

## Homework 7

### QSCI 482: Hypothesis Testing & Estimation for Ecologists & Resource Managers

1. To examine how sensitive the vegetation is, an experiment was conducted in the alpine meadows of the White Mountains of New Hampshire. Sixteen “lanes” were set up, each 0.5 m wide and 1.5 m long. These twenty lanes were randomly assigned to four treatment groups: 0, 25, 75, and 200 walking passes. Each pass consists of a 70-kg individual wearing lug-soled boots walking in a natural gait down the lane. Response measured is average height of the vegetation along the lane one year after trampling.

0 passes	25 passes	75 passes	200 passes
20.7 cm	12.9 cm	11.8 cm	7.6 cm
15.9	13.4	12.6	9.5
17.8	12.7	11.4	9.9
17.6	9.0	12.1	9.0

- [a] Write down the null and alternate hypotheses for these data.
- [b] Compute the overall (grand) mean, treatment group means, treatment group standard deviations, SSTRT, SSE, and SSTOT. Show that the numerator of the formula for computing  $s_p^2$  on page 15-5 of the course reader gives exactly the same result as SSE calculated from the formula on p. 16-3.
- [c] Complete an ANOVA table for these data. Test the hypotheses from part [a] using 0.01 as the significance level. State your conclusion in terms of the original question.
2. Four tire types (brand / model combinations, such as Goodyear / Arriva) in the size 175/80R-13 are chosen *at random* from among *all* those available in a major metropolitan area, and five of each type are taken at random from warehouses there. The tires are placed (in completely random order) on a machine that will test tread durability and report a response in thousands of miles. Here are the data:

Type	Miles (x 1000)				
1	55	56	59	55	60
2	39	42	43	41	41
3	39	41	43	40	43
4	44	44	42	39	40

- [a] Is this a fixed-effects model or a random-effects model? Write down the null and alternate hypotheses that the researchers are interested for these data.
- [b] Complete an ANOVA table for these data. Test the hypotheses from part [a] using 0.05 as the significance level. State your conclusion in terms of the original question.
3. Consider a Completely Randomized Design with five treatment groups, four replicates in each group, that resulted in the following means:

3.29                  10.26                  8.16                  8.18                  7.56

The MSE is 4.012.

- [a] Construct an ANOVA table for this experiment and test the null hypothesis that all treatment means are equal. Set your significance level so that there is a 10% or less chance of falsely rejecting the null hypothesis.
- [b] Use the HSD procedure to compare the means of the five treatment groups.

4. Refer to challenge 1, above.
- [a] Would statistical power increase or decrease if six treatment groups had been used, compared to the four that were used?
  - [b] How would statistical power change if six replicates had been used in the experiment instead of the four that were actually used?
  - [c] What power did we have to detect a difference with magnitude equal to the distance between the largest and smallest observed means using the given experimental setup?
  - [d] What power would we have if we ran the ANOVA using a significance level of 0.05 instead of 0.01?