Stats 500 Homework 3

Online Submission to Canvas, Due date: 11:59pm, September 26, 2025

1. Using the dataset `gala` discussed in Chapter 2, consider a regression model with "Endemics" as the response and "Area", "Elevation", "Nearest", "Scruz", "Adjacent" as predictors.

   (a) For the regression model above, what is the t-test results (i.e. test statistic value, p-value, and your conclusion) for testing H_0: $\beta_{Nearest} = 0$ with $\alpha = 0.05$. Find 95% confidence intervals for $\beta_{Nearest}$.

   (b) For $\alpha = 0.05$, conduct a test for H_0: $\beta_{Nearest} = \beta_{Scruz} = 0$. What would be the p-value for this test? Based on your analysis, do you feel any of these two predictors have an effect on the response? Without drawing the 95% simultaneous confidence region for $(\beta_{Nearest}, \beta_{Scruz})$, please make a guess whether $(0, 0)$ would be inside this confidence region or not. Briefly explain your answer.

   (c) What would be the H_0 and H_A if you wish to claim that an island with a large highest elevation level tends to have more endemic species. Is this a one-sided or two-sided test? What would be the corresponding t-test statistic, p-value and conclusion for your test if α-level is 0.01?

2. Use the `sat` data (see `help(sat)` for the description of variables).

   (a) Fit a model with `total` sat score as the response and `takers, ratio` and `salary` as predictors. Comment on the goodness of fit.

   (b) Using the R output from (a), test the hypothesis that the variable `ratio` (average pupil/teacher ratio) has an effect on the SAT scores. Specify H_0 and H_A, the test statistic value, p-value, and your conclusion.

   (c) For the model in (a), what would be the H_0 and H_A if you wish to claim that a higher value of `ratio` tends to lead to a lower sat score. What would be the numerical value of the test statistic, p-value and conclusion for your test?

   (d) For the model in (a), test the hypothesis $\beta_{takers} = \beta_{ratio} = \beta_{salary} = 0$. Explain in words what this hypothesis means. Specify the test statistic value, p-value, and your conclusion.

   (e) Now add `expend` (current expenditure per pupil) to the model and fit it. Comment on the estimated regression coefficients of `takers, ratio` and `salary`, their significance and the goodness of fit as compared to the results from the model in question (a).

   (f) Under the model of question (e), test the hypothesis $\beta_{takers} = \beta_{ratio} = \beta_{salary} = 0$ and show your test results. Based on your entire analysis, do you feel any of these predictors have an effect on the response?

   Note: For tests without specifying the α-level, the default value is 0.05.