Homework 4

Tianjian Shi

Due date: Tuesday, December 4

1. **Survival of root canal filled teeth** Deep caries or restorations in teeth could lead to pulpal involvement, necessitating root canal therapy or extraction. In a retrospective dental study, the primary interest is to assess the impact of pulpal involvement on tooth survival. In this data analysis, a Cox model is fitted using the survival time of the teeth as the response variable. The covariates included in the model are

$$\text{MOLAR} = \begin{cases} 1 & \text{molar tooth} \\ 0 & \text{otherwise,} \end{cases} \quad \text{ROOT} = \begin{cases} 1 & \text{root canal treatment applied} \\ 0 & \text{otherwise,} \end{cases}$$

and three mutually exclusive categories of proximal contacts

$$\text{PC1} = \begin{cases} 1 & \text{nonbridge abutment with one proximal contacts} \\ 0 & \text{otherwise,} \end{cases}$$

$$\text{PC2} = \begin{cases} 1 & \text{nonbridge abutment with two proximal contacts} \\ 0 & \text{otherwise,} \end{cases}$$

$$\text{PCABUT} = \begin{cases} 1 & \text{bridge abutment} \\ 0 & \text{otherwise,} \end{cases}$$

and the number of pockets larger than 5 mm (POCKET). Use the attached the `coxph` output to answer the following questions:

a. (2 points) Suppose the log-partial likelihood for the model is -581.4417, what is the log-partial likelihood for the reduced model with no covariates?

$$G = 2\{l_p(\hat{\beta}) - l_p(0)\}$$
$$97.66 = 2(-581.4417 - l_p(0))$$
$$l_p(0) = -630.2717$$

b. (2 points) What is the hazard ratio that compares teeth with bridge adutment with those without?

$$HR(PCABUT = 1, PCABUT = 0) = exp(\beta_{PCABUT}) = 0.5941$$

c. (2 points) What is the 95% confidence interval for the hazard ratio in #2?

$$\beta_{PCABUT} = -0.5207, se(\beta_{PCABUT}) = 0.5114$$
$$\beta_{PCABUT} \in [-0.5207 - 1.96 * 0.5114, -0.5207 + 1.96 * 0.5114] = [-1.523044, 0.481644]$$
$$exp(\beta_{PCABUT}) \in [exp(-1.523044), exp(0.481644)] = [0.218047, 1.618733]$$

d. (2 points) What is the hazard ratio that compares teeth with nonbridge abutment and one proximal contacts with those with nonbridge abutment and two proximal contacts?

$$HR(PC1, PC2) = exp(\beta_{PC1} - \beta_{PC2}) = exp(-0.7587 - (-1.5423)) = 2.18934$$

e. (2 points) What is the hazard ratio that compares molar teeth with non-molar teeth **among those underwent root canal treatment**?

$$HR(MOLAR = 1, MOLAR = 0 | ROOT = 1) = exp(\beta_{MOLAR} + \beta_{MOLAR:ROOT})$$
$$= exp(-0.8440 + 0.6645) = 0.8357$$