BIO244: Analysis of Failure Time Data

Spring, 2024

Course Introduction

- Instructors:
  - LJ Wei: Office: HSPH, Bldg 2, Room 445; Email: wei@hsph.harvard.edu
  - TA: Stephanie Armbruster; Email: sarmbruster@g.harvard.edu

- Lectures:
  - **Mondays** and **Wednesdays**, **9:45 am to 11:15 am**, Room 205
- Labs and Office hours: to be determined together
- Evaluations

Aim of Course

- Introducing statistical methods and associated theory for the analysis of censored failure time data.
- The primary focus will be on right-censored failure time data
- Some consideration will be given to other forms of incomplete observations and to competing risks, recurrent events data, and multivariate failure time data.
- Counting process/martingale methods will be introduced to study large-sample properties of estimators and tests.
- Examples and data sets will be used for illustration

Lecture topics

1. Preliminaries
   - Introduction to survival analysis
   - Survival distributions, hazard functions, cumulative hazard functions
   - Common survival distributions
   - Censoring
   - Likelihood construction with censored data
   - Parametric model and likelihood inference

2. Classical methods
   - One-sample problem, Kaplan-Meier estimate
   - Two-sample problem, logrank test, weighted logrank
   - Cox's proportional hazards model

3. Tools for theoretical justifications
   - Stochastic processes
   - Counting processes
   - Stochastic integrals
   - Martingales and martingale central limit theorem

4. Application of martingales theory to classical methods
   - One-sample problem: Asymptotic theory
   - Two-sample problem: Asymptotic theory
   - Cox's proportional hazards model: Asymptotic theory
   - Resampling methods
   - Model checking methods

5 Other regression models

- Accelerated failure time (AFT) model
- Linear transformation model
- Median and restricted mean survival regression
- Median regression

6 Some other topics

- Recurrent event data
- Competing risk problem
- Multivariate failure time data
- Prediction models with censored survival data
- Restricted mean survival time

Source of information

- Main source
  - Course Notes

- Some other references:
  - *Counting Processes and Survival Analysis, by TR Fleming and DP Harrington, 1991, Wiley*
  - *Statistical Models Based on Counting Processes, by PK Andersen, O Borgan, RD Gill, and N. Keiding, 1993, Springer-Verlag*
  - *The Statistical Analysis of Failure Time Data (2nd Edition), by JD Kalbfleisch and RL Prentice, 2002, Wiley*
  - *Analysis of Survival Data, by DR Cox and D Oakes, 1984, Chapman & Hall/CRC*

- *Survival Analysis, by JP Klein and ML Moeschberger, 1997, Springer Verlag*
- *Selected Papers from Statistical Journals*