MTH6134 2023 Sample Quiz 1

(1) Beetles

EMBEDDED ANSWERS | penalty 0.10

Consider the beetles' data as seen in the lab and fit a generalized linear model using the complementary log-log link $\eta_i = \log(-\log(1-\pi_i))$ and the binomial distribution in the `R` function `glm`. Examine the output and do calculations before replying to the questions below.

A) What is the value of $\hat{\beta}_0$?

NUMERICAL | marked out of 1

-39.5723092 ± 5e-1 ✓	

B) Write the standard error of the estimate $\hat{\beta}_0$.

NUMERICAL | marked out of 1

3.2402899 ± 5e-1 ✓	

C) Consider testing $H_0 : \beta_0 = 0$ against $H_1 : \beta_0 \neq 0$. Using the code output and the usual $\alpha = 0.05$, select the correct item below.

MULTIPLE CHOICE | marked out of 1 | One answer only | Shuffle

Reject the null hypothesis. ✓	
Do not reject the null hypothesis.	
The test is not conclusive, we need more data.	
None of the other conclusions.	

D) Write $\hat{\pi}_3$, the predicted probability for the third observation, that is the predicted fatality for data $(y_3, r_3, x_3) = (18, 62, 0.2903)$.

NUMERICAL | marked out of 1

0.33797 ± 5e-2 (0%)	

E) Write the log-likelihood for the null model, i.e. for the model with all fatality probabilities equal.

NUMERICAL | marked out of 1

-155.2002438 ± 5e-1 (0%)	

F) How many parameters are associated with the null model.

NUMERICAL marked out of 1

$1 \pm$ 1e-2 (0%)	

G) Write the residual deviance for your analysis.

NUMERICAL marked out of 1

$3.4464 \pm$ 5e-2 (0%)	

H) Write the degrees of freedom associated with the residual deviance.

NUMERICAL marked out of 1

$6 \pm$ 5e-2 (0%)	

I) For which comparison (i.e. test) do we use the residual deviance for?

MULTIPLE CHOICE marked out of 1 One answer only Shuffle

The glm fit against the maximal model. ✓	
The null model against the glm fit.	
The null model against the maximal model.	
To compare all three: null, glm and maximal models.	
None of the stated comparisons.	

(2) **Poisson**

EMBEDDED ANSWERS penalty 0.10

Consider data `5, 1, 3, 5, 5, 4, 3, 2` which are assumed to be independent realizations of the Poisson distribution with expectation μ. We want to test $H_0 : \mu = \mu_0$ with $\mu_0 = 2$.

A) Write the log-likelihood for the data under H_0.

NUMERICAL marked out of 1

-18.4091 $\pm$ 5e-2 (0%)	

B) Write the likelihood ratio $\Lambda(y)$ for testing H_0.

NUMERICAL marked out of 1

$0.0255 \pm$ 5e-2 (0%)	

C) Use Wilks' theorem to approximate the distribution of $-2 \log \Lambda(y)$ and write the pvalue for testing H_0.

NUMERICAL marked out of 1

$0.0067 \pm$ 5e-1 (0%)	

D) Using the pvalue you obtained and the usual $\alpha = 0.05$, select from below as conclusion from your analysis.

MULTIPLE CHOICE marked out of 1 One answer only Shuffle

Reject the null hypothesis. ✓	
Do not reject the null hypothesis.	
The test is not conclusive, we need more data.	
None of the other conclusions.	

Total of marks: 13