Department of Industrial Engineering & Operations Research

IEOR 165 (Spring 2017)

Homework 5

Due: Thursday, May 4

Question 1. The PCB concentration of a fish caught in Lake Michigan was measured by a technique that is known to result in an error of measurement that is normally distributed with a standard deviation of .8 ppm (parts per million). Suppose the results of 10 independent measurements of this fish are:

$$12.8,\ 11.0,\ 11.1,\ 10.6,\ 12.2,\ 9.7,\ 12.9,\ 10.9,\ 11.8,\ 11.3$$

(a) Give a 95 percent confidence interval for the PCB level of this fish.
(b) Give a 95 percent lower confidence bound.
(c) Give a 95 percent upper confidence bound.

Question 2. A sample of 10 fish were caught at lake A and their PCB concentrations were measured using a certain technique. The resulting data in parts per million were

$$\text{Lake A}: 10.4,\ 10.7,\ 10.6,\ 10.2,\ 9.8,\ 10.8,\ 10.8,\ 10.0,\ 11.0,\ 10.4$$

In addition, a sample of 8 fish were caught at lake B and their levels of PCB were measured by a different technique than that used at lake A. The resultant data were

$$\text{Lake B}: 12.3,\ 11.8,\ 11.6,\ 10.9,\ 11.5,\ 11.5,\ 11.6,\ 11.3$$

If it is known that the measuring technique used at lake A has a variance of .09 whereas the one used at lake B has a variance of .16, could you reject (at the 5 percent level of significance) a claim that the two lakes are equally contaminated? (assume the population distribution is normal)

Question 3. Suppose we have conducted 6 null hypothesis tests, with p-values as

Test #	p-value
1	0.007
2	0.025
3	0.012
4	0.051
5	0.003
6	0.068

Use both Bonferroni correction and Holm-Bonferroni method to determine which tests should be rejected when the family-wise error rate is $\alpha = 0.05$.

Question 4. A machine shop contains 3 ovens that are used to heat metal specimens. Subject to random fluctuations, they are all supposed to heat to the same temperature. To test this hypothesis, temperatures were noted on 15 separate heatings. The resulting data was measured in the table below.

Oven	Temperature
1	488.1, 494.7, 490.2, 489.6, 487.9
2	483.7, 480.5, 475.5, 482.7, 479.6
3	500.3, 492.2, 513.3, 490.1, 495.5

Do the ovens appear to operate at the same temperature? Test at the 5 percent level of significance. What is the p-value? (assume the population distribution is normal)

Question 5. Suppose that a process is in control with $\mu = 10$ and $\sigma = 1.5$. An $\overline{X}$-control chart based on subgroups of size 6 with significance level of 0.05 is employed. If a shift in the mean of 3.1 units occurs, what is the probability that the next subgroup average will fall outside the control limits? On average, how many subgroups will have to be looked at in order to detect this shift?