

Homework 3 STATS 449 (Due 10-11)

Instructions: Use R for all problems in this homework. **Attach** and annotate R output where relevant. Late homework cannot be accepted.

1) A study investigated factors that affect whether the female crab had any other males, called *satellites*, residing nearby her. The female crab's carapace width x_i , measured in centimeters, is believed to affect this. For eight groups of crabs, the data below shows the number of crabs having satellites and the average width.

Width (x_i)	Number of Crabs Having Satellites	
	Yes	No
22.69	2	13
23.84	6	14
24.77	7	23
25.84	18	22
26.79	13	12
27.74	22	3
28.67	15	5
30.41	15	1

Let y_i be the number yes in each row and fit the logistic regression model (use the actual x_i values given, not 1, 2, ..., 8)

$$y_i \sim \text{Binomial}(n_i, p_i)$$

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta x_i \quad i = 1, \dots, N$$

- Make a scatterplot of x versus the sample logits. Does there appear to be a linear trend?
- What is G^2 and the degrees of freedom for this model? Does the model fit well? Explain.
- When width increases by 1 centimeter, what is the estimated odds ratio that a crab will have a satellite? Calculate a 95% confidence interval for the estimate.
- When width increases by 2.5 centimeters, what is the estimated odds ratio that a crab will have a satellite? Calculate a 95% confidence interval for the estimate.

2) The table below shows results from a three-center clinical trial designed to assess the effects of a new drug for treating infections. At each center subjects were randomly assigned to the placebo and drug groups. Use $\alpha = 0.05$ in any tests of significance.

Center (Z)	Group (X)	Infection (Y)	
		Yes	No
1	Placebo	281	319
	Drug	182	418
2	Placebo	252	248
	Drug	160	340
3	Placebo	204	196
	Drug	114	286

- a) Fit the sequence of logistic regression models shown below and fill in the values for degrees of freedom and G^2 . For the X variable, code Placebo equal to 1 and Drug equal to 0.

Model	df	G^2
α		
$\alpha + \beta_i^X$		
$\alpha + \beta_k^Z$		
$\alpha + \beta_i^X + \beta_k^Z$		

- b) State the hypothesis of conditional independence between X and Y and use your results from the table above to give the value of the test statistic, the critical value, and your conclusion.
- c) State the hypothesis of homogeneity of odds ratios between X and Y and use your results to give the value of the test statistic, the critical value, and your conclusion.
- d) Do your results support calculation of a common odds ratio? If so, report it along with a 95% confidence interval. Interpret the results.
- e) Is a collapsibility condition satisfied for collapsing the partial $X - Y$ tables into the marginal $X - Y$ table? Must explain why or why not.