PIAAC
Small Area Estimation of Proficiency Measures: Research, Development, and Implementation

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Overview

Aim to answer the following basic questions:
1. Why small (local) area estimates are important?
2. What is the Small Area Estimation (SAE) Methodology commonly used to create local area estimates?
3. Can PIAAC data be used to produce SAE?
4. What is the status of SAE research, development, and implementation for PIAAC?
Question 1. Why small (local) area estimates are important?
Need for small (local) area estimates

Access to information at local area level critical for policy makers and researchers

- For researchers
  - To evaluate the distribution of proficiency measures across various areas and relationships with various demographic and socio economic variables

- For policy makers
  - To plan and allocate resources and target interventions as necessary
Question 2. What is the Small Area Estimation (SAE) Methodology commonly used to create local area estimates?
Small Area Estimation (SAE) Methodology
Commonly used to Create Local Area Estimates

- SAE is a model-dependent approach
  - Estimate proficiency distribution for areas where survey data are insufficient (or equal to zero) for direct estimation
- Estimates are predictions of how the adults in a small area would have performed had they been administered the PIAAC assessment
Differences Between SAE and Traditional Methods

Traditional methods are based on *implicit* models that provide a *link* to related small areas through supplementary data.

**Explicit linking** models or small area models make specific allowance for between-area variation.

- Incorporate *random area-specific effects* that account for between-area variance beyond what is explained by auxiliary variables included in the model.
Differences Between SAE and Traditional Methods (2)

SAE methodology includes

- **Linking Model** - Explicit models used as a link to relate supplementary (auxiliary) data available for the area to the dependent variable (respondent’s scores)

- **Sampling Model** - A sampling model that acknowledges the sampling variability present in the dependent variable
  - The precision measures associated with each estimate are based on statistical methodologies that attempt to account for all sources of measurable error
Critical Factors in SAE Modeling

1. Direct estimates

2. Auxiliary data

3. Model fit
Critical Factors in SAE Modeling

1. Direct estimates
   • Sample should have adequate representation of the Small Areas with respect to outcome variables (proficiency skills)

2. Auxiliary data

3. Model fit
Critical Factors in SAE Modeling

1. Direct estimates

2. Auxiliary data
   - **Highly** reliable
   - **Up-to-date** (matching PIAAC data collection date)
   - **Exact** matching of definitions with those in PIAAC (needed for some SAE models)
   - **Highly** correlated with adult proficiency (example: age, gender, educational attainment, labour force status, poverty status, etc.)

3. Model fit
Critical Factors in SAE Modeling

1. Direct estimates

2. Auxiliary data

3. Model fit
   • There needs to exist a model that fits the country data at the small area level
Question 3. Can PIAAC Data be Used (“Fit for Use”) for SAE?
Can PIAAC Data be Used ("Fit for Use") for SAE?

- Short answer:
  - It depends…

- Long answer:
  - Provided later if needed
PIAAC International SAE Research (Westat/OECD)

Purpose

- Evaluate whether national PIAAC data can be used to produce SAE
- Evaluate various methodology and approaches to SAE across different countries
  - Different population sizes and with different PIAAC sample designs

Goal

- Develop a general understanding of
  - How SAE can be implemented in PIAAC
  - Whether there is any impact on the sample design and sample size for countries interested in SAE, that should be considered at the time of sample design development
US PIAAC SAE Production Task

- Under a contract with US (National Center for Education Statistics)
  - Westat conducted research, development and implementation for SAE using US PIAAC data
Question 4. What is the status of the SAE research, development and implementation for PIAAC?
PIAAC SAE International Research – Participating Countries

- Germany
- Italy
- New Zealand
- Slovak Republic
- Sweden
Acknowledgements

- US National Center for Education Statistics
  - Some of the research and development for the international research was based on work originally done under U.S. PIAAC contract
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- **Sweden**: Lotta Larsson, Johan Lofgren
- **US**: Stephen Provasnik

- **OECD**: William Thorn
PIAAC SAE Research – Small Area Estimates of Interest

SAE estimates vary across countries, and include

- Literacy and Numeracy
  - Proportions
    - At or below Level 1
    - Level 2
    - Level 3 or above
  - Average score
PIAAC SAE – Status for Six Countries

- **Research** – Complete
- **Development** – Complete for most countries
- **Implementation** – Complete for a few countries
PIAAC SAE Research, Development, Implementation – Status Summary

- **New Zealand**
  - Website released in November 2019

- **US**
  - Website release expected in early March 2020

- **Italy**
  - Estimates produced for literacy (by gender)
  - Currently producing estimates for numeracy

- **Slovak Republic**
  - Estimates are produced and approved

- **Germany, Sweden**
  - Estimates are produced
  - Results under review
  - Further work in progress if/when needed
New Zealand SAE
Data used by NZ’s largest adult literacy education provider to

- Estimate the number of potential learners in each location
- Ensure the level of service provided in each area is roughly proportional to the likely need
- Reinforce own estimates and own local knowledge
- Fill in information for some areas
- Use the margins of error
New Zealand PIAAC SAE Website (1)

Survey of Adult Skills: Regional and local profiles

Publication Details

We have developed a visual tool that shows distribution of literacy, numeracy and problem-solving skills across the country by region and territorial authority. The tool also includes information on related variables, namely: qualification levels, use of ICT at work and having English as a first language. The last variable is important as the Survey of Adult Skills only tests skills in English. It shows that the region with the lowest skills is South and East Auckland, while Wellington has the highest skills. The low skill levels in South and East Auckland is largely driven by the high proportion of the population for whom English is not a first language. The higher skills in Wellington are largely related to qualification levels and a higher proportion of jobs requiring ICT use. Wellington is similar to North and Central Auckland on both of these variables. However, North and Central Auckland has a higher proportion of the population for whom English is not a first language.

Authors: David Earle, Tertiary, Ministry of Education.

Date Published: December 2018

Updated: November 2019

Survey of Adult Skills: regional and local profiles

The Survey of Adult Skills measures the skills of New Zealand adults in literacy, numeracy and problem solving in technology rich environments. It is part of the OECD's Programme for the
New Zealand PIAAC SAE Website

Choose a skill domain
- Literacy
- Numeracy

Choose a level
- Level 1 or below
- Level 3 and above

Proportion of literacy at Level 1 or below by territorial authority:

- Mangere-Otahuhu Local B..
- Otara-Papatoetoe Local B..
- Manurewa Local Board Area
- Puketapapa Local Board Area
- Whau Local Board Area
- Howick Local Board Area
- Henderson-Massey Local Area
- Papakura Local Board Area
New Zealand PIAAC SAE Website (5)
United States SAE
United States PIAAC SAE Website (1)

- To be released early March
- Estimates based on three rounds of data collection in Cycle 1
- Literacy and Numeracy estimates for counties and states
  - Proportions
    - At or below Level 1
    - Level 2
    - Level 3 or above
  - Average score
- Multiple statistical testing
United States PIAAC SAE Website (3)

County Comparison Summary Card

Select a county in the map

Comparison with Average Scale Score for

Literacy: BELOW State Average
Numeracy: BELOW State Average

Analysis of results

County, has a population of according to the American Community Survey 2013-2017 five-year estimate. When compared to the state of Nebraska:

- Average scale score estimate is statistically lower
- Percentage at or below Level 1 is statistically higher
- Percentage at Level 2 has no notable difference
- Percentage at or above Level 3 is statistically lower
United States PIAAC SAE Website (5)

Analysis of results

Coconino County, AZ when compared to Bethel Census Area, AK:
Italy SAE
Italy PIAAC SAE Results

Average scores (Literacy)

Northern regions
Central regions
Southern regions

Trentino A. A., Lazio, Valle d'Aosta, Veneto, Abruzzo, Marche, Molise, Emilia-Romagna, Friuli V. G., Toscana, Liguria, ITALY, Sardaigne, Piemonte, Lombardia, Calabria, Puglia, Sicilia, Umbria, Campania, Basilicata
Italy PIAAC SAE Results

Proportion in Level 1 or below (Literacy)

- Northern regions
- Central regions
- Southern regions
Italy PIAAC SAE Results

Average scores VS Proportion in Level 1 or below (Literacy)

y = 0.8117x + 230.13
R² = 0.9071

Proportion Level 1 LIT

Average literacy scores

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Italy PIAAC SAE Results

Proportion in Level 1 or below (Literacy) by gender

Northern regions: Piemonte, Lombardia, Veneto, Friuli V. G., Liguria, Emilia-Romagna, Toscana, Umbria, Marche, Abruzzo, Molise
Central regions: Trentino A. A., Veneto, Valle d’Aosta, Lazio
Southern regions: Campania, Basilicata, Calabria, Sicilia, Basilicata, Sardinia, Puglia

Graph shows the proportion of individuals in Level 1 or below literacy level by gender across different regions in Italy.
Questions and Discussion