Do your own work.

You may use any and all books, computer programs, and whatever else helps, except do not communicate with anyone (except me) about the exam.

If you’re unsure what I’m after, or don’t understand the background of any of the questions, ask me.

Hide your identity:

I want to be able to grade the exams without knowing whose is which. So please:

 do NOT put your name on your exam.

I will email a list of exam ID numbers, matched to UH ID numbers. Use this exam ID number (not your UH number) to identify your exam.

Submitting your exam:

• Answer each question on a separate set of pages, separately stapled; if you don’t, it will cost you points.
• Put your exam ID number on every page of your answers; if you don’t, it will cost you points.
• Turn in your exam on paper if at all possible. Place it unfolded in an unlabeled envelope so I don’t see your ID number when you give it to me. Bring it to me in my office (Edmondson 409) or leave it for me in the Biology office on the second floor of Edmondson.

If you cannot turn in your exam on paper, email it to Kirill (vinni@hawaii.edu) and confirm that he got it and was able to open and print it. Do not include your name or your UH ID number in the name(s) of any file(s) you email to Kirill.

Reporting your analyses:

• Answer the scientific question(s) posed. Be sure to state your scientific conclusion(s), not just your statistical results.
• If you think the data should not be analyzed by methods taught this semester, explain why not but go ahead with whatever of the covered methods comes closest to being appropriate.
• Show all relevant statistics and graphs.

• Most of all, explain the decisions you made about how to do the analyses. I am as interested in your analytical processes as in your final conclusions.
(1) 30 points — diet and stinkbug fecundity

As part of my study of the interaction of the parasitoid fly *Trichopoda pilipes* and the pest stinkbug *Nezara viridula* (lecture example Data Set 2), I conducted a study of the effect of diet on stinkbug fecundity. Specifically, I compared the fecundity of bugs which had or had not been given protein-rich food (peanuts and green beans). The bugs normally do feed on seed pods of various plants but also on vegetation, and they can survive reasonably well on diets without legume seeds.

I expected that providing peanuts and beans would increase the fecundity of the bugs.

Methods:

Female stinkbugs in my lab colony were collected immediately after molting to the adult stage and held in individual containers. They were given the standard lab diet apart from peanuts and beans (i.e. were fed cabbage and raisins) until they laid their first egg mass. The number of eggs in this egg mass was counted. I then randomly determined for each bug (flipped a coin) whether it would remain on the low-protein diet or would have peanuts and beans added to its diet. The number of eggs in its second egg mass was then counted.

Your assignment:

Determine whether access to peanuts and beans increased fecundity (number of eggs laid), and if so, by how much.

The data:

There were 46 bugs used in the study: 26 got peanuts and beans after the first egg mass and 20 did not.

The data will be distributed electronically; the first two and last two rows of the data set are shown below. The first column, labelled ‘bug,’ identifies the bugs (1…46); the second column, ‘beans,’ indicates whether the bug was fed peanuts and green beans after the first eggs mass (value = ‘yes’) or was kept on the bean-free diet (value = ‘no’); the third column, ‘egg_mass,’ indicates whether the observation is the first or second egg mass for that bug, and the final column, ‘eggs,’ is the numbers of eggs in the egg mass.

<table>
<thead>
<tr>
<th>bug</th>
<th>beans</th>
<th>egg_mass</th>
<th>eggs</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>no</td>
<td>first</td>
<td>89</td>
</tr>
<tr>
<td>2</td>
<td>no</td>
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<tr>
<td>46</td>
<td>yes</td>
<td>second</td>
<td>85</td>
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</tbody>
</table>
(2) 30 points — animal density and climate and habitat

A field study was conducted to try to develop better understanding of the local factors affecting the density of a particular animal species of interest. [I’m being vague so that you won’t be tempted to search for information about this study; if you need more information, ask me.]

This species lives in a particular kind of patchy habitat. It is a generalist herbivore but prefers certain kinds of plants. Previous studies have suggested that the animal’s distribution is limited by high summer temperatures (it requires relatively cool summers) and precipitation (it requires relatively moist conditions, presumably because of the impact on its food plants).

Within the region of this study, 18 such patches were located and surveyed. In addition to the density of the animal within each patch, several climate and habitat variables were measured, using a variety of methods.

Your assignment:
Describe the relationship of density and annual precipitation.

The data:
There are 18 observations (the sites). The variables (in order as in the data set) are:

- site ID (arbitrary)
- density (nests m\(^{-2}\))
- patch area (m\(^2\))
- annual precipitation (mm; mean over several years)
- maximum summer temperature (°C; mean over several years of summer maxima)
- fraction of winter days with temperature below \(-10^\circ\) C
- cover of usable vegetation (excludes trees; fraction)
- relative cover of preferred food plants (fraction, out of total vegetation cover)

Nest density was measured by searching along randomly placed transects. Precipitation and maximum summer temperature were interpolated from regional data, while data loggers were used to count days with temperatures below \(-10^\circ\) C. The vegetation variables were measured by the point-intercept method in multiple plots along randomly placed transects.

There are 18 observations. The data will be distributed electronically. The first two and last two rows are:

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<tr>
<th>Site</th>
<th>Density</th>
<th>Area</th>
<th>MeanPrecip</th>
<th>MaxSummerT</th>
<th>Days&lt;-10</th>
<th>VegCover</th>
<th>PrefFood</th>
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(3) 40 points – native plants and guinea grass

Discussion # 11 dealt with data from a greenhouse experiment on the effect of competition by native plants on growth of guinea grass, *Megathyrsus maximus*. To complement that study, a similar but simpler experiment was conducted in the field, to determine whether outplanting native plants was beneficial for suppressing guinea grass.

Methods:

The study was conducted in a guinea-grass dominated site in leeward Oahu. At the start of the experiment the site was fenced and mowed, and twenty 3m x 3m plots were established.

Five treatments were randomly assigned to the plots, giving four plots per treatment. Three of the treatments consisted of outplanting native plants. Each plot received 12 plants of the woody ground cover *Plumbago zeylanica* (ilie'e), nine plants of the shrub *Dodonea viscosa* (a‘ali‘i), and four plants of a canopy tree. The three treatments differed in the species of the tree: either *Thespesia populnea* (milo), *Cordia subcordata* (kou), or *Myoporum sandwicense* (naio). These plots also were treated periodically with a grass-specific herbicide.

The fourth treatment was only application of the grass-specific herbicide, at the same times as the native-plant plots were sprayed; nothing was outplanted into the plots. The final treatment plots had nothing done to them other than the initial mowing.

The five treatments thus were:

- **Tp**: *T. populnea* plus *P. zeylanica, D. viscosa* and herbicide
- **Cs**: *C. subcordata* plus *P. zeylanica, D. viscosa* and herbicide
- **Ms**: *M. sandwicense* plus *P. zeylanica, D. viscosa* and herbicide
- **h**: herbicide only
- **no**: nothing

Three years after the treatments were initiated the percent cover of guinea grass was measured in each plot, using a point-intercept method.

Your assignment:

Determine whether outplanting the native plants was beneficial in suppressing guinea grass, and if so, whether it mattered which tree species was planted.

The data:

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<tr>
<th></th>
<th>Tp</th>
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<th>Ms</th>
<th>h</th>
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