2018 PAA Short Course on "Bayesian Small Area Estimation using Complex Data" Introduction and Overview

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Introductions

Sam is a demographer with interest in population health in Africa

- Mortality and its determinants
- Epi-demographic transitions
- Experience with demographic surveillance system data collection
- Interests in population indicator measurement

Richard is a statistician, completing his thesis at UW, with interests in

- Verbal autopsy
- Bayesian methods and computation
- Estimation of subnational variation in U5MR
- Has lead the computational aspects of the U5MR project, including the creation of the `SUMMER` package

Jon is a statistician with longstanding interests in

- Bayesian statistics
- Geospatial models and applications in spatial epidemiology
- Survey sampling and design effects
- Small-area estimation

All three work with IGME group on estimating subnational variation in U5MR.

Logistics

Demonstrations of methods via `R` implementations will be carried out in class. Students are encouraged to follow along.

Code and other materials (course notes, papers) are available at the course website:

http://faculty.washington.edu/jonno/PAA-SAE.html

Overview

Objective	Totals and averages for a quantity of interest, by area	Lecture 1
Data	Surveys with a complex design. If small or no samples in some areas, there is high instability	Lectures 5, 6
Global and Spatial Smoothing	To reduce instability, use the totality of data to smooth both locally and globally over space	Lectures 3, 4
Bayesian Modeling	Is convenient/designed for smoothing	Lecture 1
Survey Sampling	Required to describe and analyze the sample	Lectures 5, 6, 7
Implementation	In `R` programming environment, with `survey` and `INLA` packages.	Lecture 2
Mapping	Maps of uncertainty, accompanied with uncertainty, GIS	Lectures 2, 8

Course Outline

DAY 1:

- 9.00–10.30 Lecture 1: Bayesian Statistics (Wakefield). Motivation; Bayesian learning, Probability and Bayes theorem; Standard distributions and conjugacy (binomial and normal distributions in detail).
- 10.30–11.00 Coffee Break
- 11.00–12.30 Lecture 2: Introduction to `R` (Li): Introduction to `R` and `RStudio`. Examples of normal and binomial sampling, introduction to GIS in `R`.
- 12.30–1.30 Lunch Break
- 1.30–2.15 Lecture 3A: Hierarchical Bayes Modeling (Wakefield). Motivation; Non-spatial hierarchical models for normal data; Non-spatial hierarchical models for binomial data.
- 2.15–3.00 Lecture 3B: Hierarchical Bayes Modeling in `R` (Li). `R` component: estimation and mapping for hierarchical Bayes models. Introduction to `INLA`. Simple SAE.
- 3.00–3.30 Coffee Break
- 3.30–4.30 Lecture 4A: Hierarchical Spatial Bayes Modeling (Wakefield). Spatial hierarchical models for normal data; Spatial hierarchical models for binomial data; Overview of spatial random effects models; normal and binomial examples.
- 4.30–5.00 Lecture 4B: Hierarchical Spatial Bayes Modeling in `R` (Li). `R` component: Discrete spatial modeling with `INLA`.

Course Outline

DAY 2:

- 9.00–10.00 Lecture 5A: Survey Sampling (Wakefield). Overview; Simple random sampling; Stratified simple random sampling; Cluster sampling.
- 10.00–10.30 Lecture 5B: Survey Sampling in R (Li): Survey sampling in R, the `survey` package.
- 10.30–11.00 Coffee Break
- 11.00–12.00 Lecture 6A Introduction to SAE: (Wakefield): Overview of SAE models; Multistage sampling; Simple SAE Models.
- 12.00–12.30 Lecture 6B: Introduction to SAE in R (Li): Simple SAE in R using the `SUMMER` package.
- 12.30–1.30 Lunch Break
- 1.30–2.15 Lecture 7A: SAE (Wakefield). More complex modeling and BRFSS example.
- 2.15–3.00 Lecture 7B: SAE in R (Li). BRFSS example. More on the `SUMMER` package (simple binary outcome, no time).
- 3.00–3.30 Coffee Break
- 3.30–4.30 Lecture 8A: Advanced SAE (Wakefield). Space-time modeling illustrated with Kenya U5MR example. Continuous spatial models and estimation at the pixel level.
- 4.30–5.00 Lecture 8B: Advanced SAE in R (Li) U5MR `SUMMER` package example.