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1 Problem 1

The following data is collected to study the relationship between frequency of chirps made by a ground cricket and the corresponding ground temperature. The frequency is measured as the number of wing vibrations per second.

chirps (/second)	20.0	16.0	19.8	18.4	17.1	15.5	14.7	17.1	15.4	16.2	15.0	17.2	16.0	17.0	14.1
temperature (F)	88.6	71.6	93.3	84.3	80.6	75.2	69.7	82.0	69.4	83.3	78.6	82.6	80.6	83.5	76.3

- (a) Fit a linear model to predict chirps from temperature. What are the slope and intercept of the model?
- (b) Fit another linear model, using a linear transformation to centralize the explanatory variable. What are the slope and intercept of the model?
- (c) Fit another linear model, using a linear transformation to centralize and standardize the explanatory variable. What are the slope and intercept of the model?
- (d) Use these three models to predict chirp frequency under similar conditions when the temperature is 88 F.

2 Problem 2

In the early 1990s, scientists became concerned about rapid declines in populations of amphibians worldwide. After some analysis, researchers consider global atmospheric causes, such as thinning of the ozone layer and the resulting increased exposure to damaging ultraviolet (UV-B) light to be the answer.

Rana cascadae is a kind of amphibians who lay eggs in open shallow water which is highly exposed to sunlight. Therefore the effect of UV-B could be explained by the damage over eggs. Researchers place *Rana* eggs under UV-B treatments having three levels: (a) a UV-B blocking filter; (b) a UV-B transmitting filter; and (c) no filter. Percentage of eggs failing to hatch (perF) is calculated at two sites:

	No filter				UV-B transmitting				UV-B blocking			
Three Creeks	38.7	44.0	30.0	38.7	28.7	32.7	36.0	40.7	25.3	18.7	21.3	16.7
Small Lake	36.7	69.6	39.3	34.0	70.0	54.0	48.7	51.3	24.7	25.3	39.3	32.7

- (a) Fit a linear model to predict perF from site and treatment, without interaction.

(b) Do a log transformation on perF and refit the linear model. Why should we do this transformation? How do you interpret this model?

(c) Predict the percentage of eggs failing to hatch in Small Lake and under UV-B blocking from both models.

3 Problem 3

The board of directors of a professional association conducted a random sample survey of 30 members to assess the effects of several possible amounts of dues increase. Two values are recorded:

(1) dollar: The dollar increase in annual dues posted in the survey interview.

(2) renew: Whether or not the interviewee indicated that the membership will not be renewed at that amount of dues.

renew	0	1	0	0	0	0	1	0	0	1	1	0	0	1	0
dollar	30	30	30	31	32	33	34	35	35	35	36	37	38	39	40
renew	1	1	0	1	1	1	0	1	1	0	1	1	0	1	1
dollar	40	40	41	42	43	44	45	45	45	46	47	48	49	50	50

(a) Fit a generalized linear model with the data, using binomial (it's actually binary here) family and logit link function.

(b) Predict the possibility of not renewing when the dollar increase is 30, 40 and 50 respectively.

Note: the data are available as three txt files on the course website.