Name Jerry

Student Number

STA 441s 2016 Quiz 8

1. (5 Points) In an agricultural experiment, farm fields were randomly assigned to one of two irrigation methods (Sprinkler or Drip), and one of three Fertilizer types, in a 2×3 factorial design. The response variable Y is crop yield. The design is shown in Question 1c.

   (a) In the space below, make a table with six rows, showing how you would set up *cell means* dummy variable coding for this problem. Cell means coding is the setup with a zero-one indicator dummy variable for each treatment combination, and no intercept.

IRRIG	Fert	d_1	d_2	d_3	d_4	d_5	d_6
S	1	1	0	0	0	0	0
S	2	0	1	0	0	0	0
S	3	0	0	1	0	0	0
D	1	0	0	0	1	0	0
D	2	0	0	0	0	1	0
D	3	0	0	0	0	0	1

   (b) In the space below, write $E(Y)$ for a regression model with the dummy variables you defined above.

$$E(Y) = \beta_1 d_1 + \beta_2 d_2 + \beta_3 d_3 + \beta_4 d_4 + \beta_5 d_5 + \beta_6 d_6$$

   (c) Write $E(Y)$ for each treatment combination in the table below, using the β symbols from your model. Symbols for the dummy variables do *not* appear in this answer.

	Fertilizer 1	Fertilizer 2	Fertilizer 3
Sprinker Irrigation	β_1	β_2	β_3
Drip Irrigation	β_4	β_5	β_6

   (d) Averaging across fertilizer types, does irrigation method affect crop yield? Give the null hypothesis in terms of β symbols from your regression model.

$$H_0: \beta_1 + \beta_2 + \beta_3 = \beta_4 + \beta_5 + \beta_6$$

   (e) Does the effect of fertilizer type depend on the irrigation method? Give the null hypothesis in terms of β symbols from your regression model.

$$\beta_1 - \beta_4 = \beta_2 - \beta_5 = \beta_3 - \beta_6 \quad \text{or}$$

Either one or anything equivalent

$$\beta_1 - \beta_2 = \beta_4 - \beta_5 \quad \text{and} \quad \beta_2 - \beta_3 = \beta_5 - \beta_6$$

2. For the bunny study, it makes sense to just interpret the main effects, since the interaction was not statistically significant. **Please base your conclusions below on the marginal sample means** as well as the relevant significance tests.

   (a) (1 Point) We want to know if the drug had an effect. Write the value if the F statistic and the p-value in the space below. On your printout, circle the F statistic and p-value, and write the question number (2a) beside it.

   $F = 11.04$, $p = 0.0022$

   (b) (4 Points) The reason for doing the bunnies study was to find out if the drug helped dental implants become more firmly attached to the bone. Based on the results of your statistical analysis (and only on the results of your statistical analysis), would you recommend proceeding to clinical trials with humans? *Answer Yes or No and briefly explain.* You can get full marks for a single sentence with no numbers and no statistical terminology. You have a lot more room than you need.

   No! The drug caused the tooth to be less firmly attached to the bone (less force to extract).

Attach your complete log file and your *COMPLETE* results file to the quiz paper. Make sure your name and student number are written clearly on both printouts.