

MTH6134 2023 Sample Quiz 1

(1) **Beetles** EMBEDDED ANSWERS

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

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

NUMERICAL

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

The test is not conclusive, we need more data.

Do not reject the null hypothesis.

None of the other conclusions.

Reject the null hypothesis.

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

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

NUMERICAL

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

NUMERICAL

G) Write the residual deviance for your analysis.

NUMERICAL

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

NUMERICAL

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

MULTIPLE CHOICE

The null model against the glm fit.

The null model against the maximal model.

None of the stated comparisons.

The glm fit against the maximal model.

To compare all three: null, glm and maximal models.

(2) **Poisson** EMBEDDED ANSWERS

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

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

NUMERICAL

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

NUMERICAL

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

MULTIPLE CHOICE

Do not reject the null hypothesis.

None of the other conclusions.

The test is not conclusive, we need more data.

Reject the null hypothesis.

Total of marks: 13