WILD 595-1 Fall 2016  
Lab 05

**Components of Inference**

Assume you are involved in an experiment to “evaluate" the effects of the chemical LLIKMALC on monthly survival probability of the hen clam *Spisula solidissima* in an area south of Cape Hatteras, NC. This chemical has been proposed for use in mosquito control in aquatic environments. However, several vocal environmental groups have protested the application of LLIKMALC because of its alleged mortality of a variety of aquatic organisms. County officials have contracted for a research study to provide some initial information about the possible deleterious effects of this chemical on hen clams.

Actually, similar studies have been conducted in the same general manner in each of 4 other coastal counties in the Carolinas. Thus, a replicated experiment has been conducted; you are asked only to analyze the results of one of these 5 reps. Note, in each case the treatment river segment is downstream (thus no drift of the chemical onto the control segment); otherwise, the two segments are thought to be virtually identical. While randomization of each segment would have been ideal, logistics demanded that the treatment segment be downstream. All the stakeholders seem to agree that this non-random allocation of sites to treatment groups has not compromised the study.

Your study area consists of two segments of a slow-moving river (the river is about 1m deep at its deepest point within the two study areas) where large populations of this bivalve occur in loose associations or groups throughout the year. The segments of the river were fenced in such a way as to keep the clams contained (no movement in or out of each of the two study segments). The control site is upstream of the treatment site and separated by about 500m. Clams are captured or recaptured on a single day, the first Monday of each month. Thus, the capture-recapture period is short (less than 10 hours) in relation to the length of the survival interval (a month). The study started in June and sampling was continued in July, August, ..., February (i.e., *i* = 1, 2, ..., 9). These months cover summer, fall and winter but there seems to be general agreement that any differences in monthly survival are quite small (e.g., no differences by summer, fall or winter). In fact, there had been 3 small-scale capture-recapture studies done on hen clams in the coastal areas of the Carolinas and these failed to show any variation in survival probabilities by month. Captured clams are given a small tag with a unique number that is glued onto the upper shell (this method has been very successful in the past and no tag loss is thought to occur). Tags for the treatment segment were different sequence than those used for the control segment. There were no “losses on capture." Handling time was 2-8 minutes and marked clams were put back within 10m of the point of capture (or recapture) in nearly all cases.

The sampling was done by trained technicians and the sampling effort on the two areas generally increased during the course of the study. This increase was the result of (1) more people participated in the one-day sampling effort as months passed, and (2) increased efficiency of the samplers due to experience. Sampling was done over the entire river segments; thus for all practical purposes ϕ = *S* in this experiment. Only clams in the 3–5 inch size were included in this study to minimize heterogeneity among individuals. Sampling (i.e., capture) effort on the control and treatment river segments are quite similar as this was a goal in the design and field protocol. The total size of the clam population within the two study segments was nearly equal. The spatial distribution of clams was quite patchy, with large aggregations, separated by substantial distances. Clams within the large aggregations seem likely to have somewhat similar “fates" with respect to both survival and recapture probability (like schools of fish where the individuals within a school are not behaving independently).

The up-stream river segment served as the control area for the experiment. The downstream treatment area was sprayed with LLIKMALC on the first Tuesday in July and November (the day following sampling in these months). The dose (6 pounds per acre) was the same during the two sprayings.

The original design idea was that the pre-treatment months of June and October would serve as a baseline to assure that survival at these times were essentially equal on the control vs. treatment segments (i.e., in June ϕ*t* = ϕ*c* and in October ϕ*t* = ϕ*c* (the subscript *t* and *c* denote treatment and control, respectively). This baseline was compromised because errors made by a single observer on occasion 2 (July); he was recapturing clams in the treatment group and failed to note that several calms marked in June were actually dead by July and re-released these clams as though they were alive. This error will cause the estimated survival of clams (during June) in the treatment group to be overestimated by some unknown amount. It was felt that this error would not compromise the study objectives. Other than this problem, all else in the study went very well (note, typically in field studies there is something that goes wrong, no matter how hard one might try to get everything right!).

Stakeholders interested in the outcome of this issue fell into three groups and these issues should be the focus of the analysis of data; these are alternatives:

1. There is a trivial difference in monthly survival and this variation cannot be attributed to the application of LLIKMALC. There is no treatment effect.
2. There is a substantial acute survival effect due to the treatment, lasting only the first month following application of LLIKMALC.
3. There is a substantial acute survival effect due to the treatment, lasting one month followed by a month-long chronic survival effect due to the treatment.

Stakeholders felt that the application of LLIKMALC would not have an effect on the capture or recapture probabilities. The analysis of the empirical data should attempt to resolve these issues in a compelling way. The capture history matrix is found under filename CLAMS.INP; the first column of frequencies represents the treatment group – those in the segment treated with LLIKMALC. Note: ignore the fact that some months have 30 vs. 31 days; treat these intervals as “months." Also, the stakeholders have agreed to let model {ϕ(g\*t)**,** *p*(g\*t)**}** serve as the global model (*g* denotes the 2 groups; treatment and control).

Students should consider what is known (i.e., given here) about this issue. Use and interpret the information provided. Students are asked to:

1. Provide a paragraph summarizing their ***strategy*** of analysis – how did you approach the analysis of these data?

2. Provide a **concise summary** of the *Results* as if the *Introduction* and *Methods* sections had already been carefully written. One table should show: QAIC- values, *K* and deviance for the (few) models considered, including the global model. Provide your conclusions (e.g., relevant estimates and measures of precision, etc., etc.) with respect to the 3 issues (I, II, and III, above) set out by the stakeholders.