10-Minute In-Class Quiz 2: Survival Analysis (Chapters 4–7)

Instructions

- You have **10 minutes** to complete this quiz.
- Answer all questions *concisely*.
- Show all relevant calculations where applicable.

Question 1 (5 points) – Left-Truncated Data

The table below presents left-truncated survival data for **6 individuals** in a study.

Entry Time T_L	Event/Censoring Time X	Event Indicator δ (1: event; 0: censoring)
0	2.2	1
1.5	3.8	0
1.8	4.1	1
3.0	6.3	0
3.5	7.0	1
5.0	8.0	1

- Compute the Kaplan-Meier estimator $\widehat{S}(t)$ at times $t = 2, 4, 6.5$, and 8. (Expressions are sufficient; no need to compute numerical values.)

Question 2 (5 points) – Time-Varying Treatment Effect in Cox Model

Consider a Cox proportional hazards model:

$$\lambda(t \mid Z) = \lambda_0(t) \exp(\beta Z), \tag{1}$$

where Z is a binary treatment indicator ($Z = 1$ for treatment, $Z = 0$ for control).

Now suppose the log-hazard ratio is not constant over time, but follows a **quadratic function**:

$$\mathrm{HR}(t) = \frac{\lambda(t \mid Z = 1)}{\lambda(t \mid Z = 0)} = \gamma_0 + \gamma_1 t + \gamma_2 t^2.$$

- To specify the above form of $\mathrm{HR}(t)$, add time-varying covariates in model (1) that are interactions between Z and certain functions of time.