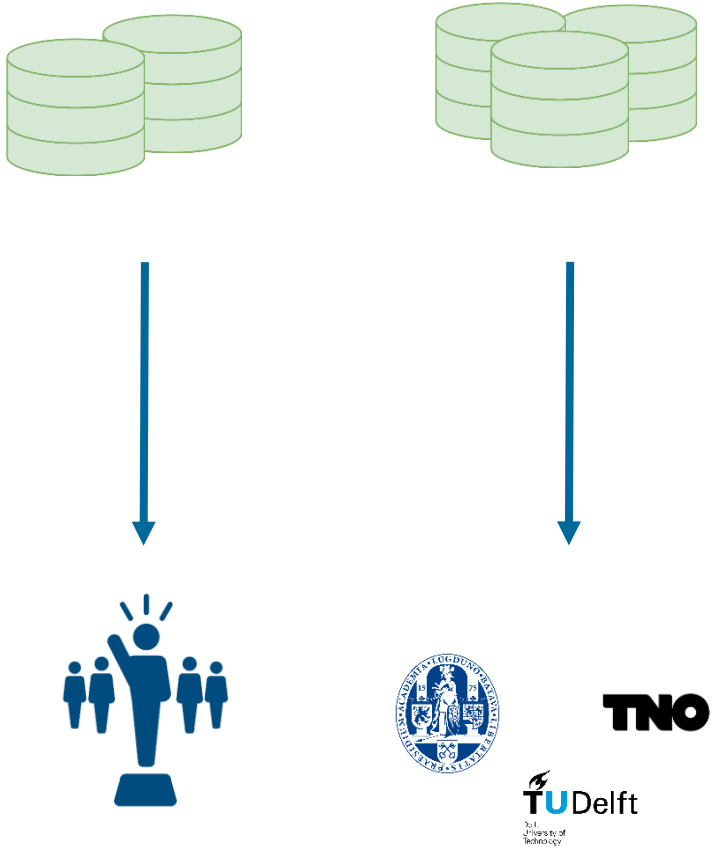
Opening data

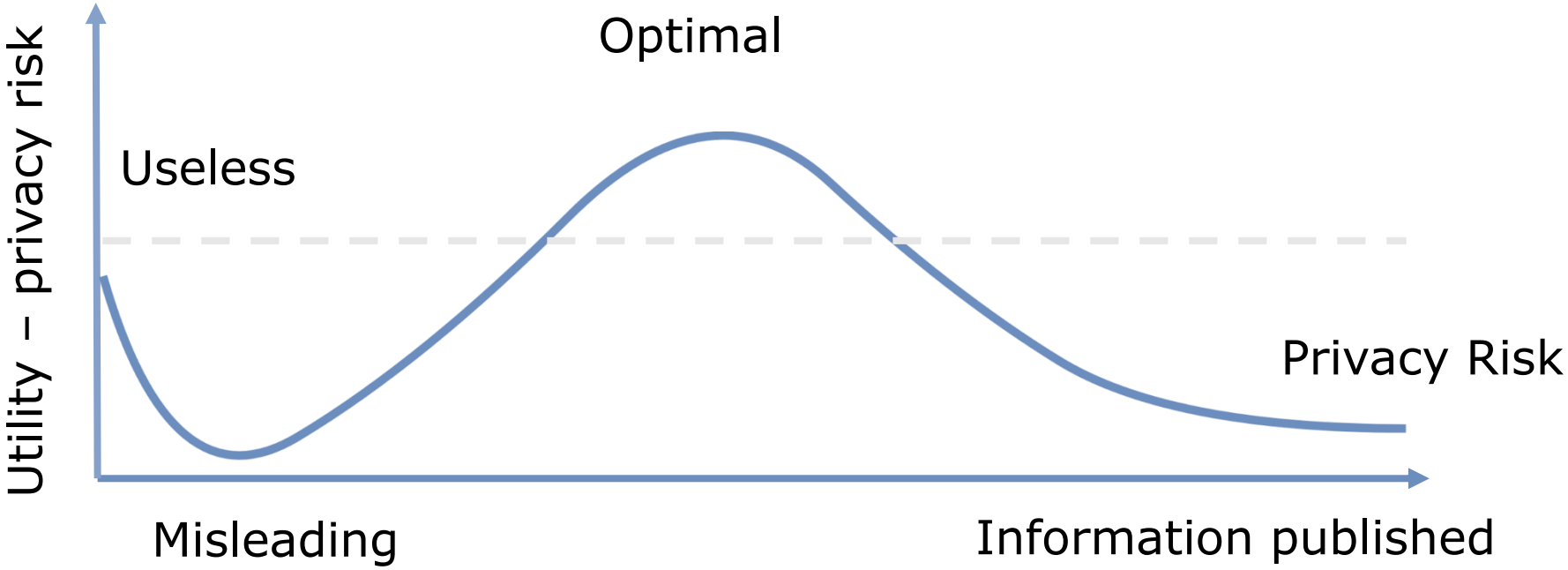
- Government setting
- Research
- Verification
- Transparency
- Public opinion

Routes for releasing data

- Generic or specific
- more eyes or more data
- Contracts



Why SDC?


Optimal
Useless
Utility – privacy risk
Privacy Risk
Misleading
Information published

Why SDC?

SDC is a step between the government data and the public

Research remains important due to advances in:

- Accessibility of (big) data
- Legislation (GDPR)

Microdata

One entity per row

High dimensionality

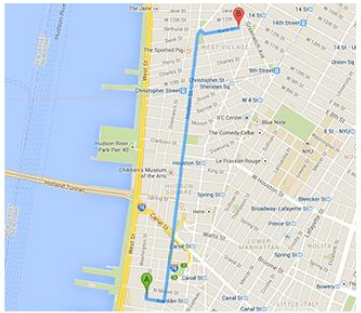
More difficult to protect

- Netflix challenge
- Taxi data

Name	Job	Sex	Age	Disease
Bob	Engineer	Male	35	Hepatitis
Fred	Engineer	Male	38	Hepatitis
Doug	Lawyer	Male	38	HIV
Alice	Writer	Female	30	Flu
Cathy	Writer	Female	30	HIV
Emily	Dance	Female	30	HIV

EID QIDs SAT

BRADLEY COOPER



JULY 8, 2013 • 7:34 PM - 7:44 PM
376 GREENWICH ST. TO 13 BANK ST.
$9.00 FARE • CASH; UNKNOWN TIP • ©SPLASH

Tabular data

- Derived from microdata
- Describe groups not individuals
- Sufficient for most transparency and verification cases.
- Still suffers from privacy risks

	Number of holdings (1 000)	Utilised agricultural area — UAA (1) (1 000 hectares)	Livestock units — LSU (1 000 LSU)	Labour force (2) (1 000 annual work units)	Standard output (EUR million)	Average area of holdings (hectares)
EU-28	12 248.0	174 115.6	135 212.3	9 945.8	307 889.5	14.2
BE	42.9	1 358.0	3 798.7	61.6	7 247.8	31.7
BG	370.5	4 475.5	1 149.5	406.5	2 536.7	12.1
CZ	22.9	3 483.5	1 722.5	108.0	3 852.2	152.4
DK	42.1	2 646.9	4 919.4	52.3	8 430.8	62.9
DE	299.1	16 704.0	17 792.6	545.5	41 494.1	55.8
EE	19.6	940.9	306.3	25.1	594.6	48.0
IE	139.9	4 991.4	5 787.4	165.4	4 297.7	35.7
EL	723.0	3 477.9	2 406.5	429.5	6 700.0	4.8
ES	989.8	23 752.7	14 830.9	889.0	34 173.1	24.0
FR	516.1	27 837.3	22 674.2	779.7	50 733.2	53.9
HR	233.3	1 316.0	1 020.2	184.5	2 114.7	5.6
IT	1 620.9	12 856.1	9 911.5	953.8	49 460.3	7.9
CY	38.9	118.4	200.8	18.6	458.9	3.0
LV	83.4	1 796.3	474.6	85.2	777.2	21.5
LT	199.9	2 742.6	900.1	146.8	1 526.3	13.7
LU	2.2	131.1	167.7	3.7	268.6	59.6
HU	576.8	4 686.3	2 483.8	423.5	5 241.0	8.1
MT	12.5	11.5	41.7	4.9	95.9	0.9
NL	72.3	1 872.4	6 711.5	161.7	18 930.0	25.9
AT	150.2	2 878.2	2 517.2	114.3	5 879.3	19.2
PL	1 506.6	14 447.3	10 377.2	1 897.2	18 987.1	9.6
PT	305.3	3 668.2	2 206.0	363.4	4 639.7	12.0
RO	3 859.0	13 306.1	5 444.2	1 610.3	10 420.3	3.4
SI	74.7	482.7	518.5	76.7	913.2	6.5
SK	24.5	1 895.5	668.3	56.1	1 731.0	77.5
FI	63.9	2 291.0	1 121.1	59.7	3 097.6	35.9
SE	71.1	3 066.3	1 751.9	56.9	3 733.3	43.1
UK	186.8	16 881.7	13 308.4	266.3	19 555.0	90.4
IS	2.6	1 595.7	161.0	4.2	237.1	616.1
NO	46.6	1 005.9	1 229.3	46.4	3 156.2	21.6
CH	59.1	1 047.8	1 793.8	96.0	5 717.1	17.7
ME	48.9	221.3	118.4	47.9	127.1	4.5

(1) Excluding common land in Greece.
(2) Labour force directly employed on the farm.
Source: Eurostat (online data code: ef_kvaareg)

Practical differences

The information is similar but the difference in usage is vast.

The are difference in:

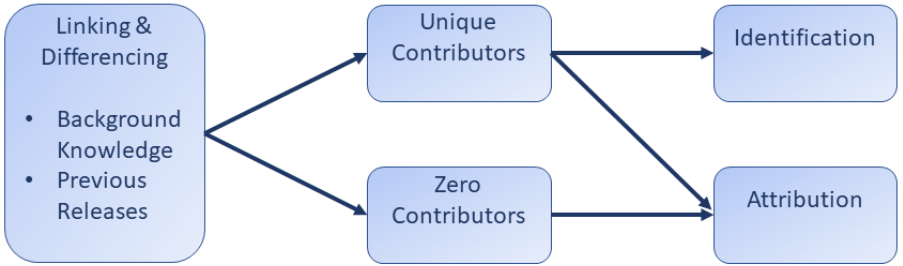
- Target audience
- Purpose
- Dimensionality
- Relations

These differences have split the existing research on protection for these data forms.

Sources of disclosure

Intruders seek to identify an individual or small group or learn something new about them (attribution).

- Background knowledge
- Tabular Disclosure scenario's
- Microdata linkage attacks



Tabular disclosure example

	Detention days<30		Detention days 30-60	
	Gender F	Gender M	Gender F	Gender M
Age=18	2	2	**1**	0
Age=19	10	10	2	2

	Crime=Assault	Crime=Petty theft	Crime= Murder
Detention days=10	0	7	5
Detention days=10-30	0	7	5
Detention days>30	5	0	2

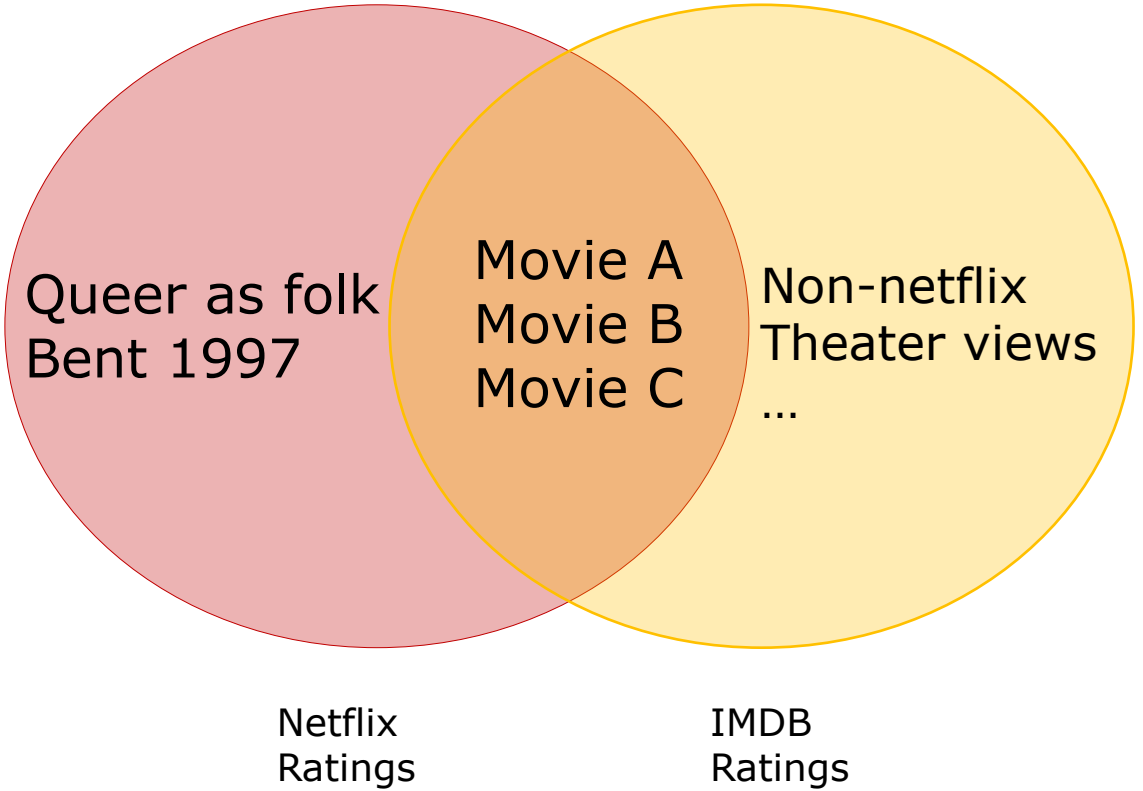
Knowledge of the age and detention days

Deriving in a chain

	Gender=F	Gender=M
Crime=Assault	3	2
Crime=Petty theft	10	10
Crime=Murder	0	2

Microdata disclosure example

- Record linkage
- Mapping Quasi identifiers
- Linkage to EIDs on IMDB
- Requires uniqueness for identification



Privacy models

- K-anonymity
  - Minimum group size for each QID is at least k
- Frequency rule
  - Minimum cell size is at least n
- Stricter rules for tables
- Margin inclusions

Name	Job	Sex	Age	Disease
Bob	Engineer	Male	35	Hepatitis
Fred	Engineer	Male	38	Hepatitis
Doug	Lawyer	Male	38	HIV
Alice	Writer	Female	30	Flu
Cathy	Writer	Female	30	HIV
Emily	Dance	Female	30	HIV

EID QIDs SAT

	Total Crimes	Section 1	Section 2	Section 3	Section 4
Original	10	2	2	2	2
Rounded	10	0	0	0	0
Range	8-12	0-2	0-2	0-2	0-2
Audited Range	8	2	2	2	2

Privacy models

- L-diversity
  - Every QID group has at minimum l SAT values.
- Entropy L-diversity
- T-closeness

- Zero cells prevention
- Prevention skewed distribution
- No tabular mapping (again)

Job	Sex	Age	Disease
Engineer	Male	35	Hepatitis
Engineer	Male	38	Hepatitis
Lawyer	Male	38	HIV
Writer	Female	30	Flu
Writer	Female	30	HIV
Dance	Female	30	HIV

QIDs SAT

	Hepatitis	Hiv	Flu
Male	2	1*	0
Female	0	2	1

Conclusions

- Differential privacy
- Simplification of microdata models
- Differences in likely sources of disclosure
- More evaluation of microdata models for tabular data is needed

Future work

- Empirical comparisons
- Protection methods comparison
- Of interest are how SDC techniques for structured data types relate to those for unstructured data, such as textual data.