Objectives

This course is the second in a two-course sequence. In Basic Demographic Methods, you learned the fundamental demographic accounting formula, the measurement of vital rates that comprise it, basic methods for calculating growth rates, and methods for decomposing rates and standardizing them for cross-population comparisons. In addition, you learned the application of basic life table methods. This course focuses almost exclusively on one component of population change: mortality. Whereas the approach to generating life tables that you learned in the previous course was a mechanical method for constructing them for a single population using age-specific mortality rates measured in discrete time intervals, in this course we will focus on the underlying theory of the life table, which involves continuous-time concepts that rely on calculus. Thus, we will begin the course with an extensive review of the basic relevant concepts and formulas from calculus. We will then turn to defining three related functions—the hazard function, the survivor function, and the probability density function for times-to-events—and spend some time discussing their interrelationship and their relationships with life table functions. Next, we will build regression models from these functions, including hazard regression models, accelerated failure time models, and others, with close attention paid to unobserved heterogeneity. We will then discuss how single decrement life tables for very specific subpopulations can be produced using hazard regression models, and we will extend these methods to multiple decrement and multistate life table methods. Finally, we will discuss stable (and stationary) population theory.

Format and Requirements

Class will follow both a lecture and a lab format. Demographic and statistical theory will be covered via lecture. However, application will be a key focus of the course. We will use software in class, including MS Excel, R, and Stata. Attendance at, and participation in, all classes is expected.

Grades will be determined by a midterm exam (20%) and a series of homework assignments of varying point values (80%). Each item will be graded on a 5 point ordinal scale, roughly corresponding to a typical A-F grade: 4=Excellent (A+), 3=Very Good (A), 2=Good (B), 1=Fair (C), 0=Poor (D/F). Your final grade will be computed as a rounded weighted average of the midterm and the homework.
Readings

There are two books for the course (see below). In addition, relevant contemporary and classic articles will be assigned during the course (TBA). You should read the material before the day listed on the schedule and be ready to discuss it.


Course Schedule (Tentative; some items may change)

**Week 1 (Jan 13) P1-2**
- Calculus, calculus, calculus
- Review of exponentials and growth
- R-programming

**Week 2 (Jan 25) H1-2**
- Hazard function, survivorship function, and time-to-event distributions
- Censoring
- Kaplan-Meier method
- Maximum likelihood estimation

**Week 3 (Feb 1) P3**
- Review of single decrement life table
- In-depth discussion of life table functions
- Constructing life tables in R

**Week 4 (Feb 8) Readings TBA**
- Discrete time logit modeling
- Generating life tables from logit models

**Week 5 (Feb 15) H8, skim H3-7**
- Parametric hazard models
- Cox Regression

**Week 6 (Feb 22)**
- continued
- Review for exam
Week 7 (Feb 29)
- Midterm exam

Week 8 (Mar 7) H9
- Unobserved heterogeneity
- Frailty modeling

Week 9 (Mar 21) P4
- Multiple decrement life tables
- Cause eliminated life tables
- Competing risk models
- Regression modeling for multiple decrement tables

Week 10 (Mar 28) P12
- Multistate life tables
- Regression models for multistate life tables
- Sullivan’s method

Week 11 (Apr 4)
- continued

Week 12 (Apr 11) P9
- Macro level mortality models
- Mortality crossovers
- Mortality compression
- Mortality deceleration

Week 13 (Apr 18) P11
- Indirect estimation methods