Bayesian Small Area Estimation

Zehang Li[1], Jon Wakefield[2,3] and Samuel J. Clark[4]

April 22 2020, 8:30 AM–6:00 PM

Course Description:

Small area estimation (SAE) is an important endeavor in global health, epidemiology, and increasingly, in demography. SAE is often based on data obtained from complex surveys, and one must acknowledge the survey design when statistical analysis is performed so that measures of uncertainty incorporate sampling variability. Often data in particular areas are sparse (perhaps non-existent) and so spatial smoothing is advantageous to 'borrow strength' from neighboring areas.

We will begin with introductions to complex survey data, SAE, space-time modeling, and Bayesian statistics and then bring these topics together to show how reliable SAE estimation can be performed. The course will end with a complex application: space-time smoothing of under-5 infant mortality using demographic and health survey (DHS) data. This application is part of an on-going collaboration that the instructors have with UNICEF. In this context, the use of both full and summary birth history data will be described. Throughout, hands-on experience will be gained through the use of the instructors' SUMMER R package that carries out space-time smoothing of area-level complex survey data, based on methodology that has been developed by the instructors [Li et al., 2019, Wakefield et al., 2019, Wakefield, 2020]. More details on the package, and more materials are available at `http://faculty.washington.edu/jonno/space-station.html`.

There are no prerequisites, although familiarity with R, Bayesian methods, and mortality measurement would be helpful. Participants should bring their own laptop with R and RStudio installed so that they can follow along and experiment with the data and code.

When you leave the workshop you will:

- Have an overview of small area estimation (SAE).

1

- Understand the need for special methods for the analysis of survey data.

- Understand the need for special methods for the analysis of spatial data.

- Have a grasp of the basics of Bayesian inference.

Presenters:

Zehang Richard Li `https://zehangli.com`

Jon Wakefield `http://faculty.washington.edu/jonno/index.html`

Sam Clark `http://www.samclark.net`

References

Zehang R Li, Yuan Hsiao, Jessica Godwin, Bryan D Martin, Jon Wakefield, and Samuel J Clark. Changes in the spatial distribution of the under five mortality rate: small-area analysis of 122 DHS surveys in 262 subregions of 35 countries in Africa. *PLoS One*, 2019. Published January 22, 2019.

J. Wakefield, G.-A. Fuglstad, A. Riebler, J. Godwin, K. Wilson, and S.J. Clark. Estimating under five mortality in space and time in a developing world context. *Statistical Methods in Medical Research*, 28:2614–2634, 2019.

Jon Wakefield. Prevalence mapping. In *Wiley StatsRef: Statistics Reference Online*. 2020.