Differential Privacy in Tripartite Interaction: A Case Study with Linguistic Minorities in Canada

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Data Privacy Management (DPM)

–

Septembre 12, 2012

Institut de recherche de l'Hôpital **Montfort**

uOttawa

L'Université canadienne
Canada's university

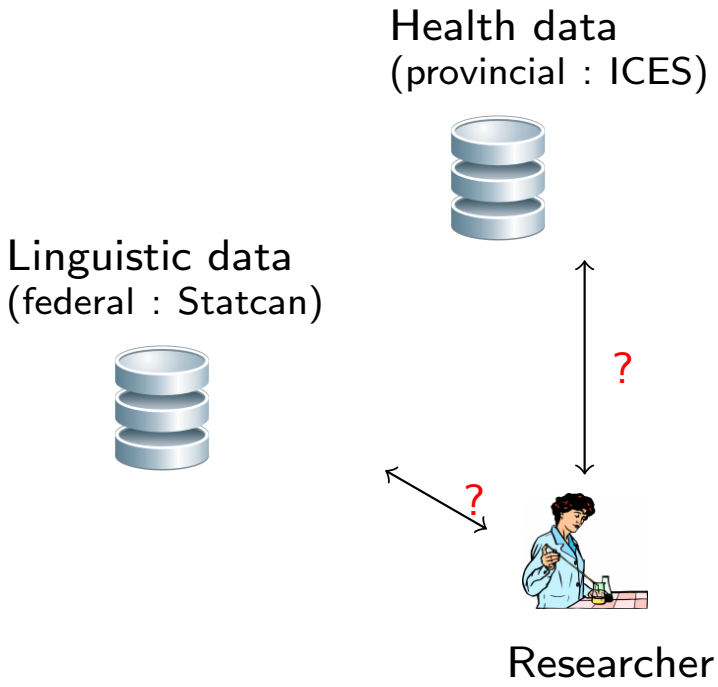
Context & Motivation

Health data
(provincial : ICES)

Linguistic data
(federal : Statcan)

Researcher

Context & Motivation



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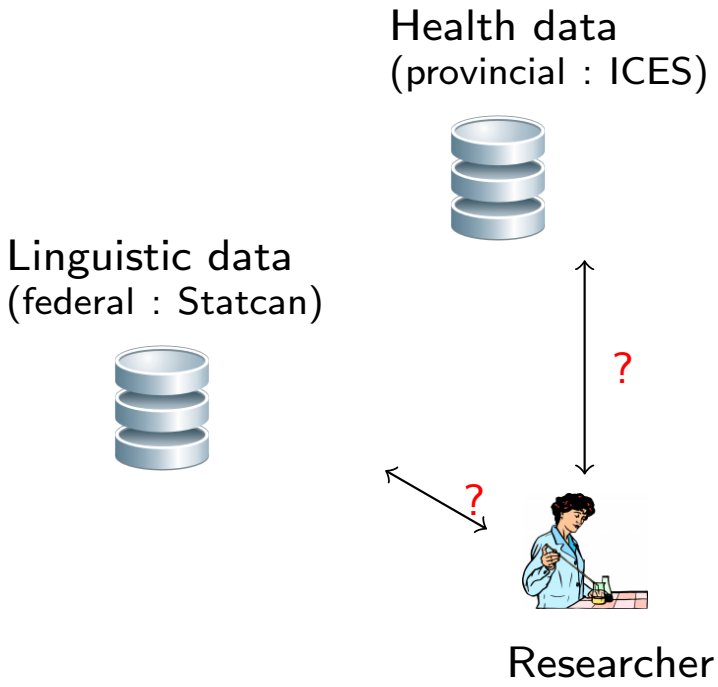
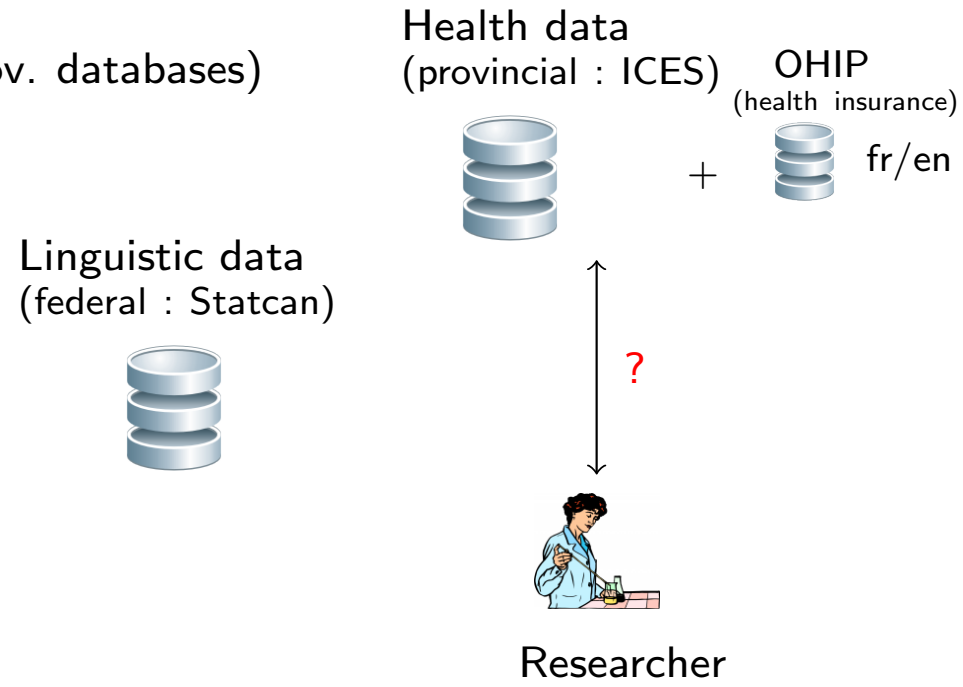


Ex : Rate of type-2 diabete among 65+ Francophones (vs. 65+ Anglophones) ?

Context & Motivation

Option 1

(lang. variable $\rightarrow$ prov. databases)



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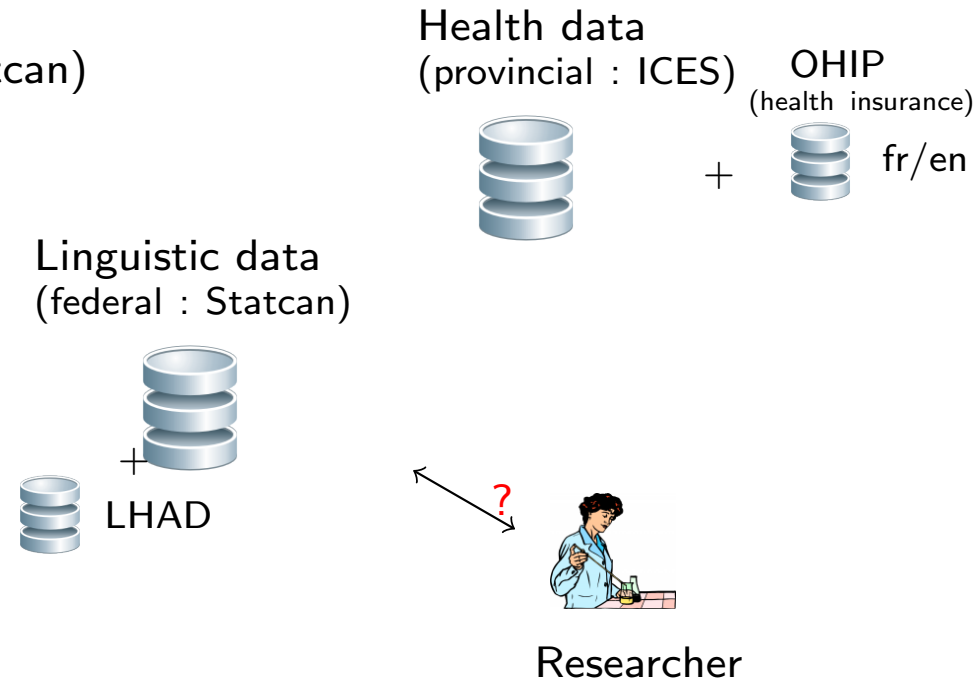
Context & Motivation

Option 2

(health data → Statcan)



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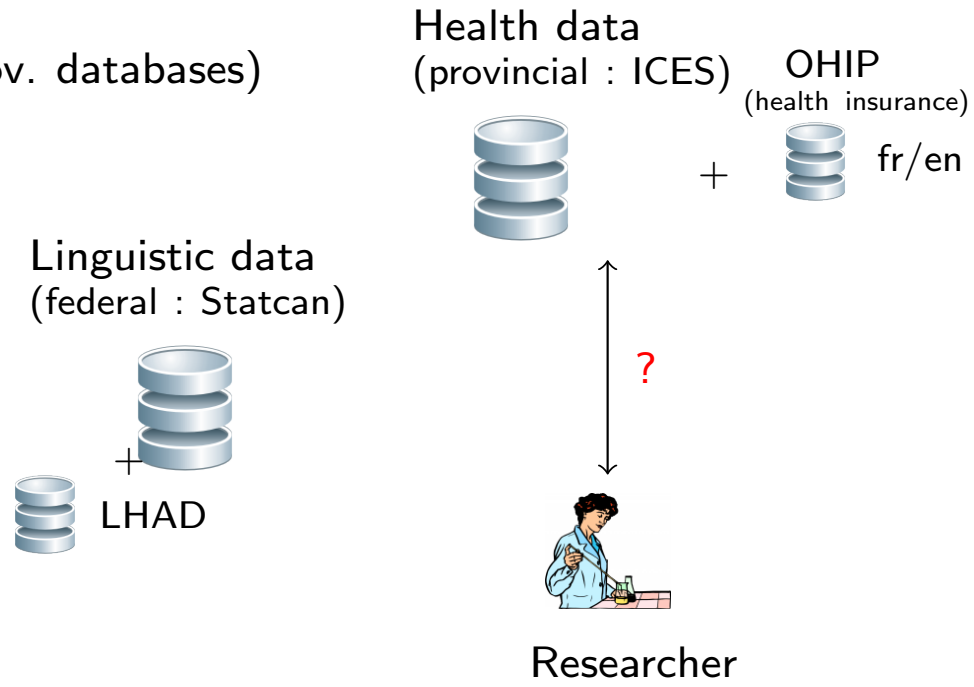

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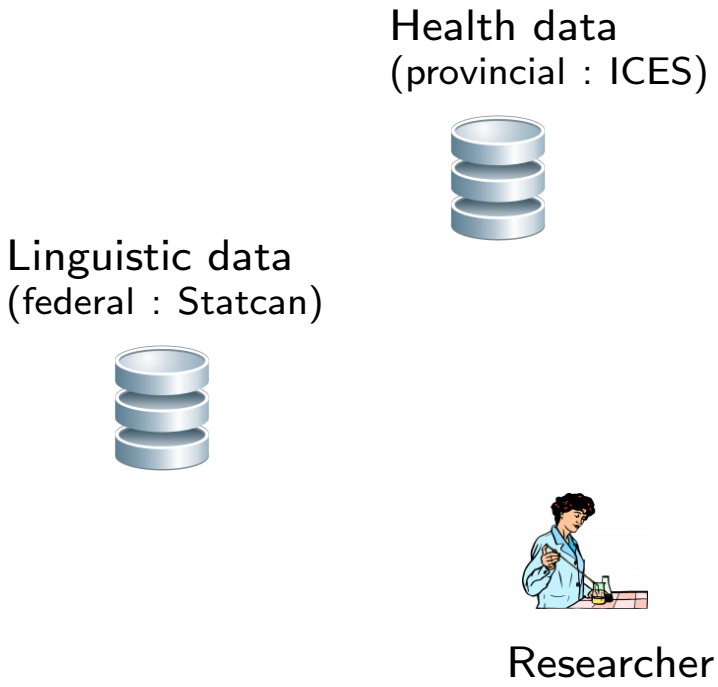

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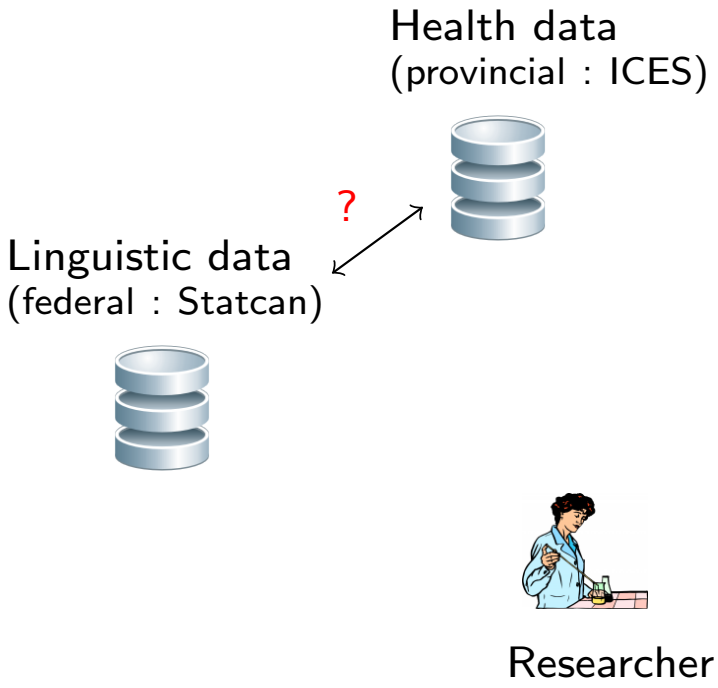
Context & Motivation

Option 3
(Data linkage)



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Option 4

(Geographical correlations ?)

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Linguistic data
(federal : Statcan)

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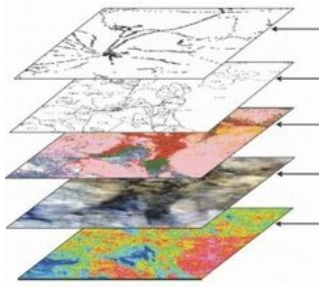

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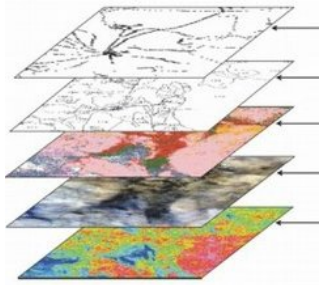

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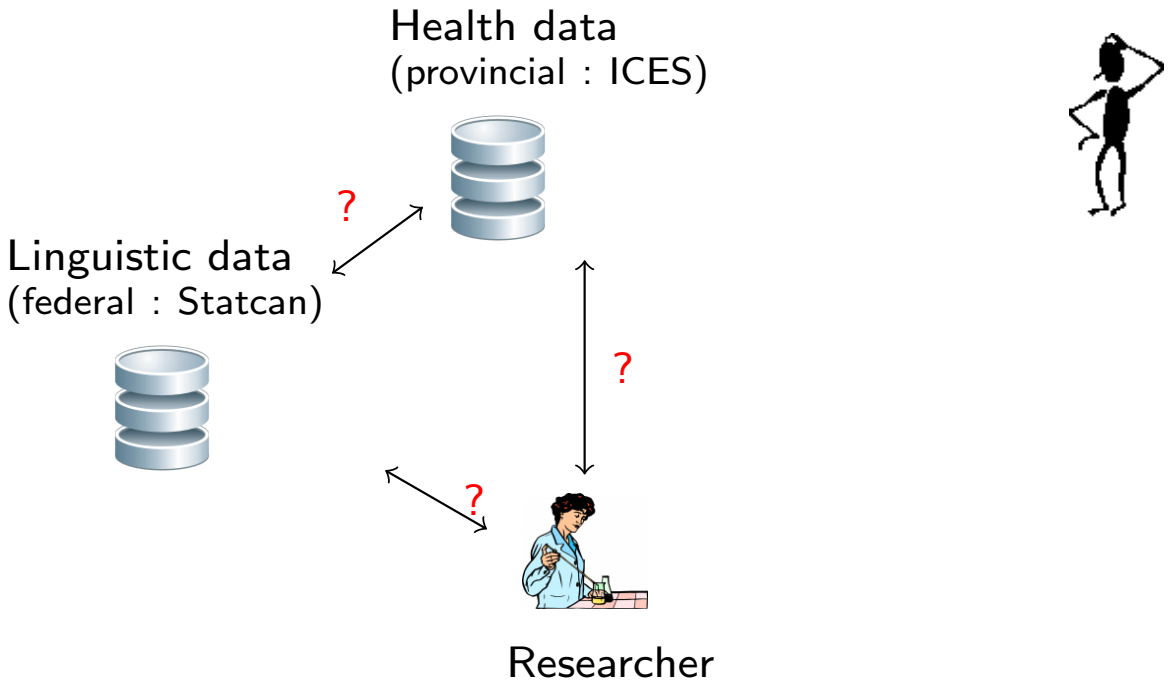
Ex. 2 : Rate of angioplasty ? ($\Longrightarrow$ not enough density...)

Context & Motivation



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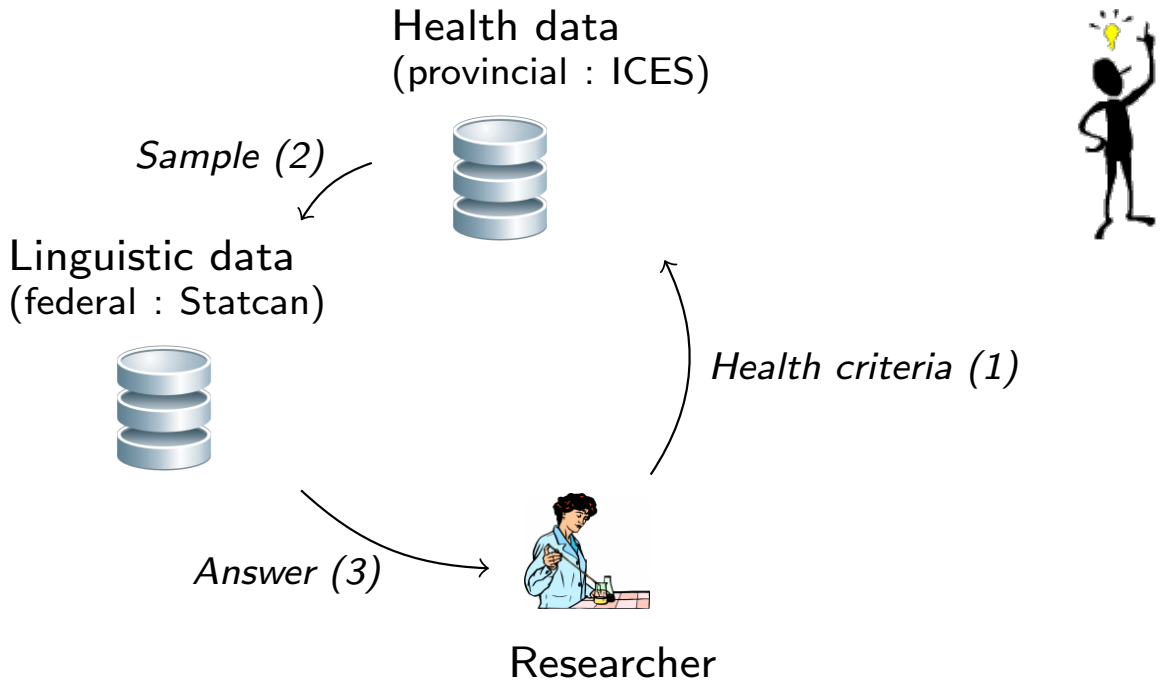
Context & Motivation

Suggestion 1

(Tripartite tabulation)



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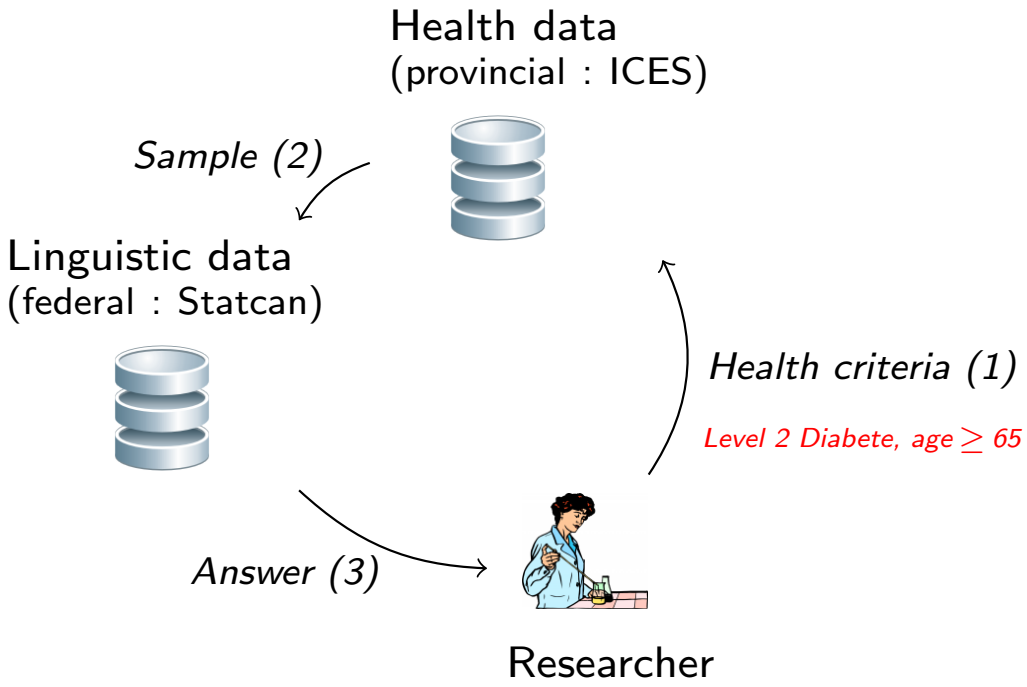

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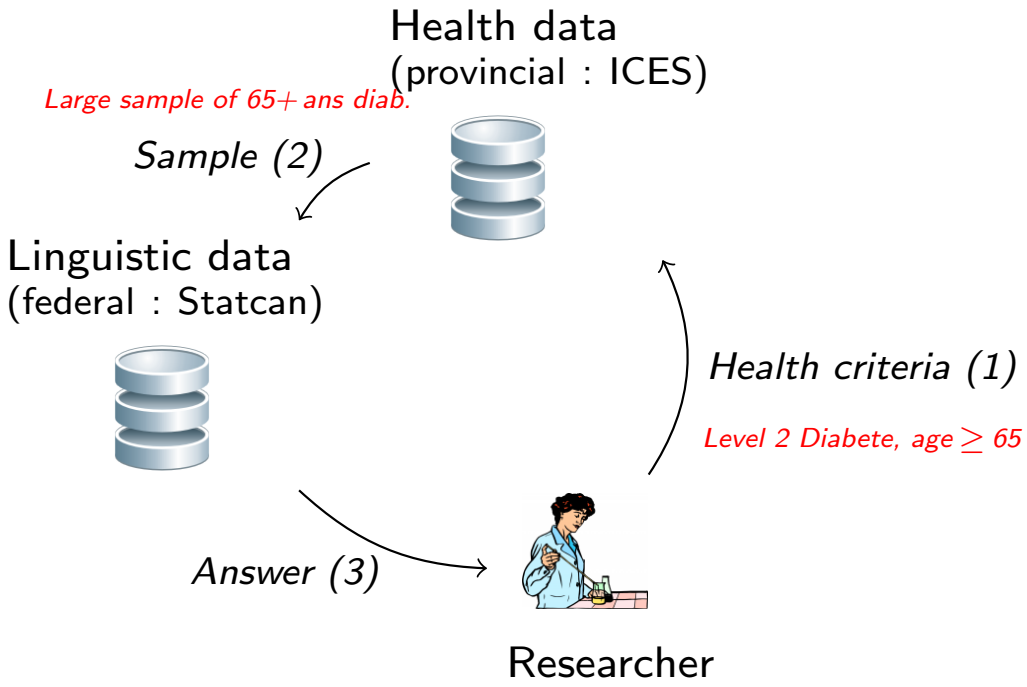

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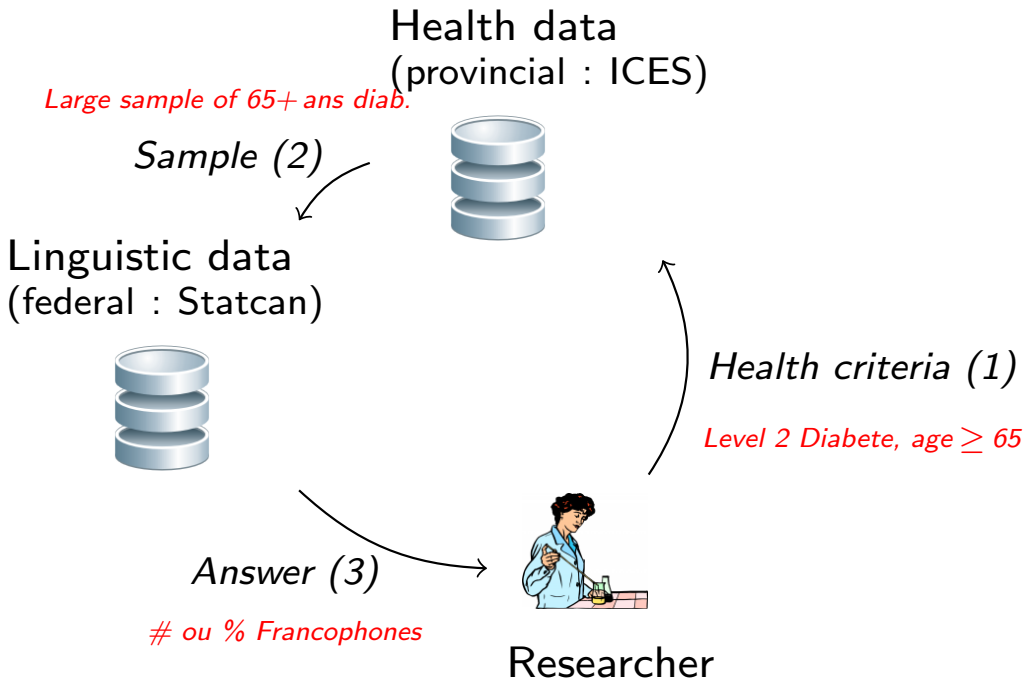

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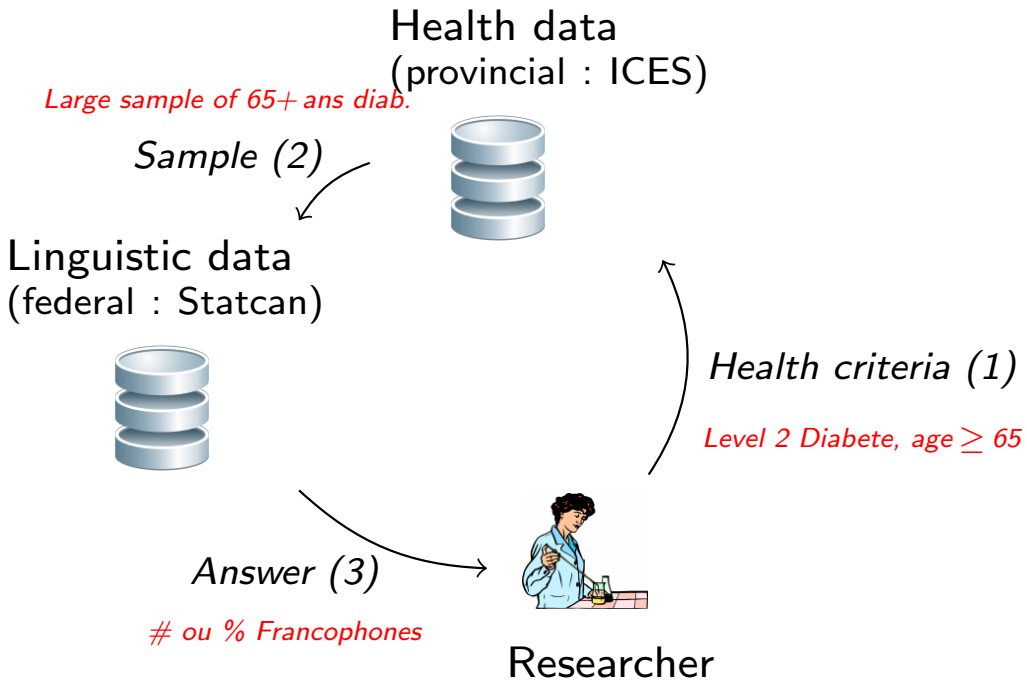

Normalization over # Franco. in Ontario $\Longrightarrow$ *Answer*

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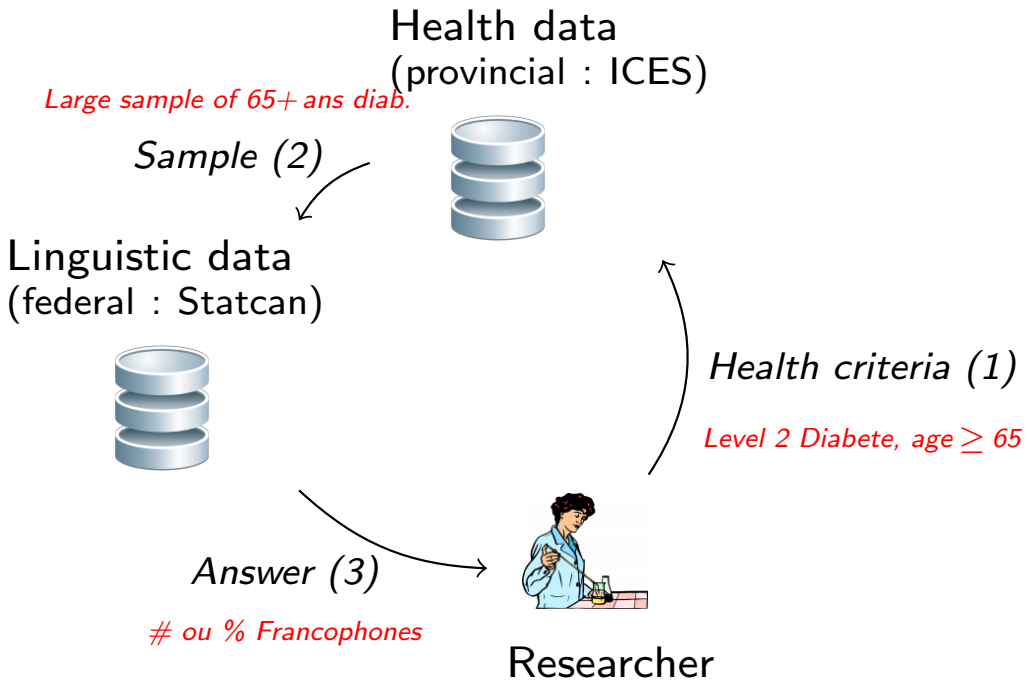

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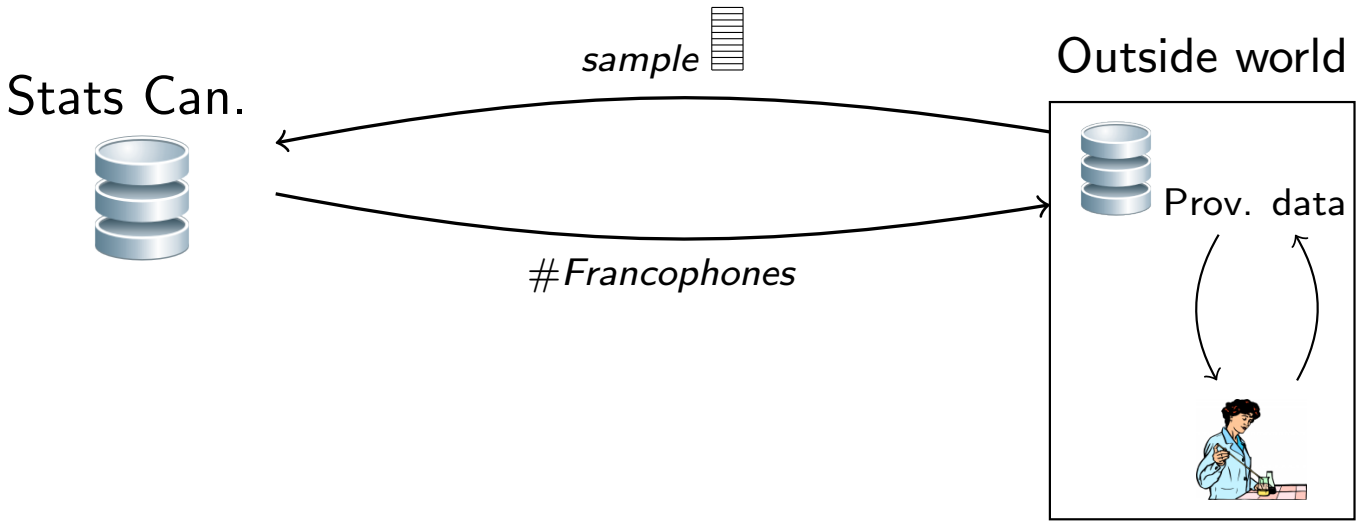
Unfortunately..

"There is no such thing as a *tri*-partite tabulation !"
(from Statcan point of view)

Statistics Canada point of view

This is a type of *tabulation*.



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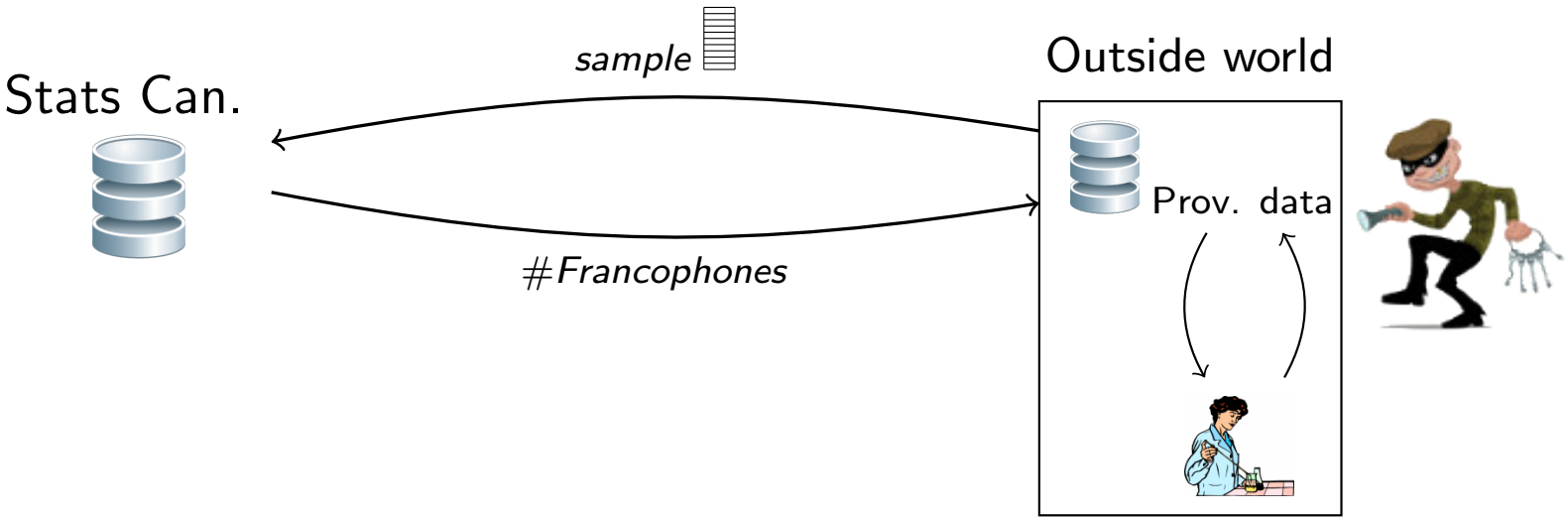

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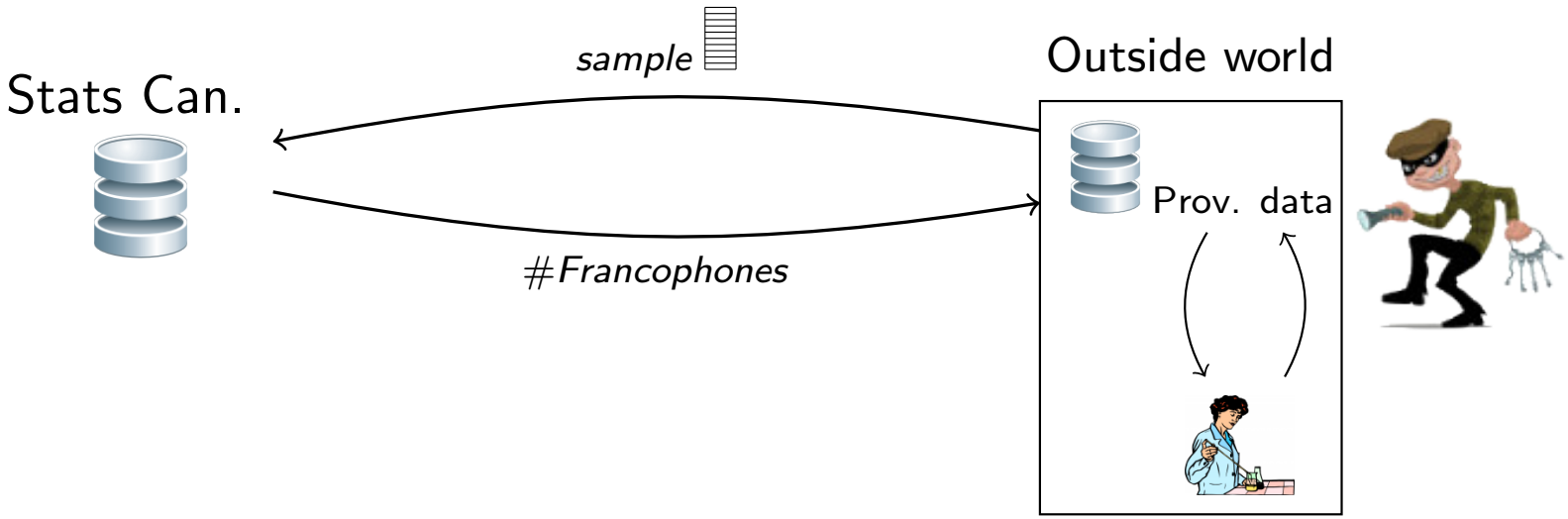
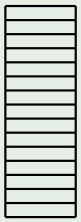


Problem..

Collection of residual information by an adversary possible, e.g. :

$s_1 =$  $s_2 =$  x

$$answer(s1) - answer(s2) \implies language(x)$$

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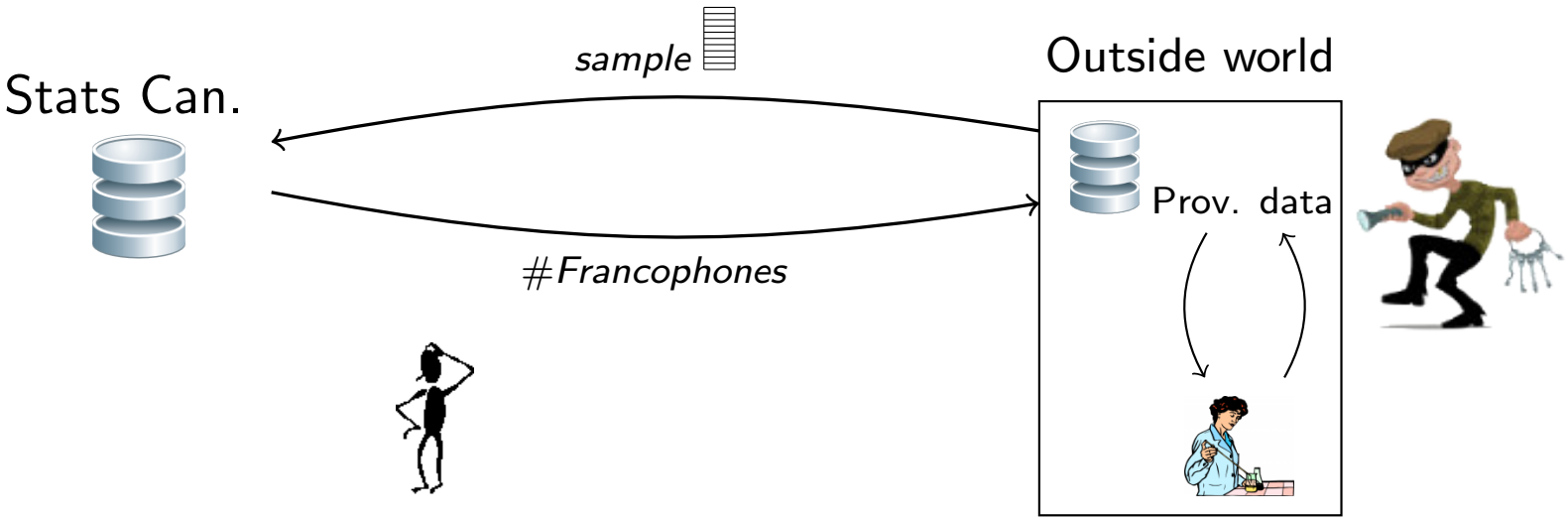

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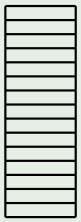
$s_1 =$  $s_2 =$  x

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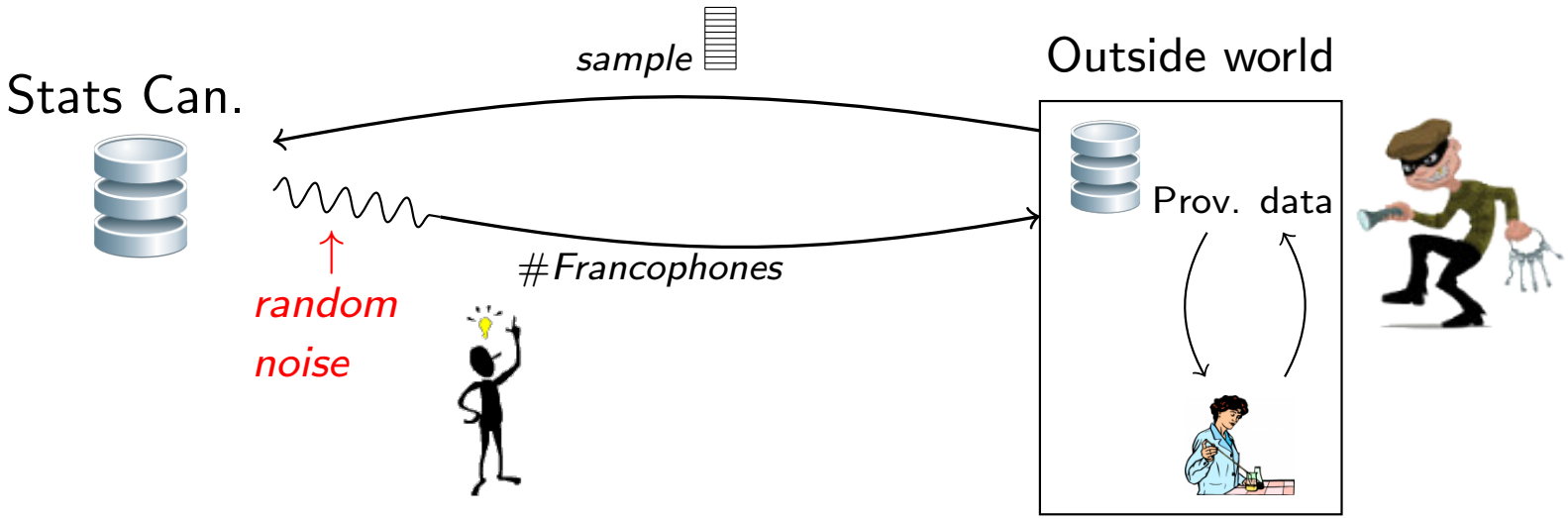

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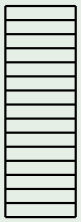
$s_1 =$  $s_2 =$  x

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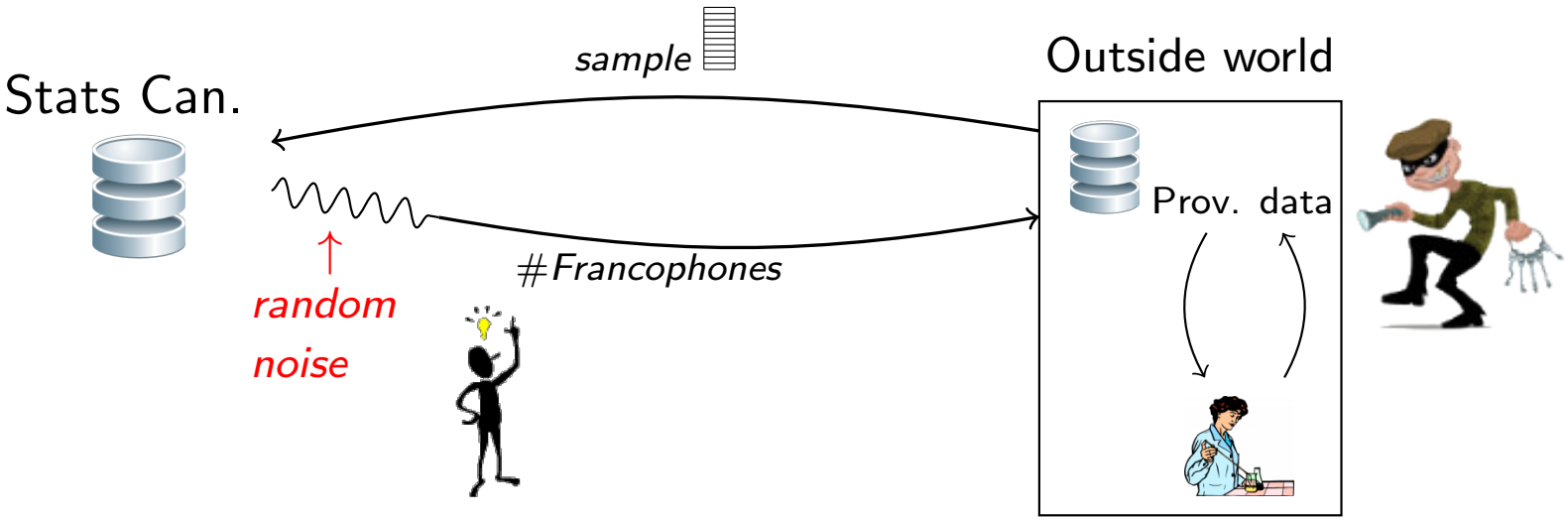

Problem..

extremely limited

Collection of residual information by an adversary ~~possible~~, e.g. :

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Understanding the noise

Problem.. extremely limited

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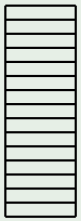
$s_1 =$  $s_2 =$  x

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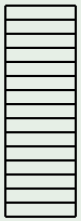
$s_1 =$  $s_2 =$  x

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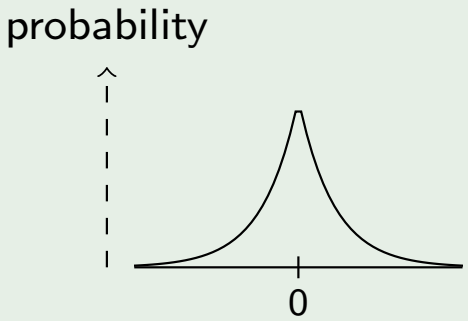
Random noise



(a) Random number

Understanding the noise

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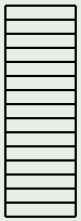
$s_1 =$  $s_2 =$  x

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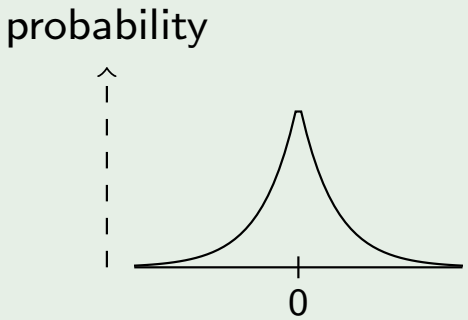

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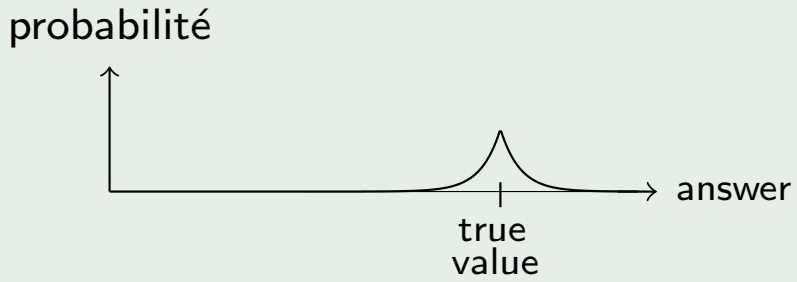

(b) Probability (answer)

Understanding the noise

Problem.. extremely limited

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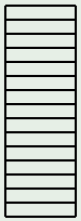
$s_1 =$  $s_2 =$  x

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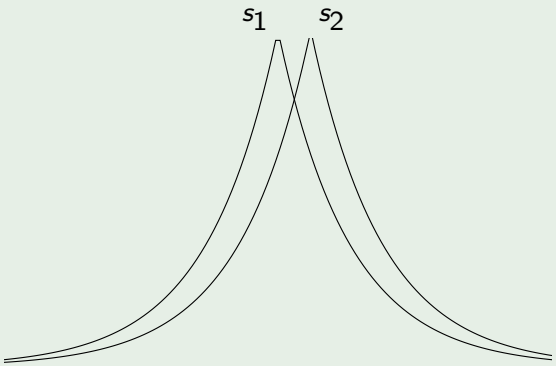

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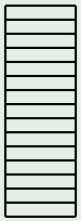
$s_1 =$  $s_2 =$  x

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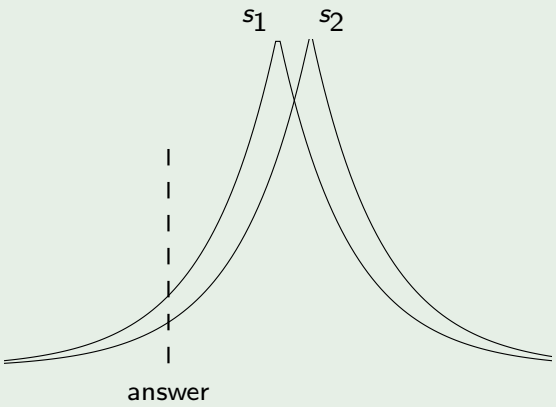

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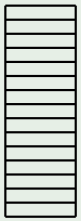
$s_1 =$  $s_2 =$  x

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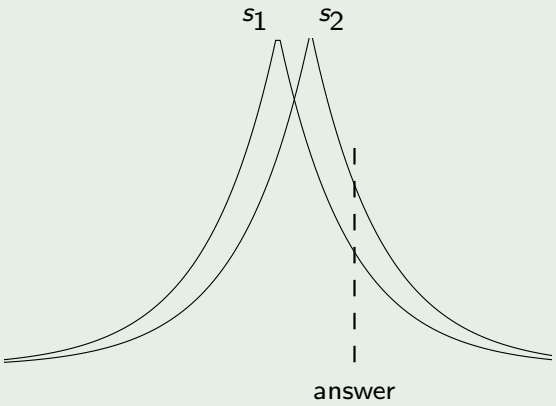

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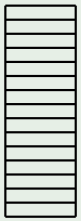
$s_1 =$  $s_2 =$  x

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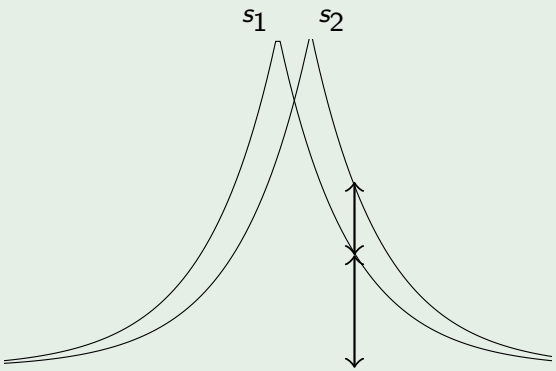

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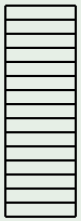
$s_1 =$  $s_2 =$  x

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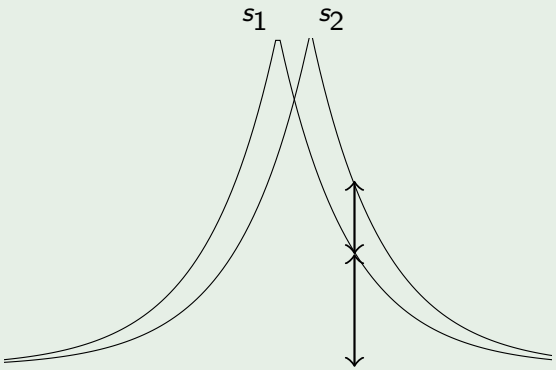
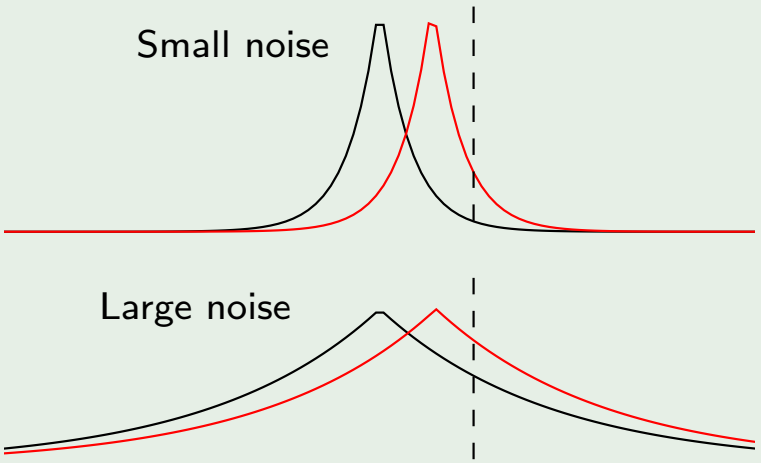
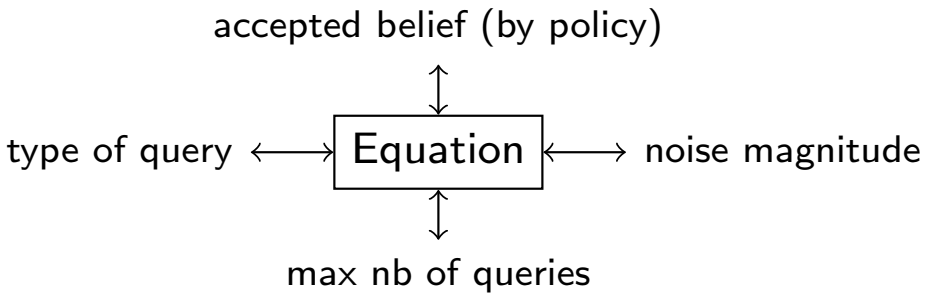




Setting up the tradeoff

"Calibrating noise to sensitivity in private data analysis."

(Dwork *et. al*, Theory of Cryptography, 2006)



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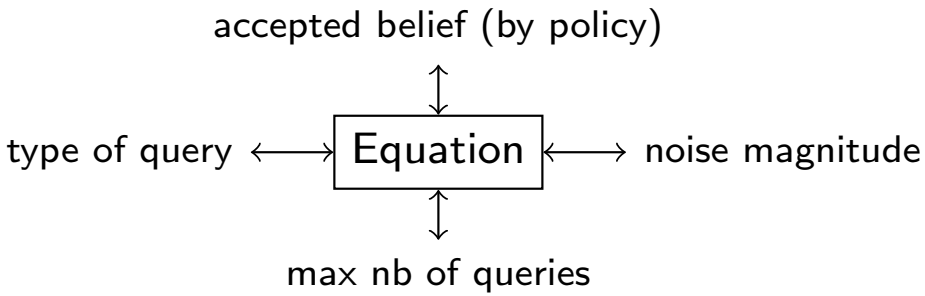

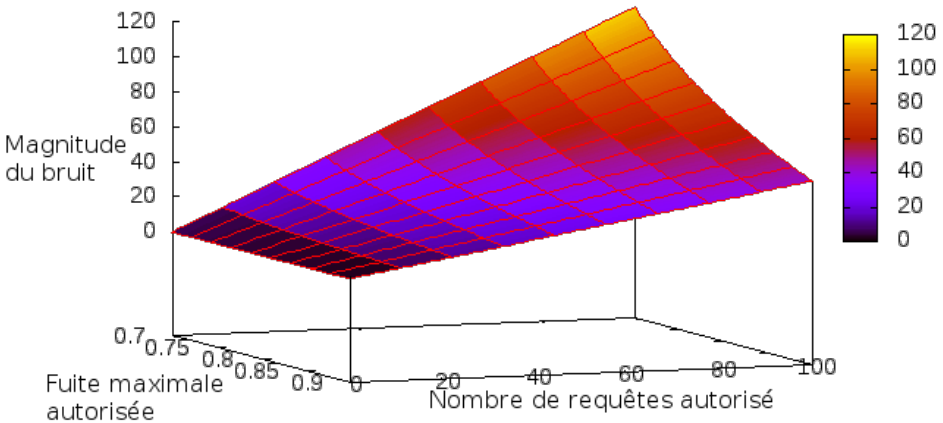

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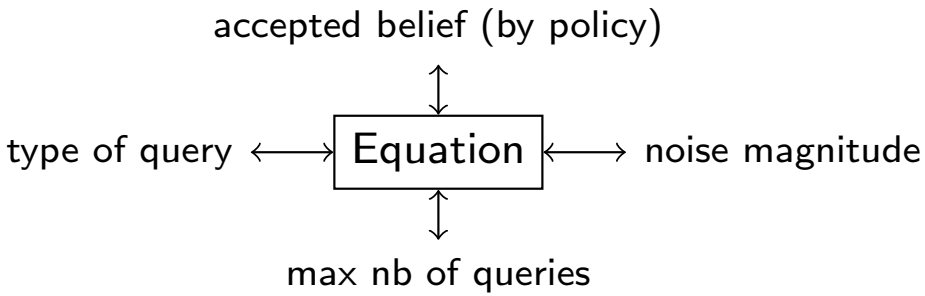

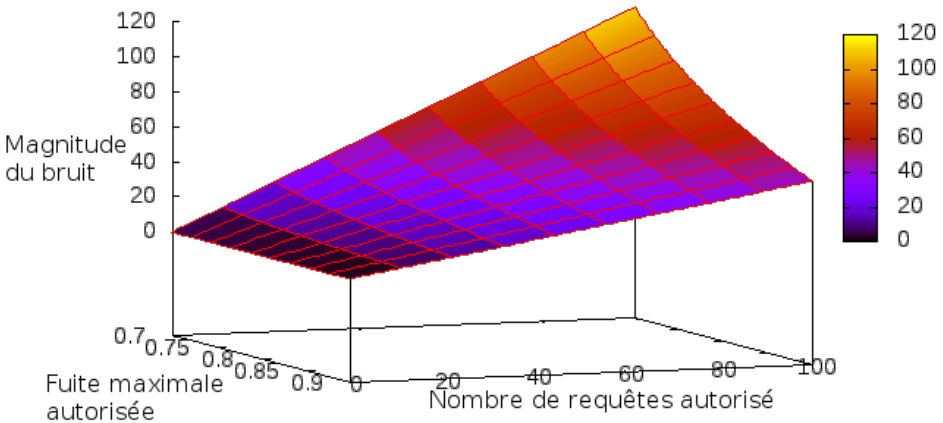

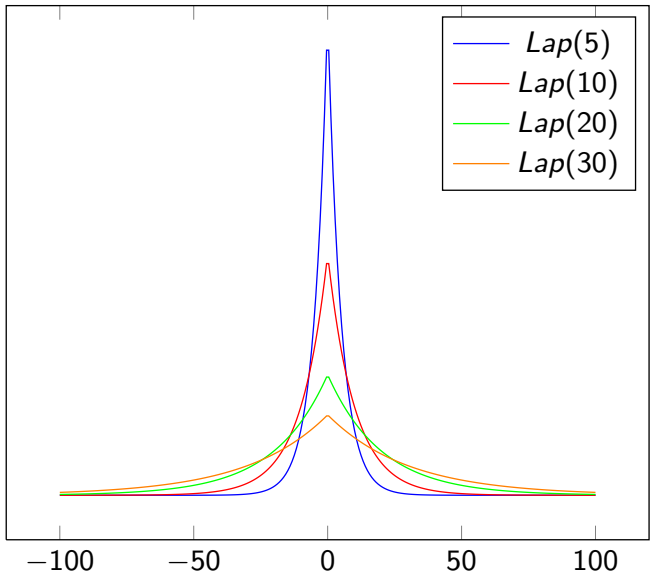

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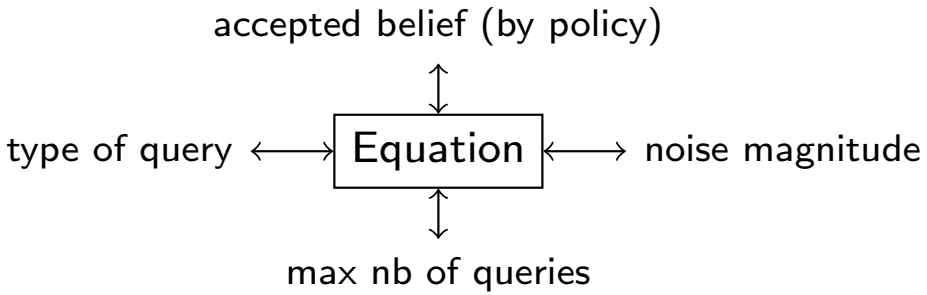

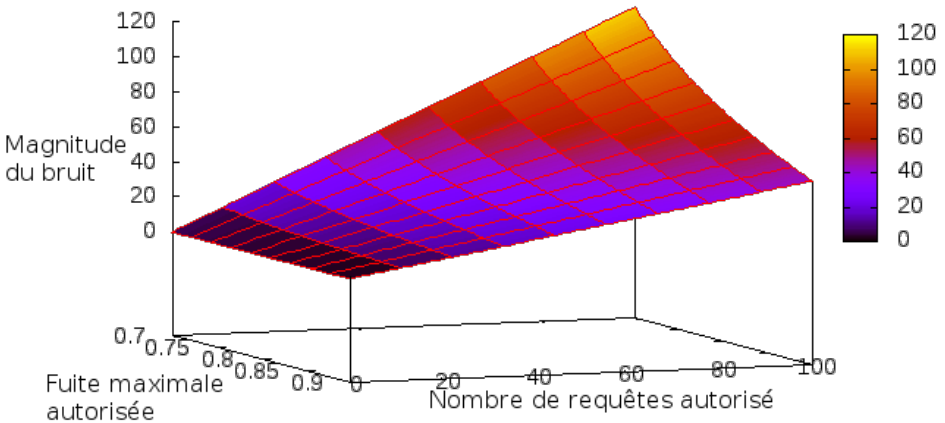

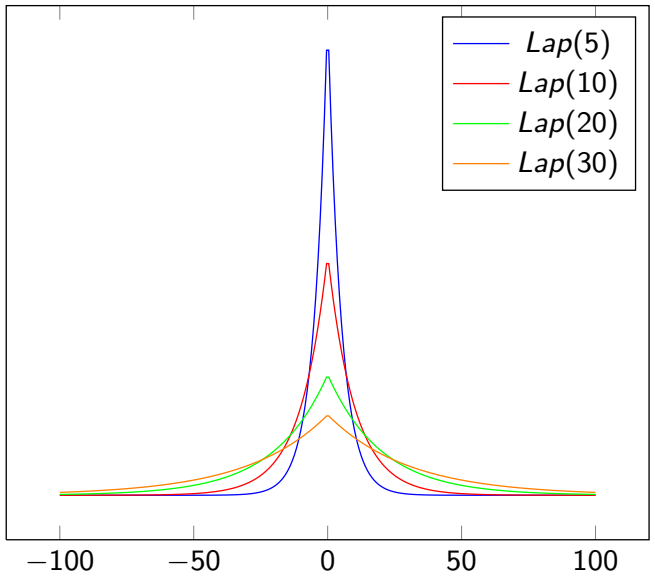

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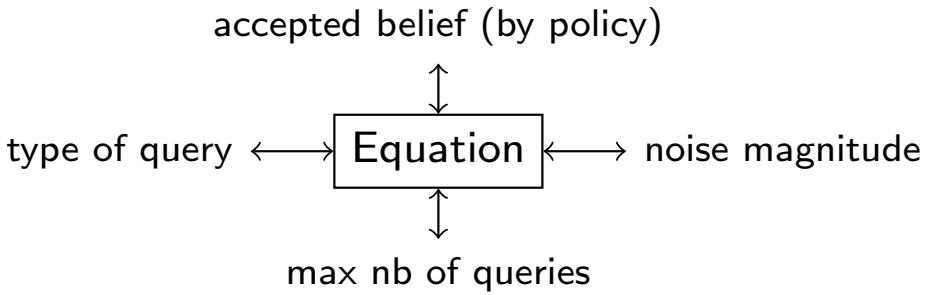

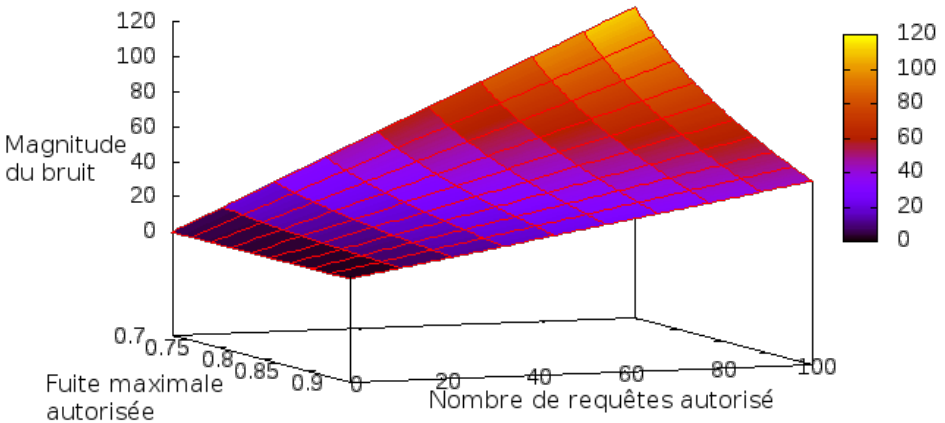

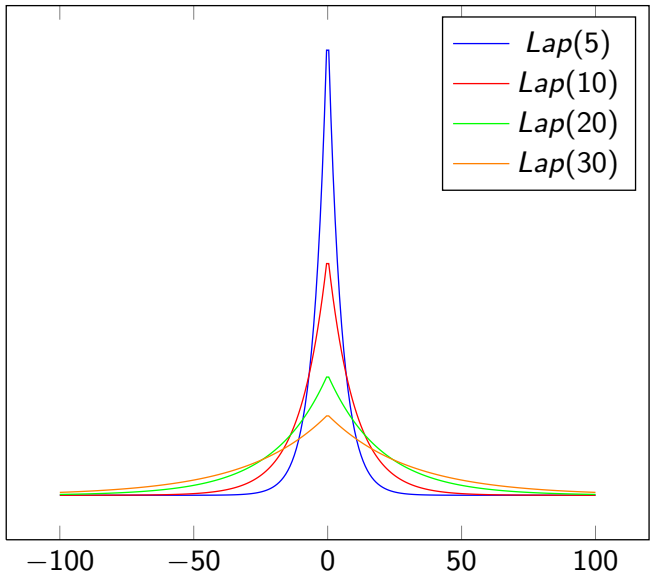

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Perspectives

- Seamingly extending data of provincial agencies
- Other variables than language
- How could such a mechanism be implemented ?

References

This work :

Enabling Dynamic Linkage of Linguistic Census Data at Statistics Canada.

A. Casteigts, M.-H. Chomienne, L. Bouchard, G.-V. Jourdan

Technical Repport, RRASFO, 2011

The theoretical result we have used :

Calibrating Noise to Sensitivity in Private Data Analysis

C. Dwork and F. McSherry and K. Nissim and A. Smith

Theory of Cryptography, 2006

Thank you !

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