**Lecture twenty-four: Overview of survival data analysis PQHS 435**

Comments about HW#10: Event time ratio (ETR) vs. acceleration factor in AFT model.

1. **General Assumptions:**
   1. **Observations (times) are independent**

**-** No: Multivariate survival times. See chapters 10 and 13 of the textbook, and see also chapters 8, 9, of Terry Therneau’s book.

* 1. **Non-informative censoring**
     + Left truncation/right truncation (Channing house: an individual must survive to a sufficient age to enter the retirement community).
     + Interval censoring (chapter 9) – special case: current status data
     + No: Chapter 14 (brief); Drop out and compliance – Foreword by Bradley Efron, 1998 vol. 17, 249-250, stat in medicine

Survival data structure; S(t), h(t), H(t) and their relationship

1. **Non-parametric approach**
   * + - Life-table
       - KM estimate
     + Derivation: Conditional probability vs. NPMLE (Kalbfleisch & Prentice, p17)
     + Greenwood’s formula
     + Tests: log-rank, Wilcoxon, the family of weighted log-rank statistics, trend test, stratified tests
       - Nelson-Aalen estimate

In general**, ,** Both are asymptotically unbiased**.**

Delta-method:

1. **Parametric approach**
   * + - Proportional hazard models: Weibull and Gompertz
       - AFT: exponential, Weibull, Gamma, log-logistic, log-normal
       - Proportional odds model

Specifics:

* + - Weibull PH vs. Weibull AFT; log-logistic AFT vs. log-logistic proportional odds
    - Parameterizations: the relationship between two sets of parameters
    - Interpretation: hazard ratio, acceleration factor, odds ratio

1. **Semi-parametric approach**

**Extended Cox models:**

* + - * Multivariate (correlated) survival times: in the frame work of Cox model
        + Marginal (Similar to GEE, chapter 13)
    - WLW (Wei, Lin, Weisfeld) – multiple (types of) events: JASA 1989
    - AG (Anderson and Gill) – recurrent event data: Annals of Statistics 1982
    - PWP (Prentice/Williams/Peterson) - recurrent events: Biometrika, 1981
      * + Frailty (similar to Mixed models, chapter 10)

(See also *Analysis of Multivariate Survival Data* by P. Hougaard, Spring, 2000)

Gama, (inverse) Gaussian, positive stable, etc

* + - * PH

Model checking specifics:

* + - Check (test) PH assumption
    - Determine the functional form
    - Influential observations
      * Non-PH
        + Time-dependent covariate
        + Piece-wise Cox model
        + Varying coefficient model
        + Stratification
      * Left-truncation (right censoring) data

1. **Software**
   * + - * SAS: Procedures: lifetest, lifereg, phreg.
         * R packages for survival analysis: survival, survminer, WeibullReg, etc.

See also Chapter 17: Survival Analysis with R

* + - * + Splus: Functions: survdiff(), survfit(), survreg() (censorReg()), coxph(),

cox.zph().

1. **Multistate models:** section 13.4; A review paper: stat methods in medical research, 2002, 11 91-115.
2. **Aalen’s additive regression model** (Splus: aareg())
3. **Competing risk:** Chapter 12 (R: cmprsk package; SAS PROC LIFETEST, PROC PHREG).
4. **Transformation survival models:** Biometrika, 2002, vol. 89: 659-668; JASA, 1997, 968-976; Biometrika, 2005, vol. 92: 619–632.