CDR Data vs. Long-Distance Travel Surveys

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Outline

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2. CDR Data
   - Description
   - Framework
   - Identifying Long Distance Tours

3. Validation
   - French National Travel Survey

4. Conclusion

Motivation

Long-Distance Travel

- Responsible for 35-50% of overall VMT.
- Need for models and simulations.
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Problem:

Long-distance travel surveys are limited:

- known to report low trip rates,
- number of observations is comparably low.

Alternative data sources are needed.

Mobile Phone Billing Data

The biggest data set available to researchers at Orange Labs.

Some facts:

- reports all GSM actions (originating/terminating calls/SMS) in Orange network
- for each action a Call Data Record (CDR) appears in the data
- users are anonymised
- covers the time period: 16 May 2007 till 15 October 2007
- in total 22.3 million customers
- in total 15.5 billion CDRs

Advantages and Drawbacks of CDR Data

Advantages:

- The amount of data is huge.
- The effort needed to collect the (raw) data is much lower than for surveys.

Drawbacks:

- The action frequency is low (back in 2007).
- Not precise, because just the position of (one of) the next towers is known.
- No travel purposes, modes etc. are available.
- No sociodemographic information is available.
- In this case: no roaming information.

Methodology - Framework

Approach:

1. Identify home locations.
2. Select customers (by home location).
3. Extract data for selected customers.
4. Reconstruct long-distance tours.
5. Store the tours.
6. Impute a tour purpose.
7. Compare results to survey results

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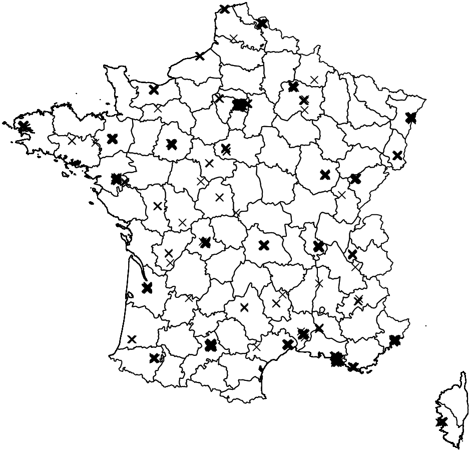
Selected Municipalities - Figure

14854 towers in 2977 distinct locations are considered



Selected Customers - Statistics

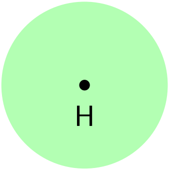
Population [*in* 1000]	Tracked Persons	Number of Communes
Paris	4953	1
200-900	19394	10
100-200	25294	13
50-100	9580	5
20-50	7461	4
10-20	7730	5
5-10	3190	5
1-5	1376	7
rural (< 1)	896	8
Total	79874	58

Identifying Long Distance Tours - Algorithm

CDR Long-Distance-Tour Reconstruction Algorithm

```
for all customers $C$ do
    $cdr\_set \leftarrow get\_cdr(C)$
    $order(cdr\_set, time)$
    for all $cdr \in cdr\_set$ do
        if not $next(cdr) \in UE(C)$ then
            new tour $t$
            while not $cdr \in UE(C)$ do
                $t \leftarrow t + cdr$
                $cdr \leftarrow next(cdr)$
            end while
            $tour\_set \leftarrow tour\_set + tour$
        end if
    end for
end for
```

LD Tour Reconstruction



Legend

H - Home anchor,

C1...C6 - CDR positions,

🟢 - User environment,

⤻ - Reconstructed tour,

⇢ - Real world tour

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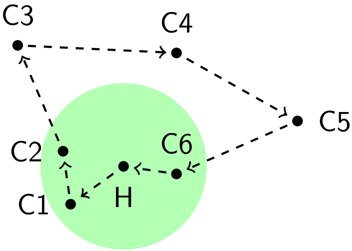

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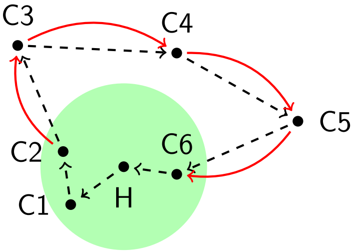

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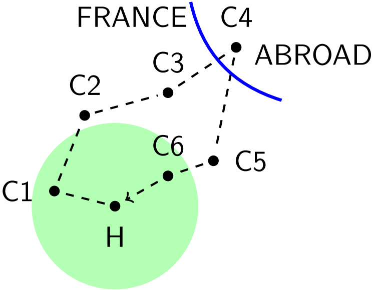

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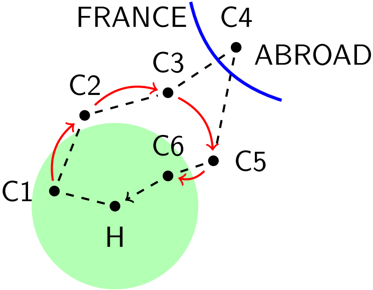

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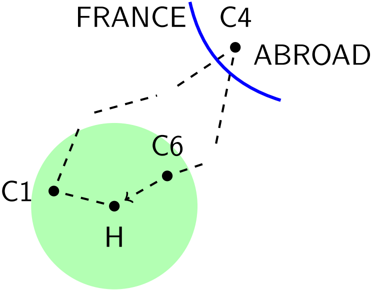

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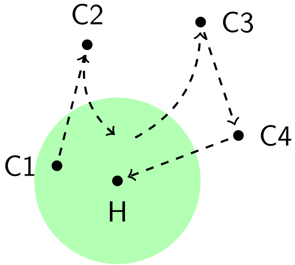
Problem II - Merging two Tours



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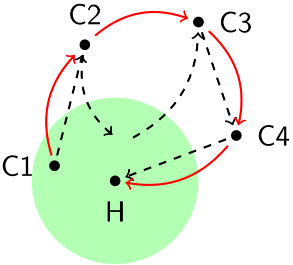

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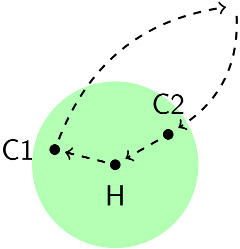
Problem III - Missing a Tour



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Results

Main Question:
CDR Data = Survey Data ?

French National Travel Survey

Enquête Nationale Transports et Déplacements (ENTD)

- performed every 10-15 years:
  1967, 1974, 1982, 1994, 2008
- we focus on last one: April 2007-April 2008 (6 waves)
- cooperation of a large number of actors, including ministries (CGDD, DGAC, RDG, DRAST, DSCR, DGITM), INSEE, Ifsttar, the Directorate of Tourism, SNCF, RFF, CCFA, FFSA, ADEME, IFEN, EDF, FIU.
- the goal is the analysis of
  1. regular and local mobility,
  2. vehicle fleet and its uses,
  3. **long-distance mobility**.

ENTD 2008

In total

- 20’178 households and
- 44’958 individuals.

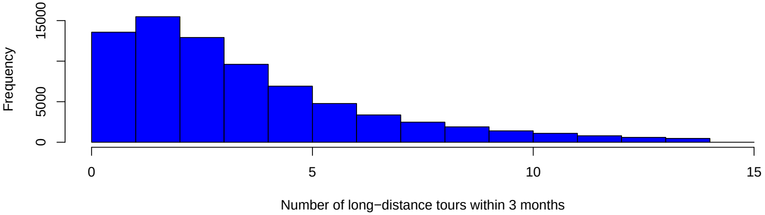
18’632 (representative) were chosen for LD questionnaire.

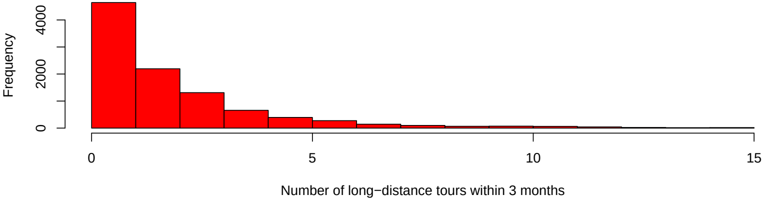
- 10’095 persons did a LD tour in previous 13 weeks.
- 5’670 persons did a LD tour in previous 4 weeks.
- 18’718 LD trips in 4 weeks form
- 8’505 LD tours, which were
    - 7’623 within France,
    - 6’978 in France and longer than 80km from home and

Results - Mobile Persons

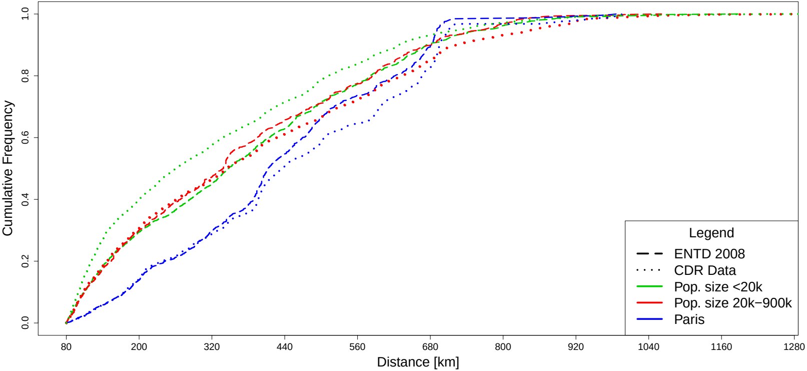
Data	Tracked Interval	Surveyed Persons	Mobile Persons	Mobile Share	Selected for analysis
CDR	30 days	1’388’941	814’381	58.6%	79’874
ENTD	28 days	18’632	4’796	25.7%	4’796
ENTD	91 days	18’632	8’743	46.9%	8’743

Results - Histogram: LD Tour Rates

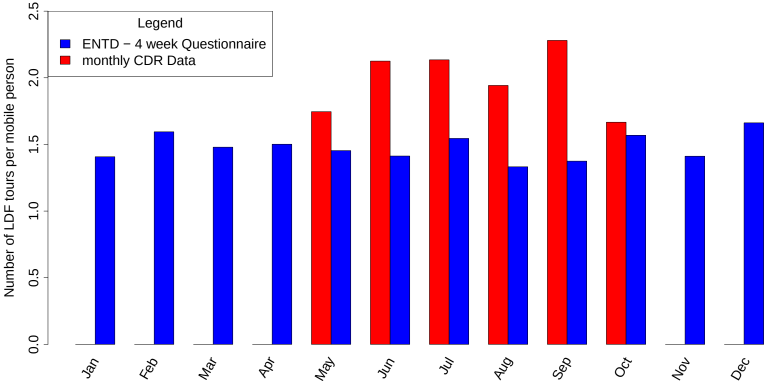




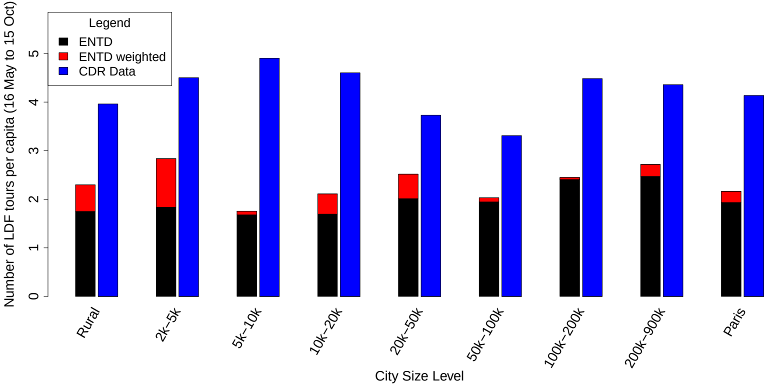
Results - Tour Distance Distribution



Results - Tour Frequency for Mobile Persons



Results - Tour Frequency per Capita



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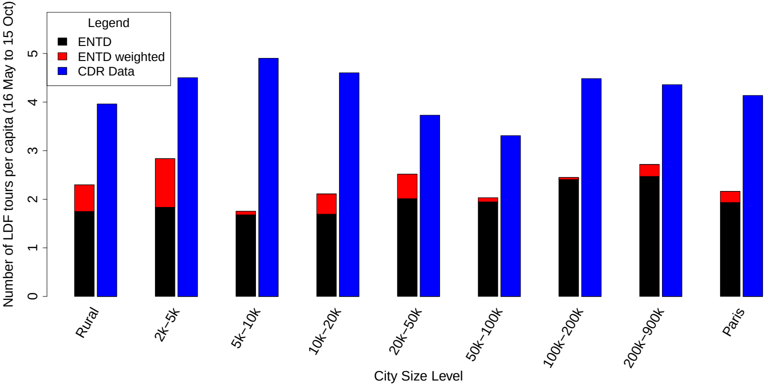

Reference Interval	CDR data 5 months	ENTD 4 weeks	ENTD 13 weeks	ENTD weighted 1 year
Tours in 5 months per capita	4.27	2.25 (52.7%)	1.96 (45.9%)	2.36 (55.3%)

Discussion - Limitations

(Our) CDR data has limitations:

1. Selection of customers might be biased
   (frequent callers are more likely to be chosen)
2. Computation of home locations.
3. No Roaming/International tours
4. Spatial inaccuracy.
5. Frequency of CDR data points.

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5. Frequency of CDR data points.
   ⇒ **The results provide a lower bound**

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Mobile phone data suggests that long-distance tour frequency is **twice as high** as in the National Travel Survey results

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There is a big need of alternative data collection methods!

Thank You!