

BIOS 622 Homework 3

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Please answer each question precisely and completely. It is permissible to discuss each other, but all of your work must be your own.

1. The time in days to development of a tumor for rats exposed to a carcinogen follows a Weibull distribution with $\lambda = 0.002$ (scale parameter) and $\gamma = 2$ (shape parameter).
 - (a) Find the median and mean time to tumor development.
 - (b) Find the probabilities that a (random) rat will be tumor free at 10 days, 20 days and 30 days.
 - (c) Find the hazard rate of time to tumor development at 10 days, 20 days and 30 days.
2. A modification of example from the course notes (Page 60). T_1, \dots, T_n iid exponential(λ). The outcome is time to death from severe viral disease. The modified data are as follows:
 - Steroid: 1(2), 1+(2), 4+, 5, 7, 8, 10, 10+, 12+, 16+(3)
 - Control: 1, 2, 3(2), 3+, 5+(2), 16+(8)
 - (a) Find the MLE of hazard $h(t) = \lambda$ for each of two treatment groups
 - (b) Find median and mean survival time for each treatment group
 - (c) For each treatment group, what is the p-value for $H_0 : \lambda = 1$ versus $H_1 : \lambda \neq 1$, using likelihood ratio test and Wald test? Hint: you may find a p-value from chi-square score or zscore (after taking square of root) in R using `2*(1-pnorm(zscore))`, for example.
 - (d) For each treatment group, what is the p-value for $H_0 : \lambda = 0.05$ versus $H_1 : \lambda \neq 0.05$, using likelihood ratio test and Wald test?
 - (e) Construct 95% Wald confidence interval on λ for each group, is there overlap between these two 95% confidence intervals?
 - (f) What is the hazard ratio (HR) and its 95%CI between two treatment groups? Hint: you may find 95%CI for log (HR) first (similar to page 66 in the course notes).