STA4525H Demographic Methods: Course outline

Monica Alexander

Time and place:

- Fridays 2-5pm, starting 11 January for six weeks
- Room 581, Sidney Smith Hall (SSH581)

My contact details:

- monica.alexander@utoronto.ca
- Room 380, Sociology (725 Spadina, level 3)
- Room 6010, Statistics (100 St. George, level 6)

Course website:

https://github.com/MJAlexander/demographic-methods

1 Course Structure

This course introduces methods for demographic and population analysis. The goal of the course is to introduce graduate students to demography and illustrate how demographic methods could be used in their own work. Topics include population growth, mortality, fertility and migration.

This is a six-week course. The course will be structured as a combination of readings and examples. Each week, we will discuss topics, and work through example computer code which highlights the issues and the main concepts covered in the readings. Assessment will be through a short project applying the concepts to a dataset of the student's choosing. Students will give a short presentation on their projects in Week 6.

1.1 Course material

Lecture slides will give a summary of the material. Recommended readings are listed below under each week. Computer code and support material will also be provided.

1.2 Computing

A goal of this course is to familiarize students with using the statitsical language R to perform demographic and statistical analyses. You will need to download R and RStudio onto your computer:

- Download R here: https://www.r-project.org/
- Download RStudio (free version) here: https://www.rstudio.com/products/rstudio/download/

1.3 Textbooks and readings

A lot of the reaadings will come from:

- Preston, Heuveline and Guillot (2001): 'Demography: Measuring and Modeling Population Processes' (PHG)
- Wachter (2014): 'Essential demographic methods' (EDM)

2 Course outline

2.1 Week 1: Introduction

- What is demography and why does it matter?
- Demographic identity and other basic measures
- Models without age
- Age, periods, cohorts
- The demographic transition

Readings:

- PHG Chapters 1-2
- EDM Chapters 1-2
- Keyfitz, N. 1975. 'How Do We Know the Facts of Demography?' Population and Development Review. 1(2):267-288.
- Keyfitz, N. 1980. 'Population Appearances and Demographic Reality.' Population and Development Review 6(1):47-64.
- Lee, R. 2003. 'The Demographic Transition: Three Centuries of Fundamental Change.' Journal of Economic Perspectives 17(4):167-190.
- Malthus, T. 1798. 'An Essay on the Principle of Population'. Chapters 4-5
- Ryder, NB. 1964. 'Notes on the Concept of a Population.' American Journal of Sociology 69: 447-62.

2.2 Week 2: Mortality

- Life tables
- Multi-state life tables, cause-deleted life expectancy
- Mortality models: parametric, non-parametric, relational
- Hazard models
- Oldest-old mortality

Readings:

- PHG Chapters 3,4, 9.1, 11.1
- EDM Chapters 3,7,8
- Keyfitz, N. 1985. Applied mathematical demography. Second edition. Chapter 2.
- Barbi, E, Lagona, F, Marsili, M, Vaupel, J and Wachter, K. 2018. 'The plateau of human mortality: Demography of longevity pioneers', Science, 360: 1459-1461.
  - Critique: Newman, SJ. 2018. 'Plane inclinations: A critique of hypothesis and model choice in Barbi et al'. PLoS Biol 16(12): e3000048.
  - Ken's response: Wachter, K. 2018. 'Hypothetical errors and plateaus: A response to Newman'. PLoS Biol 16(12): e3000076.
- Graunt, J. 1662. 'Natural and Political Observations Mentioned in a Following Index, and Made Upon the Bills of Mortality' in Smith, D and Keyfitz, N. 'Mathematical Demography'. Chapter 2.
- Lee, RD, and Carter, LR. 1992. 'Modeling and Forecasting US Mortality.' Journal of the American Statistical Association 87 (419). Taylor & Francis: 659-71.
- Oeppen, J, and Vaupel, JW. 2002. 'Broken limits to life expectancy.' Science 296.5570: 1029-1031.

2.3 Week 3: Fertility

- Basic indicators
- Parity
- Mean age at childbearing
- Fertility models
- Tempo and quantum

Readings:

- PHG Chapters 5, 9.3
- EDM Chapters 4, 6
- Alkema, L, Raftery, A, Gerland, P and Clark, S 2011. 'Probabilistic Projections of the Total Fertility Rate for All Countries'. Demography. 48(3): 815-839.
- Bongaarts, J and Feeney, G. 1998. 'On the Quantum and Tempo of Fertility'. Population and Development Review, 24(2):271-291.
- Coale, A. and Trussel, J. 1974. 'Model Fertility Tables: Variations in the Age Structure of Childbearing in Human Populations' in Smith, D and Keyfitz, N. 'Mathematical Demography'. Chapter 30.
- Kohler, H and Philipov, D. 2001. 'Variance effects in the Bongaarts-Feeney Formula'. Demography. 38(1): 1-16.
- Schmertmann, C and Hauer, M. 2018. 'Bayesian estimation of total fertility from a population's age–sex structure'. Statistical Modelling 19(3): 1-23.

2.4 Week 4: Population projection and stable populations

- Leslie matricies
- Lotka's r
- Reproductive value
- Population momentum
- Generational waves
- Probabilistic projections

Readings:

- PHG Chapters 6,7
- EDM Chapters 5,10
- Keyfitz, N. 1985. Applied mathematical demography. Second edition. Chapter 6.
- Bernadelli, H. 1941. 'Population Waves' in Smith, D and Keyfitz, N. 'Mathematical Demography'. Chapter 23.
- Goodkind, D. 2017. 'The Astonishing Population Averted by China's Birth Restrictions: Estimates, Nightmares and Reprogrammed Ambitions'. 54:1375-1400.
  - Lots of responses, e.g.: Zhao, Z and Zhang, G. 2018. 'Socioeconomic Factors Have Been the Major Driving Force of China's Fertility Changes Since the Mid-1990s'. Demography. 55: 733-742.

2.5 Week 5: Migration amd misc topics

- Incorporating migration into Leslie Matrix
- Migration models (parametric, gravity)
- Kinship
- Bayesian demography

Readings:

- PHG Chapter 9.4
- EDM Chapter 11
- Raftery, A, Alkema, L and Clark, S. 2014. 'Bayesian Population Projections for the United Nations', Statistical Science. 29(1):58-68.
- Goodman, L, Keyfitz, N and Pullum, T. 1974 'Family Formation and the Frequency of Various Kin Relationships'. Theoretical Population Biology. 5: 1-27.
- Zagheni, E, Weber, I and Gummadi K. 2017. 'Leveraging Facebook's Advertising Platform to Monitor Stocks of Migrants'. Population and Development Review. 43(4): 721-734.

2.6 Week 6: wrap-up, project presentations

The future?

- APC models
- Estimating the probability of events without denominators
- Generative models