Homework 4

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Problem 1

(a)

Proportional Hazards Model: $h(t|Z) = h_0(t)exp(Z^{'}\hat{\beta})$,

where $Z^{'}\hat{\beta}$ is a linear combination of predictors. In our case, $\hat{\beta}$ is a vector of length one, a single model estimate that governs estimated differences between groups.

So, the full expression for the model is: $h(t|Z) = h_0(t)exp(\hat{\beta} * I(Group\ 2))$, thus $Group\ 1$ is a reference level.

(b)

We create a dummy variable to conduct regression analysis, set indicator to 0 when an individual is in an 'Untreated' group, and 1 when in 'Radiated' group

To write down the partial likelihood for the model, we need to specify the hazard function for the survival times. For Cox proportional hazards model we assume that the hazard function for each group is proportional to the hazard function for the other group, with a constant hazard ratio over the entire observed timeline.

Generally, partial likelihood for the Cox model is given by:

$$L = \prod_{i=1}^{N} h_0(T_i)^{\delta_i} * [exp(\beta^{'} X_i)]^{\delta_i} * exp(-H_0(T_i)\ exp(\beta^{'} X_i))$$

where:

1. N is the sample size,
2. β is the log hazard ratio for the radiated group compared to the untreated group

3. X_i is the value of the dummy variable for the ith individual (i.e., 0 for untreated, 1 for radiated)
4. T_i is the observed survival time for the ith individual,
5. δ_i is an indicator variable that takes the value 1 if the survival time is uncensored

(c)

(d)

Problem 2

(a)

To perform the score test to test the hypothesis of no effect of ploidy on survival, we will use CoxPH, and a χ^2 distribution to hypothesis testing.

To use Breslow method of handling ties we will use log-rank test

```
fit <- coxph(Surv(time, delta) ~ type, data = tongue)

# Score test
sum <- summary(fit)
score_test <-sum$sctest[1]
p_value_score <- 1 - pchisq(score_test, 1)

#breslow
breslow_test <- survdiff(Surv(time, delta) ~ type, data = tongue, rho = 0)
p_value_breslow <- 1 - pchisq(breslow_test$chisq, 1)
```

Score Test

1. Null hypothesis: no difference in survival rates between the two groups
2. Alternative hypothesis: some difference between survival rates for two groups
3. Test statistic: 2.81, p-value: 0.0934
4. Conclusion: there is some suggestive, but weak evidence that the survival rates for the two groups can be different. However, due to lack of strong evidence we do not reject the null hypothesis

Breslow Test

1. Null hypothesis: no difference in survival rates between the two groups

2. Alternative hypothesis: some difference between survival rates for two groups
3. Test statistic: 2.79, p-value: 0.0949
4. Conclusion: there is some suggestive, but weak evidence that the survival rates for the two groups can be different. However, due to lack of strong evidence we do not reject the null hypothesis

Conclusion

Both tests provide similar results, p-values are very close to each other, which gives us more confidence in obtained results.

(b)

(c)

(d)

(e)

Problem 3

(a)

(b)

(c)

(d)

(e)

(g)