Correcting for misclassification under edit restrictions in combined survey-register data

Laura Boeschoten[12], Daniel Oberski[3], Ton de Waal[12] & Marcel Croon[1]

1 Tilburg University
2 Statistics Netherlands
3 Utrecht University

April 2017

Key Messages

- We developed a method that corrects for misclassification in combined datasets and simultaneously handles edit restrictions: MILC.

Key Messages

- We developed a method that corrects for misclassification in combined datasets and simultaneously handles edit restrictions: MILC.
- The method is based on a combination of Latent Class (LC) analysis and Multiple Imputation (MI).

Key Messages

- We developed a method that corrects for misclassification in combined datasets and simultaneously handles edit restrictions: MILC.
- The method is based on a combination of Latent Class (LC) analysis and Multiple Imputation (MI).
- Variables can be added to the LC model at a later stage.

Key Messages

- We developed a method that corrects for misclassification in combined datasets and simultaneously handles edit restrictions: MILC.
- The method is based on a combination of Latent Class (LC) analysis and Multiple Imputation (MI).
- Variables can be added to the LC model at a later stage.
- The LC model can be extended in many ways.

Why use the MILC method?

- Combined sources are often used by researchers.

Why use the MILC method?

- Combined sources are often used by researchers.
- Both surveys and registers always contain some misclassification.

Why use the MILC method?

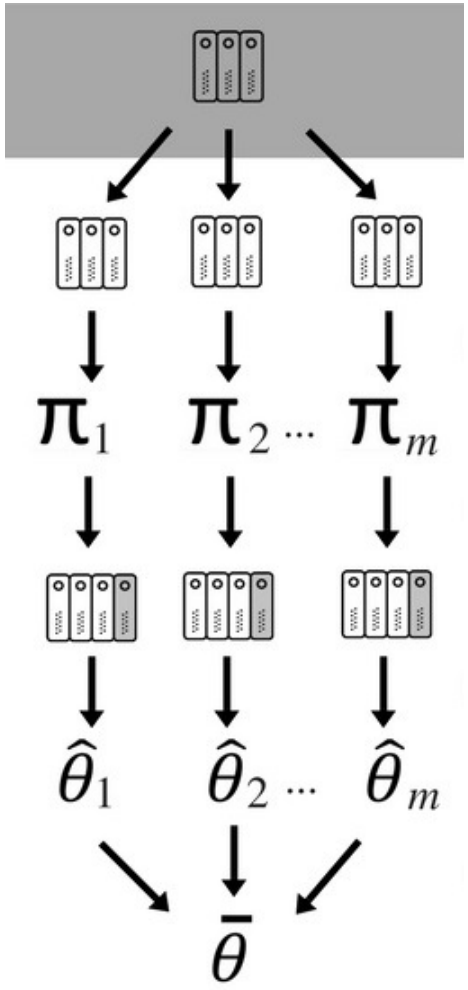
- Combined sources are often used by researchers.
- Both surveys and registers always contain some misclassification.
- The causes for misclassification in registers and in surveys can be very different.

Why use the MILC method?

- Combined sources are often used by researchers.
- Both surveys and registers always contain some misclassification.
- The causes for misclassification in registers and in surveys can be very different.
- Edit restrictions can be applied simultaneously.

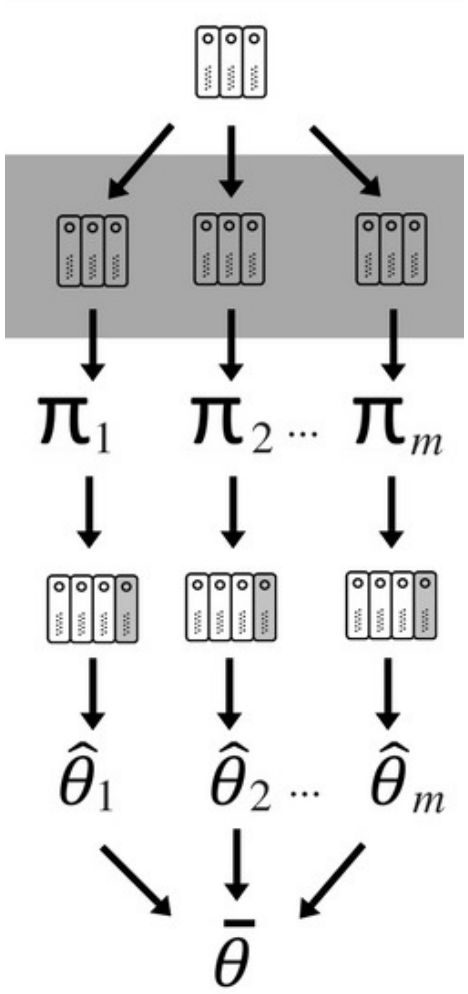
Step 1: Combined survey-register dataset

- Misclassification in surveys and registers can be detected by variables in each dataset measuring the same attribute.
- These variables can be considered indicators measuring a latent (unobserved) 'true' variable.



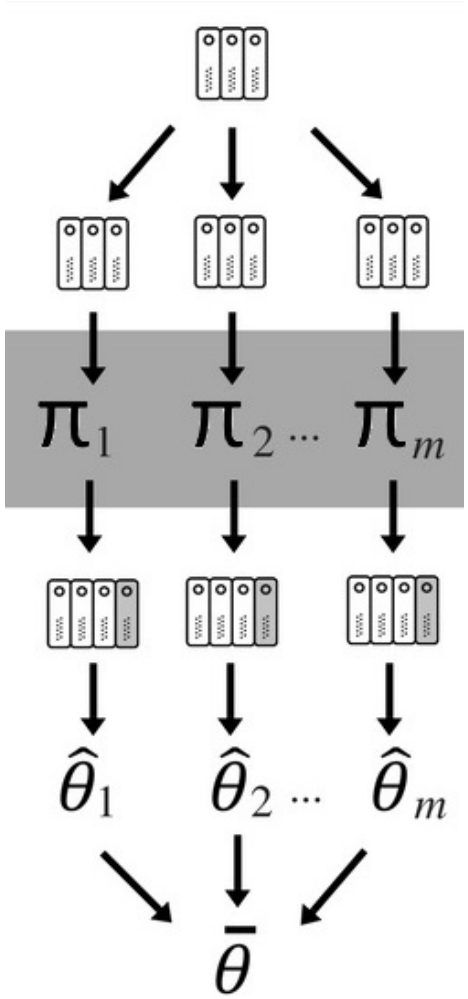
Step 2: Bootstrap samples

- m bootstrap samples are drawn from the original combined dataset.
- The bootstrap samples are taken to incorporate parameter uncertainty.
- $m = 5$ is generally enough to obtain valid inference.



Step 3: The LC model

- For each bootstrap sample, an LC model is constructed to measure latent variable X using indicators Y.
- The number of categories of X is equal to the number of categories in the indicators.
- Covariates Q are also included.
- We specify the model in Latent GOLD, which uses ML for parameter estimation.



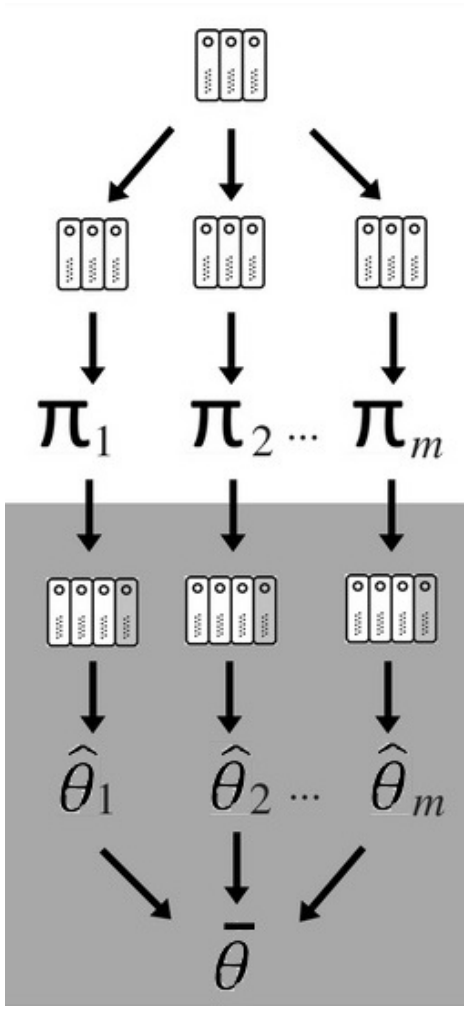
Step 3: Incorporating edit restrictions into the LC model

If Q is a covariate and the combination of scores $X = 1$ and $Q = 2$ is impossible in practice, the corresponding edit restriction is:

$$P(X = 1|Q = 2) = 0$$

Last steps...

- 4. Multiple imputations
- 5. Obtain estimates of interest
- 6. Pool the estimates using Rubin's rules



When can we use MILC

- Your data needs to be of a certain quality.
- Latent GOLD output gives you the entropy R^2, which is a value between 0 and 1 that indicates how well you can predict class membership based on the observed variables.
- For valid inference, you need an entropy R^2 of 0.90 or higher.

The three-step approach

- The imputed variable (W) is used in further analysis with other variables.

The three-step approach

- The imputed variable (W) is used in further analysis with other variables.
- Although we investigate the relation between W and covariates Q, we are actually interested in the relation between latent 'true' variable X and Q.

The three-step approach

- The imputed variable (W) is used in further analysis with other variables.
- Although we investigate the relation between W and covariates Q, we are actually interested in the relation between latent 'true' variable X and Q.
- W is not equal to X, there is some misclassification.

Two methods to update the LC model

1. ML approach

By using W as an indicator for X, a new LC model is created:

$$P(W = w, Q = q) = \sum_{x=1}^{C} P(X = x, Q = q) P(W = w | X = x) \tag{1}$$

Two methods to update the LC model

1. ML approach

By using W as an indicator for X, a new LC model is created:

$$P(W = w, Q = q) = \sum_{x=1}^{C} P(X = x, Q = q) P(W = w | X = x) \tag{1}$$

2. BCH approach:

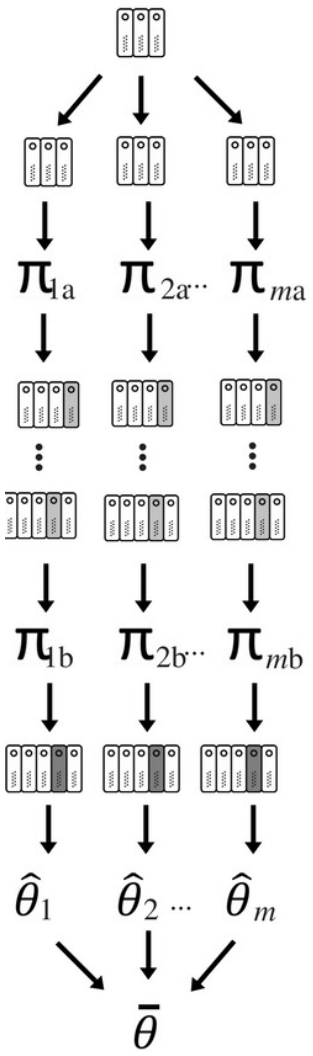
We re-express:

$$P(X = x, Q = q) = \sum_{w=1}^{W} P(W = w, Q = q) d^*_{wx}, \tag{2}$$

where we weight the $W - Q$ distribution by the inverse of the classification errors.

Combining MILC and three-step

1. Combined survey-register dataset.
2. Bootstrap samples.
3. The LC model.
4. Multiple imputations.
5. **Acquire new information.**
6. **Updating the LC model.**
7. Creating new imputations.
8. Obtain estimates of interest.
9. Pool using Rubin's rules.



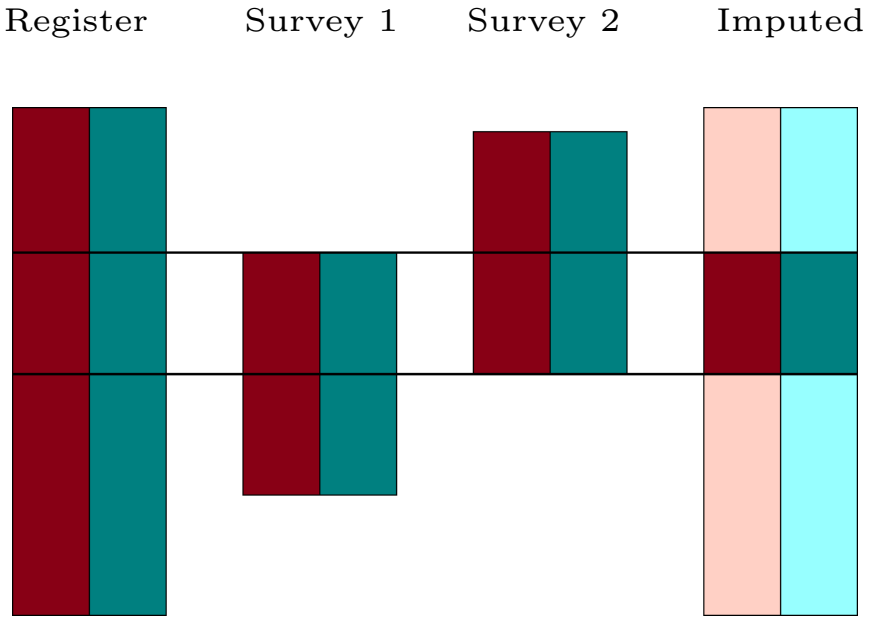
Further research

1. **Assumptions:**
   - Observed indicators are independent of each other.
   - Misclassification is independent of covariates.
   - Covariates are free of error.
   - Edit rules applied are ‘hard edits’.

Further research

2. Missing data:

- Item non-response
- Unit non-response



Thank you!