MTH6134 Sample qmplus quiz exam 2022-2023

Question **1**

Not yet answered

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An experiment was conducted on the yield y of a chemical process, depending on the addition of catalyst x used. Three levels of catalyst x were considered in the experiment, which were coded as $-1, 0, 1$. There were $n = 12$ experiments carried out, and the yield values y measured for when $x = -1$ were 64.6, 63.2, 64.6; while for $x = 0$ were 68.4, 69.9, 72.2, 68.1, 69.9 and for $x = 1$ were 76.8, 75.2, 76.7, 78.1.

You are required to analyze the data using a generalized linear model with a normal distribution and the identity link. Run the R command `glm` and examine the output before answering the questions in the textbox below:

1. Write the estimated coefficient of catalyst.
2. Write the residual deviance.
3. Compute the pvalue of the residual deviance.
4. Consider the test that H_0 that data supports the regression model against the hypothesis H_1 that data backs the maximal model. Using your results, perform the test and write your conclusions. Use $\alpha = 0.05$.

Question **2**

Not yet answered

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A study was carried out in $n = 6$ small apple orchards. The $i-th$ orchard has r_i trees which were all given a dose of additive x_i. After one month, y_i, the number of trees that did not have certain fungus was recorded. The following is the data per orchard, presented in the format (r_i, y_i, x_i): (20,13,-1), (45,26,-0.6), (25,12,-0.2), (25,12,0.2), (30,11,0.6), (45,11,1). In this problem, the values of doses of additive are coded, hence the negative x_i values.

The following are outputs from the analysis of these data after fitting a glm model with logit link and binomial distribution.

$\hat{\beta}_0 = -0.1588, \hat{\beta}_1 = -0.8267$

The null deviance was 15.3814 on 5 degrees of freedom.

The residual deviance was 0.6882 on 4 degrees of freedom.

AIC: 27.4617

Examine the information given and do computations before answering the questions below.

A) We use the null deviance to test

B) Compute the p-value for comparing (i.e. testing) the model with common probability (null hypothesis) against the maximal model (alternative hypoyhesis).

C) For the hypothesis described in B), use the p-value you computed also in B) and $\alpha = 0.05$ to select the correct statement below.

D) Compute the log-likelihood of the maximal model. Hint: Use the R function `dbinom` and estimate the probability using the observed proportion of trees with no fungi in each orchard.

E) Compute the predicted proportion of trees without fungus when the dose of additive is $x = -1$:

Question **3**

Not yet answered

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Patients were classified according to the clinic they were treated. The contingency table below shows the number of patients (y) that were treated at each clinic and whether they survived.

	Survived	Died
Clinic A	89	14
Clinic B	66	8
Clinic C	91	6

The null hypothesis is that survival is independent of the clinic attended.

Analyze the data to answer the questions below.

A) What is the deviance value to test the alternative hypothesis that the chances of survival depend on the clinic?

B) What are the degrees of freedom for the deviance above?

C) What is the limit of the critical region for the deviance above for a significance level of 0.05?

D) Which statement is correct?

Question **4**

Not yet answered

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The following data are number of months in service of air conditioning units in airplanes before the units develop a fault. In below, the symbol "+" represents a censored observation, that is, the corresponding unit is still working at the time of data collection:

$$1+, 1, 1, 1, 2, 2, 4, 4, 5, 12.$$

Assume that survival times are exponentially distributed $S(t) = e^{-\mu t}$.

A) Compute $\sum_{i=1}^{n} \delta_i$.

B) Compute $\sum_{i=1}^{n} t_i$.

C) Estimate μ by maximum likelihood.

Question **5**

Not yet answered

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The link $g(\mu_i) = \tan(\pi(\mu_i - 1/2))$ is known as the Cauchy link. This link works best (select only one from below)

Select one:

- a. with normal data as it transforms real inputs into the whole real line.
- b. with Poisson data as it transforms positive inputs into the whole real line.
- c. with binomial data as it transforms proportions into the whole real line.

Question **6**

Not yet answered

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Recall the general linear model given by

$$Y = X\beta + \epsilon,$$

where $Y = (Y_1, \ldots, Y_n)^\top$ is the vector of responses, X is the $n \times p$ design matrix, $\beta = (\beta_0, \ldots, \beta_{p-1})^\top$ is the parameter vector and $\epsilon = (\epsilon_1, \ldots, \epsilon_n)^\top$ is the error vector. Say that you have 145 observations and you want to write the simple linear model

$$y = \beta_0 + \beta_1 x + \epsilon$$

in matrix form. How many rows does X have? [ ]

What is the value of the first element of X (ie $X_{(1,1)}$)? [ ]

Question **7**

Not yet answered

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Match the following concepts.

$\mu_i = \beta_0 + \beta_1 x_i$	Choose...
$\log\left(\frac{\pi_i}{1-\pi_i}\right) = \beta_0 + \beta_1 x_i$	Choose...
$\mu_i = \beta_0 + \beta_1^2 x_i$	Choose...
$\log(\mu_i) = \beta_0 + \beta_1 x_i$	Choose...

Question **8**

Not yet answered

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Suppose that $T \sim \text{Exp}(3)$.

Select one:

- a. The survivor function is $S(t) = e^{-3t}$.
- b. The hazard function is a constant.
- c. All of the above.
- d. None of the above.
- e. The hazard function is 3.

MTH6134 Notes and some solutions for Sample qmplus quiz exam

Q1 (1) the estimated is coefficient of catalyst 6.326506; (2) the residual deviance is 17.5918072, with (3) pvalue 0.0622522255; (4) concerning the hypothesis, we do not reject H_0.

Q2 (A) We use the null deviance to test "the model with common p (null hypothesis) against the maximal model (alternative hypothesis)"; (B) the pvalue is 0.0088511400; (C) "We reject the model with common probability"; (D) the log-likelihood is -11.3867464; (E) Predicted proportion of trees is 0.6610346.

Q3 (A) Deviance is 3.1718123; (B) Degrees of freedom are 2; (C) limit of critical region is 5.9914645; (D) Statement is "We cannot reject the null hypothesis that the chances of survival are independent on the clinic".

Q4 (A) sum of δ_i is 9; (B) sum of t_i equals 33; (C) the estimate is 0.272727.

Q7 Items for matching (note that items are **not** in the correct order).

is an example of logistic regression model.

is an example of Poisson regression model.

is an example of linear regression model.

is not an example of a generalised linear model.