Department of Statistics

COURSE STATS 330/762

Assignment 4, 2010

Instructions: Hand in your completed assignment to the Student Resource Centre by **4pm September 30th**

The data set for this assignment is in the file **muscle.txt** which is available on the course web page.

In an experiment to study the effect of electrical stimulation on muscle atrophy in rats, a particular muscle in a number of rats was stimulated, and the muscle weight recorded. Also recorded was the weight of an untreated muscle in the same rat.

Each stimulation used one of four types of current, "galvanic", "faradic", "60.cycle" or "25.cycle". Depending on the rat, these stimulations were applied either once daily, three times daily, or six times daily. The data frame contains the following variables. Each line represents a rat.

wt.d: The weight of the treated muscle,
wt.n: The weight of the untreated muscle.

1. Read the data into R, and make a data frame containing the continuous variables wt.d and wt.n, plus the factors factors n.treat and current. Note that only the values for wt.d and wt.n are given in the data file. You will need to create the factors. The data are in the following order:

    8 observations with current = "galvanic" and n.treat=1,
    8 observations with current = "galvanic" and n.treat=3,
    8 observations with current = "galvanic" and n.treat=6,
    8 observations with current = "faradic" and n.treat=1,
    8 observations with current = "faradic" and n.treat=3,
    8 observations with current = "faradic" and n.treat=6,
    8 observations with current = "60.cycles" and n.treat=1,
    8 observations with current = "60.cycles" and n.treat=3,
    8 observations with current = "60.cycles" and n.treat=6,
    8 observations with current = "25.cycles" and n.treat=1,
    8 observations with current = "25.cycles" and n.treat=3,
    8 observations with current = "25.cycles" and n.treat=6,

    for a total of 96 observations. Check for gross errors. Print out the first 16 lines. [5 marks]

2. Make a suitable plot that will let you see how the number of treatments and the type of current affect the relationship between the variables wt.d and wt.n. What are these effects? [5 marks]

3. Fit the following models to the data, and choose the one you think fits best. You must provide a justification for your choice. [10 marks]

    a. A model with a common slope and intercept for all 12 factor level combinations.

    b. A model with a common slope and but intercepts depending on the current only.

    c. A model with a common slope and but different intercepts for all 12 factor level combinations.

    d. A model with different intercepts for all 12 factor level combinations, but the slopes depending on current only.

    e. A model with different intercepts and slopes for all 12 factor level combinations.

4. For the model you have chosen, draw a plot showing the 12 fitted lines (which could coincide). Comment on the effect of the factors on the weight of the treated muscle. [10 marks]

5. Now make a new variable which is the ratio of the weights of the treated and untreated muscles. Draw a graph or graphs that show the effect of the factors on the ratio. Fit a two-way anova model to these ratios. Do the factors interact? What is the effect of the factors on the ratios? Do the results of this analysis confirm the conclusions you reached in Q4?
   [10 marks]

Extra question for 762 students

Calculate confidence intervals for the means of each of the 12 factor combinations, based on the model indicated by the result of Q5 above. *Hint: use the function* `test.lc` *in the "330.functions".*

R hints:

1. The function rep is useful for making factors. You can use rep to make a sequence of levels in the correct order, then use the factor function to turn the sequence into a factor. See the code in Lecture 17, slides 17 and 19.

2. To draw the plot in Q4, you can calculate the equations of the lines as in Tutorial 6, and plot as shown there, or use the predict function to calculate the predicted values, then plot these against the values of wt.n. You will need to overcome the problem we saw in the rat graphs in Lecture 2.

The data:

wt.d	wt.n	wt.d	wt.n	wt.d	wt.n	wt.d	wt.n
72	152	61	130	62	141	85	147
67	136	60	111	64	126	67	123
57	120	72	165	63	112	56	125
57	121	60	87	61	93	73	108
46	97	60	126	71	129	53	108
44	83	57	104	62	114	60	105
53	101	56	120	56	101	56	97
46	107	56	109	64	114	59	102
74	131	61	129	65	112	76	125
52	110	55	180	65	190	72	117
66	132	43	95	66	130	75	130
56	160	63	115	79	126	86	140
74	131	64	124	64	117	65	108
58	117	55	112	61	100	78	112
50	103	57	110	56	109	58	87
55	108	55	104	66	101	58	98
69	131	65	126	70	111	61	130
62	122	59	122	64	98	60	92
72	129	43	97	72	180	92	162
78	135	58	118	68	160	71	120
58	81	52	102	71	108	66	108
54	97	51	100	79	115	82	102
61	115	56	105	71	105	69	107
64	115	57	103	62	99	88	135