Descriptions of several studies, conducted by members of previous Advanced Biometry classes, are given below. Your task is to decide how you would analyze the data from each study:

• What are the factors in the design?
• Which factors would be crossed with, or nested in, which others?
• Which terms would you treat as random, and which as fixed?
• From the preceding choices, what is the model you would use for this analysis?
• What would be the denominator MS for the F test for each fixed effect, if you were to analyze the study data using traditional ANOVA?
• What is the ‘scope of inference’ from the study as you would analyze it? That is, how far would you generalize the conclusions? What if any conclusions could be drawn about causation?

We likely will not have time to discuss all these study designs, but please look at all of them so that we can discuss any that you have questions about. They are not given below in any particular order, i.e. I do not intend that we discuss them in this order.

Your write-ups will only include the designs we do discuss.

(1) effects of grass species and variety on soil carbon dynamics

A study was conducted to compare the soil carbon dynamics—especially the amount of carbon sequestration—among several varieties of two species of grass. These grasses were being evaluated as possible biofuel crops.

A field was divided into 4 sections, each further divided into 25 plots. Initially 25 varieties of grasses were grown, with one randomly assigned plot per variety in each of the 4 sections of the field. For the present study, 8 high-yielding varieties were chosen for in-depth study of soil C variables: 4 varieties each of Napier grass and Guinea grass.

Soil samples were collected approximately 18 months after the start of the experiment. A large number of soil variables related to carbon pools and fluxes were measured.

(2) effects of closure on fish communities at ‘Åhihi Kīnau Natural Area Reserve

In 2008 a large portion of the Reserve was closed to all public access and use. The goal of this study is to determine the effect of the closure on the fish assemblage: Does fish assemblage (density, mean biomass, and diversity) change with levels of accessibility and time? If so how?

Three sites were selected within the area of the Reserve closed to public use, and three sites within the area still open to the public.

At each site four transects (25m x 5m) were randomly placed.

Observations of the fish were made on each transect at the time of the closure in 2008, and every 6 months for 2 years thereafter (so at 0, 6, 12, 18, and 24 months after closure).
(3) effects of conservation agriculture practices in Nepal

An experiment is underway to determine the effects of various “conservation agriculture practices” on crop yield and soil properties in India. There are four treatments, consisting of various combinations of conventional or strip tillage, monocropping or intercropping, and use or not of a cover crop. All treatments have maize grown in the first season. The treatments are:

- maize followed by a millet crop, with conventional tillage (this is current practice by farmers in the region where this study is being done)
- maize followed by a cowpea cover crop, with conventional tillage
- maize followed by millet and cowpea intercropped, with conventional tillage
- maize followed by millet and cowpea intercropped, with strip tillage.

Three villages were randomly chosen to represent villages dominated by the Chepang tribal community; multiple villages (rather than one) were used so that there would be variability in soil, weather and technology.

In each village 9 farmers were chosen randomly to conduct the trials. Each farmer has one plot of each of the four treatments.

Many response variables are being recorded, related both to yield and to soil health.

(4) effects of fire and habitat condition on vegetation

The objective was to compare the effects of fire on vegetation, in relation to both the timing of the fire and the ecological condition of the habitat. This research was done at Lava Beds National Monument in California.

The study was done at three sites:

- Fleener Chimneys: pristine sagebrush/bunchgrass ecosystem, in which the historic fire regime has remained intact, with naturally occurring fires being allowed to burn;
- Gillems Camp: Invasive annual grass has formed a more continuous fuel load and fires are occurring more frequently than they were historically;
- Merrill Caves: Fire has been excluded due to proximity to road and park headquarters, juniper has been expanding and is now co-dominant with sagebrush, and native bunchgrass understory is diminished.

Three fire treatments were applied:

- spring burn (June): nearly complete combustion;
- fall burn (October): it was cold so the fire didn’t carry well;
- unburned controls.

At each site 5 blocks were established, with large buffers between them. Within each block three plots were established, also with large buffers between them, and the three treatments were randomly assigned to the plots.

Five permanent transects were placed within each plot.

Vegetation surveys were conducted on each transect immediately prior to the first burns and then the summer after the burns (both surveys being in June). Various response variables describing vegetation cover were recorded.
(5) Effects of foliage harvest on tree growth

From the dissertation research of Orou Gaoue, recent Botany Ph.D. and new Botany faculty member. This problem was used on the 2007 final exam.

Orou studied the effects of foliage harvesting on the tree species *Khaya senegalensis* (Senegal mahogany) in his home country of Benin. Cattle herders cut foliage from trees to feed their cattle during the dry season; in some places many trees are nearly defoliated. Orou wanted to determine the effect of this on the population dynamics of the tree, and whether this effect differs between different climatic regions of the country. His sampling was roughly as follows:

- The northern part of Benin, where harvesting of *K. senegalensis* occurs, has been classified into two climatic and ecological regions: a drier region to the northeast and a somewhat less dry region west and south of the dry region.
- Within each of these regions Orou selected four sites containing *K. senegalensis*, two of which are subjected to harvesting and two of which are in parks or other protected areas and not subjected to harvesting.
- Within each site he identified all mature *K. senegalensis* trees, and randomly selected 10 for detailed demographic study; in the harvested sites, these were selected from among only the trees which actually had had foliage harvested in the recent past, as evident from the growth form of the tree.
- For each tree he randomly selected 20 fruits and weighed each one. (He also measured other variables such as the numbers of flowers and fruits but for this exam question, consider only the fruit weights as the dependent variable.)

(6) Impacts of the season of fire on plant growth

A study was conducted to test whether fire in different seasons would have different impacts on the population dynamics of a harvested wild plant (“golden grass,” *Syngonanthus nitens*) in Brazil.

Six sites were chosen randomly among sites that had been burned by harvesters the year before the study started and were considered good harvesting areas.

In each site, three 10x20m plots was established, and one was randomly assigned to each of three fire treatments: early fire (June); late fire (September); and no fire.

Within each plot, five 0.5x0.5m quadrats were randomly placed, within which all golden grass plants were tagged and measured. The number of plants in each quadrat varied but averaged about 40. Plants also were categorized into three stages based on the number of plants in each clonal clump.

The response variable was plant growth.