

**IUSSP 2017: Two-Day Short Course**  
**Bayesian Population Projections: Theory and Practice**  
**Cape Town, October 28-29, 2017**

**Instructors:** Adrian Raftery and Hana Ševčíková (University of Washington)

The instructors are leaders of the research group that developed the methods to be taught in the course (<http://bayespop.csss.washington.edu>).

**Course description:** Population projections have until recently usually been done deterministically using the cohort component method, yielding a single value for each projected future population quantity of interest. Recently, the United Nation Population Division adopted a probabilistic approach to project fertility, mortality and population for all countries. In this approach, the total fertility rate and female and male life expectancy at birth are projected using Bayesian hierarchical models estimated via Markov Chain Monte Carlo. They are then combined with a cohort component model which yields probabilistic projection for any quantity of interest. The methodology is implemented in a suite of R packages which has been used by the UN analysts to produce the most recent revision of the World Population Prospects.

This course will teach the theory and practice behind the UN probabilistic projections. Ideas of the Bayesian hierarchical modeling for the two main components, fertility and mortality, will be explained. In hands-on exercises, students will become familiar with the functionality of the R packages. By the end of the course, they will have a basic understanding of the methods, be able to generate projections using their own data, and visualize probabilistic projections for many quantities of interest using various output formats, such as graphs, tables, maps, and pyramids.

The target audience for the course includes professional demographers in government, international agencies, universities and industry, as well as advanced students in relevant disciplines (demography, statistics, sociology, economics, anthropology, actuarial science, etc.).

**Organization:** We will alternate between lectures and computer labs. The computer labs give students the opportunity to put the theory into practice.

**Saturday, October 28:**

1. Introduction to Bayesian statistics and Markov chain Monte Carlo
2. Introduction to probabilistic population projections
3. Probabilistic projection of fertility
4. Computer lab: Projecting the total fertility rate using the `bayesTFR` R package

**Sunday, October 29:**

5. Probabilistic projection of life expectancy
6. Computer lab: Projecting life expectancy using the `bayesLife` R package
7. Probabilistic Population Projection
8. Computer lab: Generating and visualizing probabilistic population projections using the `bayesPop` R package.

**Course prerequisites:** Students are expected to be familiar with basic probability and statistics (at least at the level of linear regression), and to have a basic knowledge of the R programming language. Online tutorials for R are available at [cran.r-project.org](http://cran.r-project.org).

Students should bring a recent good laptop with R installed. They are encouraged to download, install and experiment with the `bayesTFR`, `bayesLife` and `bayesPop` R packages before the course at [cran.r-project.org](http://cran.r-project.org). A list of course readings will be provided.