26 BE 7023 & 26 PH 7023: Advanced Biostatistics

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Homework Sheet No. 7 Due Date: November 8, 2018 Maximum points: 30

All questions carry one point except the last one, which carries six points.

On Multinomial Logistic Regression and Proportional Odds Model

Subarachnoid hemorrhage (SAH) refers to bleeding within the subarachnoid space, which is the area between the brain and the tissues that cover the brain.

The subarachnoid space is the space where the cerebrospinal fluid circulates, and it is responsible for protecting your brain from serious injuries by serving as a cushion. A hemorrhage in this space can cause coma, paralysis, and even death.

This condition requires immediate medical attention. A surgery is done right away to stop hemorrhage. Medication is prescribed to bring the patient back to normalcy. A team of medical doctors specializing in this medical condition want to experiment a particular medication on patients who have undergone surgery. The main goal is to examine effects of the new medication. A clinical trial is conducted focusing on four different levels of medication. A total of 802 patients was recruited into the trial. The patients were randomized into four groups: Placebo (210); Low dose (190); Medium dose (207); High dose (195). The patients were monitored over a year. The treatment regimen is also ordinal. The consequences of each treatment regimen are tabulated below.

Number of patients by treatment group and outcomes

Treatment Outcomes

Group Death Vegetative Major Minor Good

State Disability Disability Recovery

Placebo 59 25 46 48 32

Low dose 48 21 44 47 30

Medium 44 14 54 64 31

High dose 43 4 49 58 41

Here the response variable is ‘Outcome,’ which is categorical. The outcome can be viewed as ordinal with Death < Vegetative < Major Disability < Minor Disability < Good Recovery in increasing order of good outcomes. There is only one covariate, Treatment. This variable can be viewed as categorical with four levels or numerically codified as 1 = Placebo, 2 = Low dose, 3 = Medium dose, and 4 = High dose.

1. Postulate a multinomial logistic regression model by treating the covariate as numerical.
2. Count the number of parameters in the model.
3. Fit the model to the data. Write the prediction model.
4. Check the adequacy of the model.
5. Compare the observed and predicted probabilities and frequencies.
6. Obtain bar plots of predicted probabilities in two different ways.
7. Postulate a multinomial logistic regression model by treating the covariate as categorical.
8. Count the number of parameters in the model.
9. Fit the model to the data. Write the prediction model.
10. Check the adequacy of the model.
11. Compare the observed and predicted probabilities and frequencies.
12. Obtain bar plots of predicted probabilities in two different ways.
13. Postulate a proportional odds model by treating the covariate as numerical.
14. Count the number of parameters in the model.
15. Fit the model to the data. Write the prediction model.
16. Check the adequacy of the model.
17. Compare the observed and predicted probabilities and frequencies.
18. Obtain bar plots of predicted probabilities in two different ways.
19. Postulate a proportional odds model by treating the covariate as categorical.
20. Count the number of parameters in the model.
21. Fit the model to the data. Write the prediction model.
22. Check the adequacy of the model.
23. Compare the observed and predicted probabilities and frequencies.
24. Obtain bar plots of predicted probabilities in two different ways.
25. Compare and contrast the four models. Which of the four models would you propose as summary of the data? Why? Which treatment regimen would you recommend? Why?