POSSIBLE IMPUTATION PROCEDURES FOR THE CENSUS 2021

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Motivation

- **German Population Census 2011:**
  - Validation and imputation was executed by IT-NRW (the Central statistical and IT services provider of one of the German Federal States, i.e. North Rhine-Westphalia)
  - Extra ad hoc nearest neighbour imputation tool was developed for the respective IT-environment
  - No exact error estimation for most survey estimates

- **German Population Census 2021:**
  - Validation and imputation will most probably be executed by the Federal Statistical Office
  - Exact error estimation for more than just the population figures is under evaluation
Considered imputation methods and tools

**Methods**
- Multiple imputation
- Nearest neighbour imputation

**Tools**
- R package *mice*
- SAS 9.4 MI procedure
- German ad hoc imputation tool
- CANCEIS
Multiple imputation

- Fully conditional specification
- Mixture of polytomous regression models and predictive mean matching
- \( m = 10 \)
- Re-imputation of implausible imputed values (shoot-out)
- Application of the same procedure and models in R and SAS
- Ad hoc implementation of the shoot-out procedure
Advantages and challenges of MI

- **Advantage:**
  - Enables correct error estimation
    - MI makes only sense if an exact error estimation is applied

- **Challenges:**
  - Results in m datasets
    - Every analysis has to be performed m times
    - Extra user interface necessary
  - Computationally very expensive
    - Neither R nor SAS are able to generate the multiple imputations in an acceptable time
    - Ad hoc implementation necessary
Advantages and challenges of MI

- Quality of the results not comparable to the quality of other statistics
  - Relative standard deviation rises when considering the variance due to imputation but not because of a lower quality but due to an improved methodology
- Deviation from standard publication rule
  - Results with a relative standard deviation of 15% and higher are usually not published
  - Sticking to this rule would cause a reduction of publishable results
- Edit rules cannot be incorporated into the imputation process
  - Shoot-out procedure can be very time consuming
Conclusions about MI

- MI is only an option if an exact error estimation is applied
- MI comes along with a lot of mostly practical challenges
- Before MI can be applied on the German population census a lot of work still has to be done
- Focusing on MI would bear a high project risk
Nearest neighbour imputation tools

- **German ad hoc imputation tool:**
  - Two distance measures implemented
    - For categorial variables only a simple comparison is available
  - All variables get the same weight
  - Subsequent validation step and additional adoption of the now implausible values from the same donor

- **CANCEIS:**
  - Ten distance measures implemented
  - Variable weights can be chosen
  - Near minimum change imputation action
Comparison of nearest neighbour imputation tools

- Advantages CANCEIS:
  - Flexible distance functions
  - Elaborated quality assessment of potential donors
  - Result of over 20 years of improvements

- Advantages German ad hoc imputation tool:
  - Is able to interact with the German standard validation tools
  - Expandable
  - Potential for a German standard nearest neighbour imputation tool
Conclusions about nearest neighbour imputation tools

- Improving the German ad hoc tool might be worth the effort
- Ad hoc solutions of other statistics could be included later on
- But this takes a lot of time and effort
- Simulation study planned to compare the quality of the results of CANCEIS and the German ad hoc tool