Mobile Network Operator data –
Methods for Integrating New Data Sources

2022-IT-TSS-METH-TOO
Project n. 101132744

ISI WSC 2025, 9 October 2025, The Hague

Integrating MNO Data into Official Statistics: Challenges and Innovation

Can a traditional survey reduce the bias of mobile phone data based statistics?

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This presentation is mainly based on the deliverable *"**Deliverable 4.2** Report on a possible ad-hoc survey to improve the usage of MNO data in official statistics"* by

- Alexander Kowarik, Tiziana Tuoto, Loredana Di Consiglio, Gloria Deetjen, Maurice Brandt, Remy Kamali, Kira Gylling, Cristina Faricelli, Sara Piombo and Tiziana Pichiorri

- FAKE: Numeric results are just for illustrative purposes. They are extrapolated from the non-representative friendly user test in a very simple manner.

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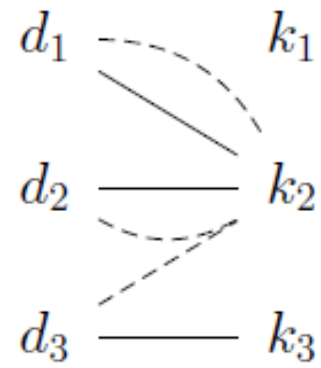
Current Challenges with MNO Data



- **User ambiguity:** contract holder ≠ primary user (family plans, business contracts)
- **Device duplication:** multiple devices/SIM cards → duplicate records.

$$Z = \sum_{d\in D} y_d \Big(\sum_{j,k\in U} c_{dk} a_{dj} \Big) = \sum_{j,k\in U} \nu_{kj} y_j = \sum_{\substack{k\in U \\ \zeta_k > 0}} y_k \nu_{kk} + \sum_{\substack{k\in U \\ \zeta_k > 0}} \sum_{\substack{j\in U \\ j\neq k}} y_j \nu_{kj}$$

$$\nu_{kj} \overset{\uparrow}{=} \sum_{d\in D} c_{dk} a_{dj} \qquad \zeta_k \overset{\uparrow}{=} \sum_{j\in U} \nu_{kj}$$

- **Behavioural variation**: differences by age, employment, lifestyle.

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Segmentation of MNO User Group

- Looking at the actual main user of a certain mobile phone

- Covered by standard **NSI sampling frame**:
  - Registered resident
  - Children via proxy information.
- Not covered in traditional surveys – **no frame readily available**:
  - Tourists, persons in transit
  - Non-registered residents, irregular migrants

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Need for (a) Dedicated Survey(s)

- **Purpose:** Collect systematic data on device usage and user profiles.
- **Objectives**:
  - Determine devices/SIM cards per individual.
  - Quantify mismatches between contract holders and users.
  - Analyse demographic usage patterns.
  - Gather socio-demographic background.

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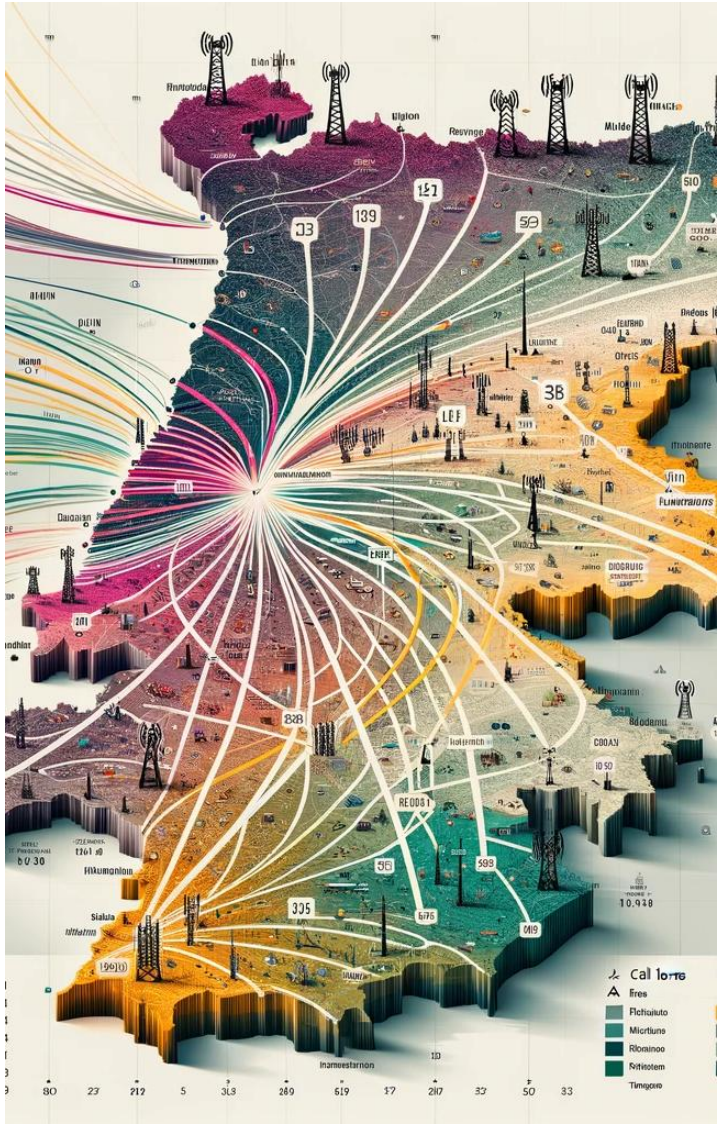
Survey Questionnaire



- Questionnaire Design
  - Core module with potential extensions for specific domains.
  - Sections:
    - Device and SIM Card Usage
    - Contract Details
    - Demographics & Lifestyle

https://ec.europa.eu/eusurvey/runner/MNOMINDS_WP4

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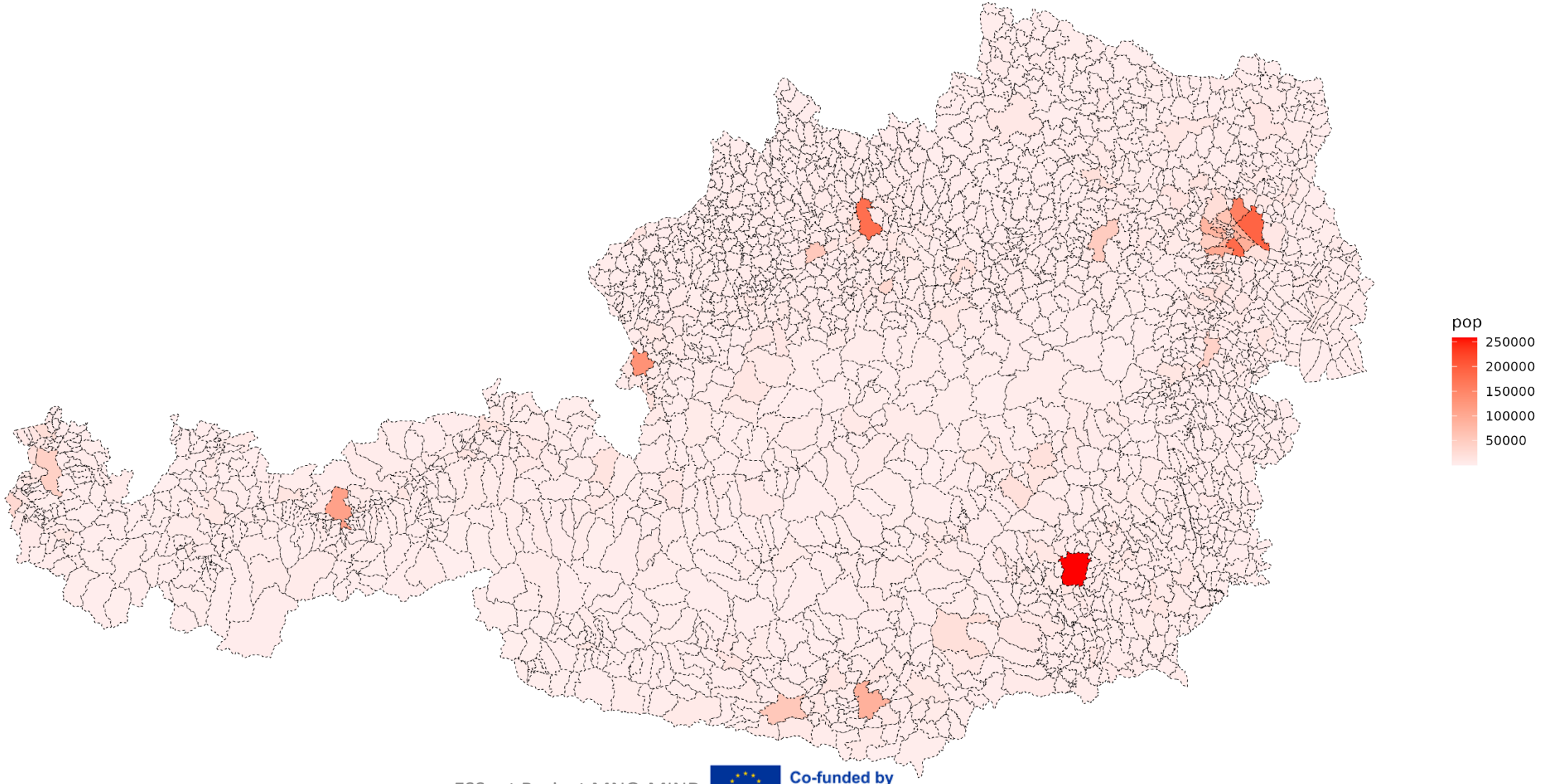
Population in Austria >15years, about 8 million



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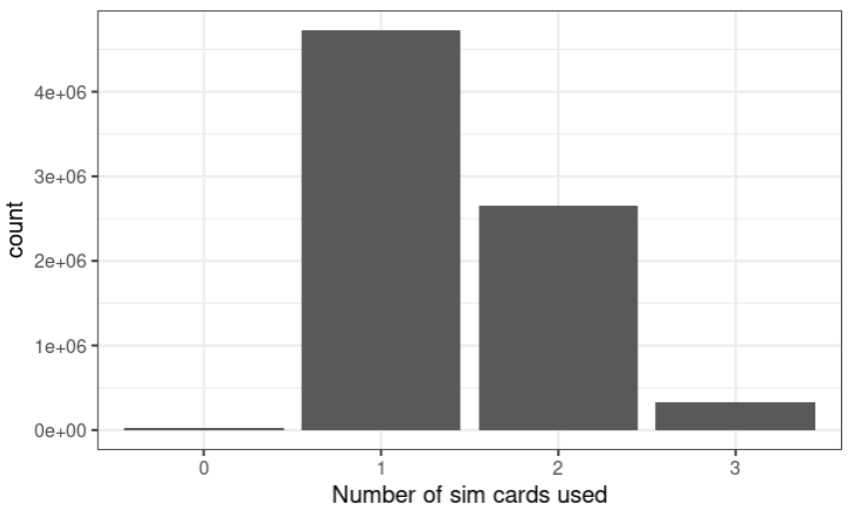
Approx. 11 million local SIM cards in use

Correlation
97%



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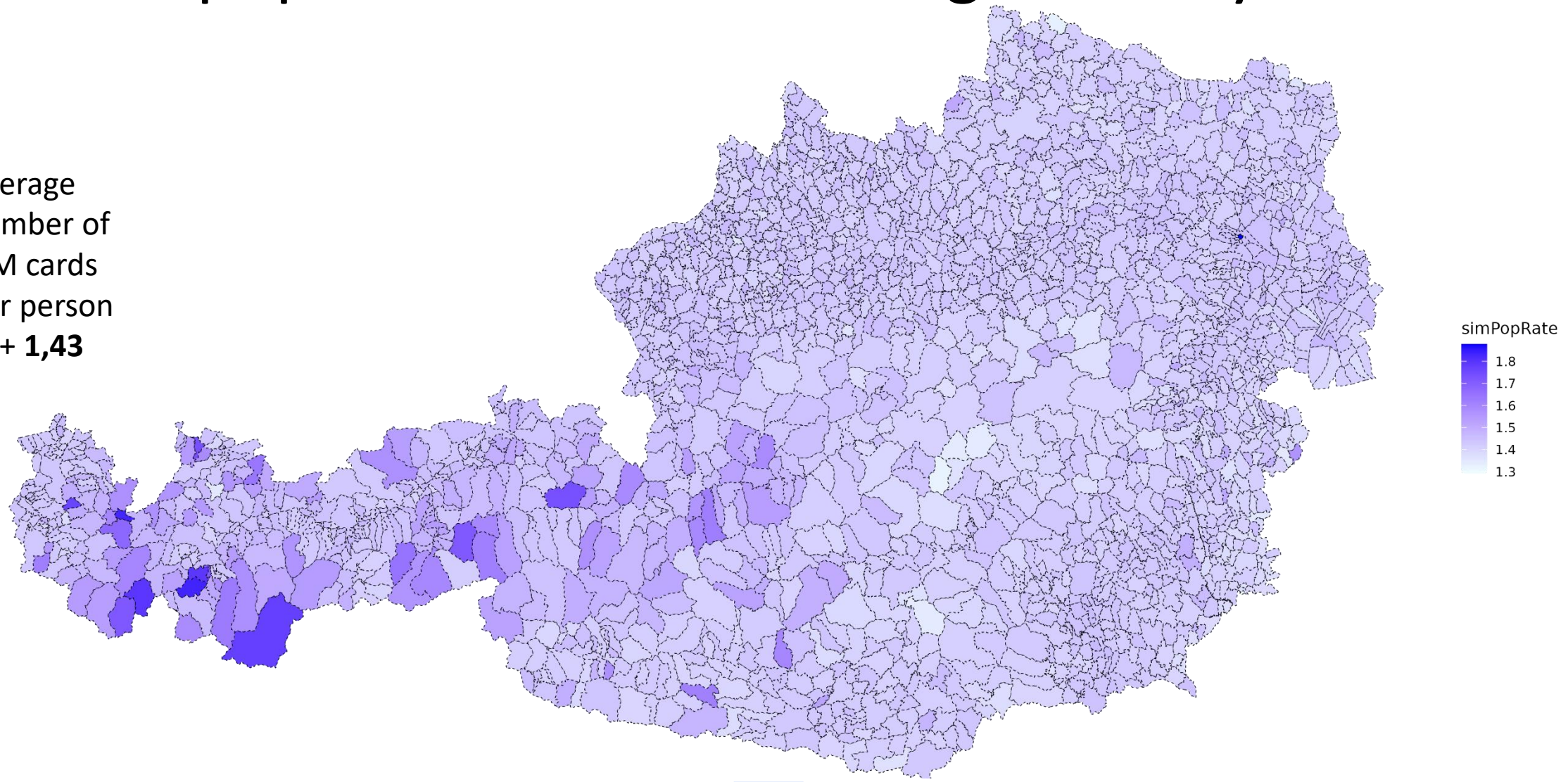
SIM-to-population ratio varies significantly.

Average number of SIM cards per person 15+ **1,43**



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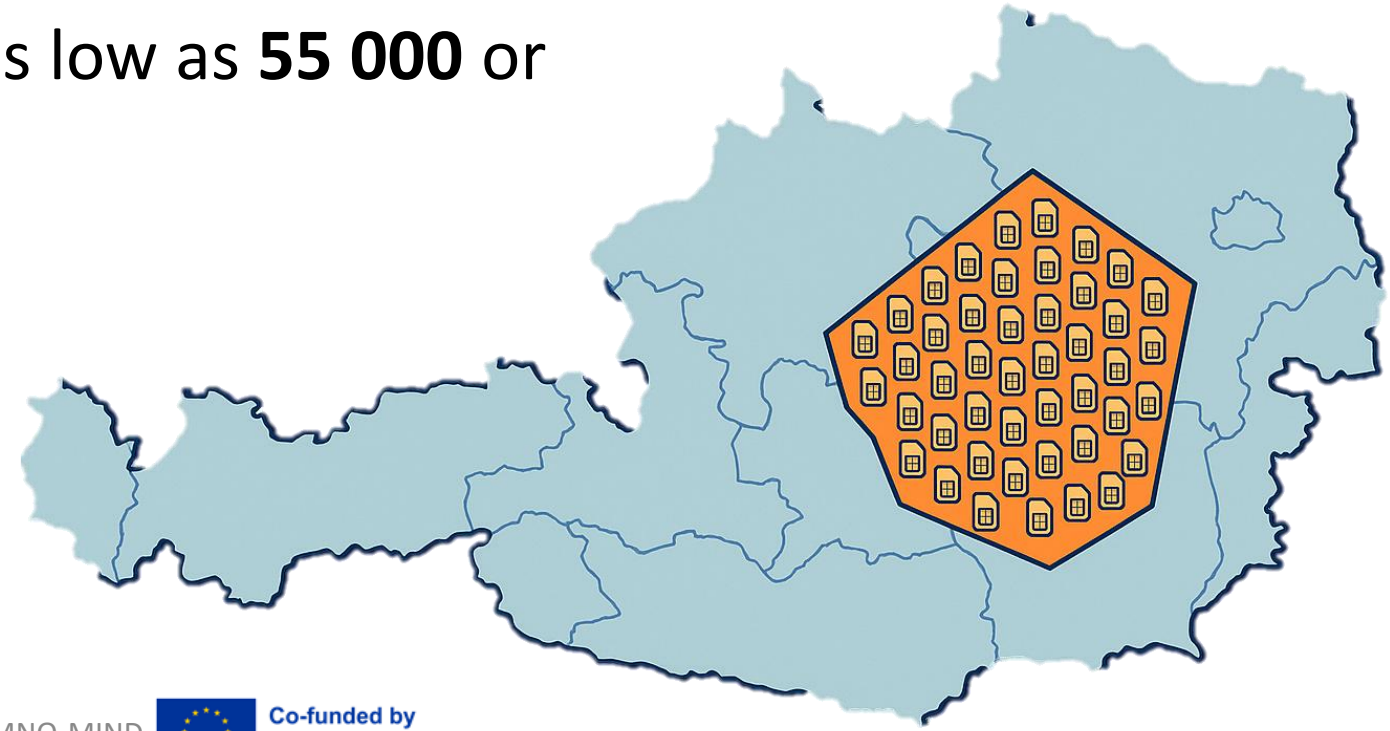
Illustrative Example (not real data).

- Example: **100 000 SIM cards** observed in an area within a time window.
- With the mean ratio SIM cards/person this leads to an estimate of **70 000 persons**
- But in specific areas it could be as low as **55 000** or as high as **77 000**



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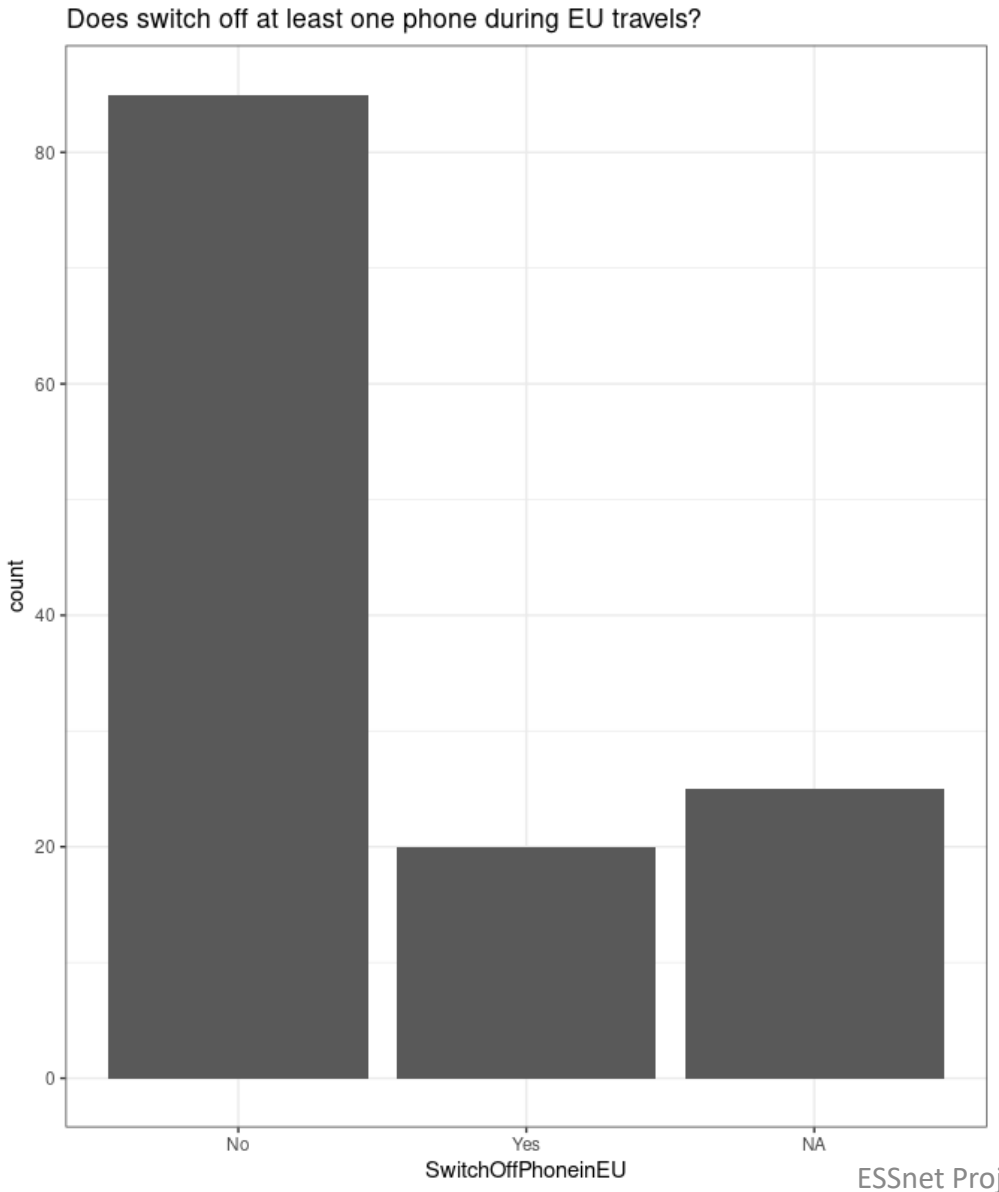
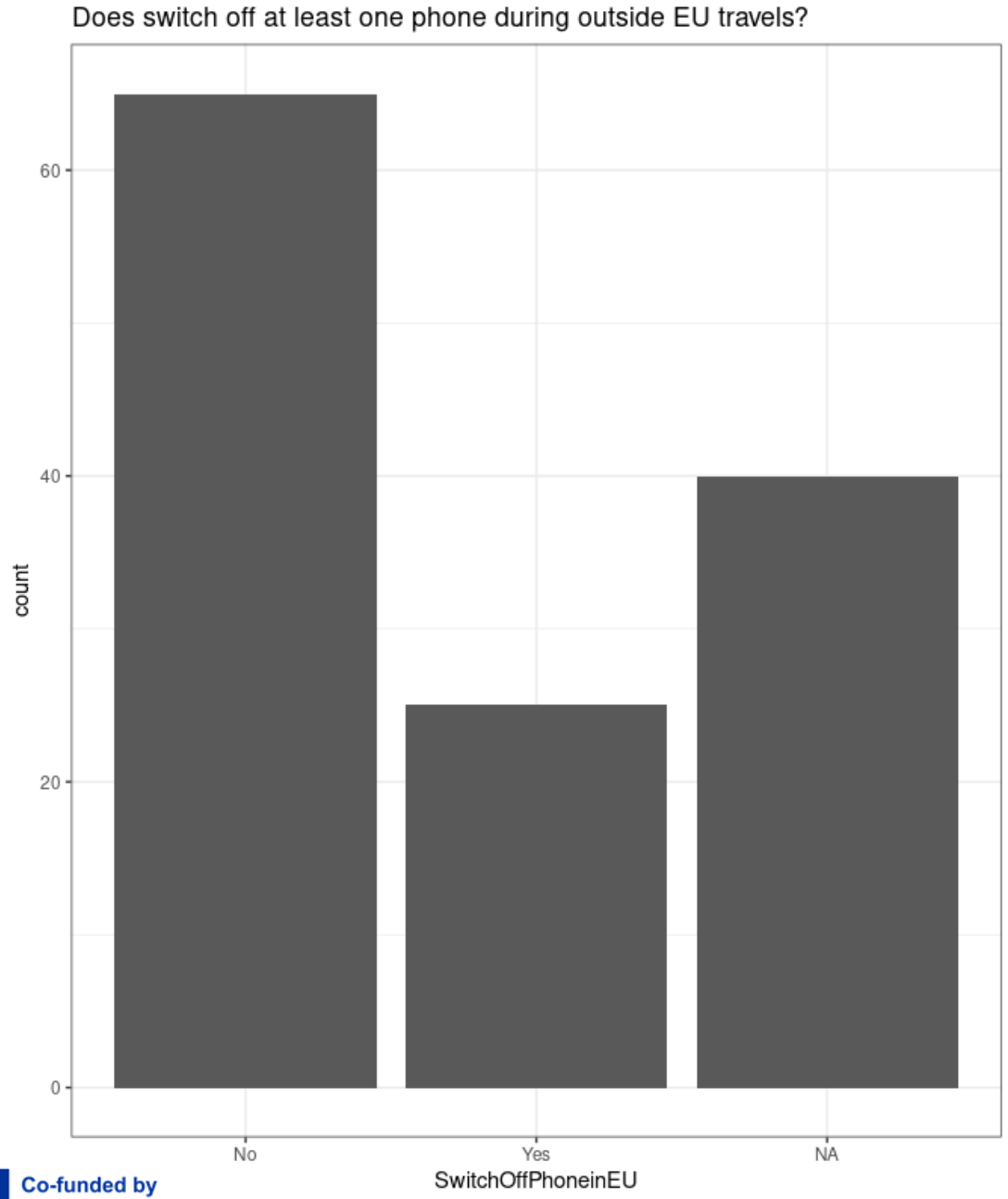
Phone Usage During Travel





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Alternative Approaches

- Area Sample Surveys
  - Target population : National SIM cards
  - Sampling based on geographical areas (antennae).
  - Consideration of technical and legal challenges.
  - Should cover all MNO users
  - Segmentation can be estimated
  - # SIM cards per user
- Border Surveys
  - Airports, border crossings etc.
  - Covers international tourists.

$$Y = MW \quad \text{and} \quad W = \xi^{-1}\{P_r(1 - P_w)\}(1 - P_{nr})^{-1}$$

P_r = Proportion of foreign residents among travellers

P_w = Proportion of workers among foreign residents

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What Could an Area Sample Look Like?

- Sampling Design:
  - Sample geographical areas or antennae and time intervals
  - Stratification into areas with different expected shares of non-residents
  - Oversampling of areas with higher rates
  - Either take all active SIM cards or sample SIM cards

- Survey Design:
  - Questionnaire (simple adaptions from the resident version)
  - Contact via MNO – e.g. SMS to phone or cell broadcast
  - Expected response rate: very low

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What Is the Optimum?

- Multiple surveys?
  - Traditional surveys for residents + MNO data limited to residents?
  - Survey covering non-residents
    - Area sample?
    - Border survey?
  - Ideally the measurement (position data) would be linked to the respondent. Theoretically, possible when starting from a SIM card.

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Conclusion

- **Survey necessity**: Quantify and reduce MNO data biases.
- **Implementation**: Promote adoption across ESS countries.
- **Goal**: Improved data quality through collaborative effort.

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- uRos2025 on-site event
24-26 November 2025

https://www.urosconf.org/