STAT 6390: Analysis of Survival Data

Textbook coverage: Chapter 3

Steven Chiou

Department of Mathematical Sciences,
University of Texas at Dallas

Cox proportional hazards model

- The Cox model is expressed by the hazard function.
- The hazard function can be (loosely) interpreted as the risk of dying at time t.
- The Cox model has the form:

$$h(t) = h_0(t) \cdot \exp\{\beta_1 x_1 + \beta_2 x_2 + \ldots \beta_p x_p\},$$

where

- t is the survival time.
- $\{x_1, \ldots, x_p\}$ is a set of p covariates.
- $\{\beta_1, \ldots, \beta_p\}$ is the regression parameters; effect of covariates.
- $h_0(t)$ is the baseline hazard. It is the value of the hazard when all x's are 0.
- No need to specify an "intercept" term as it gets absorb to $h_0(t)$.

Cox proportional hazards model

- The quantity e^{β_i} is interpreted as the hazard ratio (HR).
  - $\beta_i > 0 \rightarrow$ HR $> 1 \rightarrow$ hazard increases $\rightarrow$ survival time decreases.
  - $\beta_i = 0 \rightarrow$ HR $= 1 \rightarrow$ no change in hazard $\rightarrow$ no change in survival time.
  - $\beta_i < 0 \rightarrow$ HR $< 1 \rightarrow$ hazard decreases $\rightarrow$ survival time increases.
- HR (and hazard) is negatively associated with the length of survival.
- The Cox model assumes the hazard curves among different patients should be proportional and cannot cross.

Fitting Cox model in R