GENERAL INFORMATION AND COURSE REQUIREMENTS

Instructor  Stephen H. Jenkins
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            Office Hours: 9:30-10:45 Tues-Thurs or by appointment or stop by to see if I’m home

Meeting Times and Places
            11:00-12:15 Tuesday and Thursday, Room 110 KRC (Valley Road); 8-10 or 10-noon Wednesday,
            Room 136 FA

COURSE DESCRIPTION AND OBJECTIVES

Most of you are preparing for careers involving independent research. The main goal of this course is to
steer you toward research careers that are stimulating, productive, and enjoyable. The specific objectives are:

(1) To help you learn how to design effective research projects in ecology, evolution, and conservation biology.

(2) To help you understand important statistical issues in designing observational and experimental research.

(3) To help you think about your own research in a broader context.

(4) To help you learn how to write convincing and successful research proposals.

We will attempt to meet these objectives in four ways:

(1) By discussing classic and contemporary papers about philosophy, research design, and statistics.

(2) By discussing case studies illustrating research design in ecology, evolution, and conservation biology.

(3) By writing and critiquing each other’s research proposals.

(4) By using computer simulations to explore statistical aspects of research design.

The general components of the course – philosophy, research design, and proposal writing – will be
interspersed throughout the semester.

WARNING

You should have at least a beginning course in statistics before taking this course, and you should not
plan to use this course as a substitute for advanced statistics. If anything, this course will persuade you that
you need to take more statistics, not less.

WEB SITE

We will use WebCampus (https://webct.unr.edu) for posting readings and handouts in electronic form and
exchanging information. Some Discussion Boards on WebCampus will require your participation.
REcADING

There will be several books on reserve in the Knowledge Center that are useful for reference and may provide some readings for the course. We will also read papers and other material that I will make available electronically on WebCampus. You should purchase *Experimental design for the life sciences*, 2nd edition, by G. D. Ruxton and N. Colegrave (2006, Oxford University Press) and *Writing successful science proposals*, 2nd edition, by A. J. Friedland and C. L. Folt (2009, Yale University Press); both are available in the ASUN Bookstore. I also strongly recommend *The craft of research*, 3rd edition, by W. C. Booth et al. (2003, University of Chicago Press). This is not only a great writing guide, but also a wonderful introduction to asking good questions, which is often the hardest thing to do in research.

You should have at least one general statistics book for reference for this course and for your future work. My current favorites are *Experimental design and data analysis for biologists* by G. P. Quinn and M. J. Keough (2002, Cambridge University Press; the most comprehensive of those listed here), *A primer of ecological statistics* by N. J. Gotelli and A. M. Ellison (2004, Sinauer; the best introduction, but surprisingly sophisticated in places), and *Statistics: An introduction using R* by M. J. Crawley (2005, Wiley; we’ll use R for statistical work in lab, so this book will be most useful if you want to learn statistics in the context of this specific software package).

SOFTWARE

We will use various programs in lab, but mostly R for statistical analysis. This is free, open-source software with a huge number of libraries of functions available for specialized analyses. There are many resources for learning about R at [http://cran.r-project.org](http://cran.r-project.org). If you’d like a relatively user-friendly reference book, I recommend *The R book* by M. J. Crawley (2007, Wiley, 942 pages!). Crawley is a plant ecologist, so many of his examples are ecological. Another useful resource, especially for ecological modeling, is *Ecological models and data in R* by B. M. Bolker (2008, Princeton University Press).

ZOTERO

Zotero is a free Firefox add-on for building and managing a bibliographic database ([https://www.zotero.org](https://www.zotero.org)). It has many attractive features. For example, suppose you are viewing a journal paper in pdf format in a Firefox window. With one mouse click, you can create a bibliographic record for this paper. You can download references from online sources, organize references in collections, add keywords (tags) and notes, do sophisticated searches, and export references to EndNote. You can establish a free account with Zotero, then synchronize databases between multiple computers. I have invited you to join a private Zotero group (just for this class), and I will use this group to provide you with reading lists for various topics.

COURSE REQUIREMENTS

A. Class Participation

The success of this class depends on everyone reading the background material carefully and being fully engaged in class discussions. I will often ask individual students to serve as discussion leaders or resource persons for various topics. In addition, I will sometimes ask you to do take-home assignments based on laboratory exercises.
B. Developing the Components of an Effective Research Proposal

During the first half of the semester, we will develop several research proposals in a stepwise process. Here is how this will work:

(1) Each of you will pose one (or more) questions that might lead to an interesting research project. **These questions should not represent the central core of your own thesis research**, although they may be peripherally related to it. They may also be in a completely different area of biology, and I encourage you to be adventurous in thinking up questions. You should do enough background reading to become somewhat convinced that your questions don’t yet have definitive answers. However, don’t let this deter you from being creative in posing questions. Keep in mind that some questions in biology may be thought to have definitive answers by members of the public or by some scientists, but are really still open questions.

Our goal is to define questions that are general enough to be exciting and significant, but specific enough to be answerable through research. We will use a Discussion Board on WebCampus to do this. This will be available from 1–7 September, during which time you should post potential questions and comments aimed at refining questions posted by others. Your questions should be stated succinctly and explicitly and should include brief explanations of reasons for asking these questions. Commenters may restate a question for clarity, discuss arguments for the significance of a question, or discuss tractability of a potential study to answer a question.

(2) We will spend one or two class periods discussing all of the questions, focusing on which questions seem especially exciting, interesting, and promising for developing good research proposals.

(3) **I will ask each of you to develop a significance statement for a research proposal based on one of the questions.** As described in Writing successful science proposals, this is a key section that often comes first in a research proposal and should encourage reviewers to keep reading. See pages 35–48 of this book for suggestions about how to write a significance statement.

Your significance statement should be no more than about 3 to 4 double-spaced pages, excluding references. You should use appropriate references to justify your arguments, but you don’t have enough space to do a full review of the literature on your topic (this is not a full introduction or background section for a proposal, just the significance statement).

You may write a significance statement for one of your own questions or for any of the others submitted. We may decide on a subset of all the questions posted on WebCampus for further use; if so, two or more of you may write significance statements for the same question. As you develop your significance statement, you may want to reformulate the question for greater clarity, interest, tractability, or some other reason. Your significance statement is due on Monday, 21 September.

(4) We will spend two or three class periods discussing these significance statements to try to learn the most effective way to build a persuasive proposal that will convince reviewers of its importance.

(5) We will use another Discussion Board on WebCampus to develop objectives and hypotheses for questions that remain viable following our class discussion of significance statements. The hypotheses should flow from the initial question (or a further modified version of it) and associated significance statement. The hypotheses should also be testable. If appropriate, I encourage you to develop a set of alternative hypotheses.
that can be definitively tested because they lead to different predictions. Like development of the questions in the first place, this will be a group effort, relying on contributions from everyone. For example, person A might propose hypothesis 1 to answer question X, person B might propose alternative hypothesis 2 for question X, person C might clarify hypotheses 1 and 2, person D might suggest that 1 and 2 aren’t really alternatives but just different ways of stating the same thing and that hypothesis 3 is a meaningful alternative to 1+2, etc.

This *Discussion Board* will be available from 29 September-6 October, after which we will spend one or two class periods discussing the objectives and hypotheses for the various questions, focusing on which ones might be most interesting for development of research proposals.

(6) We will select 6 to 8 questions for further work, which will be done in groups of 3-4 students. I will ask each of you to choose three questions (*excluding your own initial questions!* ) that you would be willing to work on, and I’ll form groups based on your preferences.

Each group will formulate testable predictions for one or more of the hypotheses derived from their question and design an experimental or observational study to test those predictions. As a group, you should produce a research design/methods section of a proposal linked to your predictions. This should include a concise statement of the statistical methods that would be used to analyze the results.

This description of research design and methods should be no longer than about 7 double-spaced pages, excluding references. It is due on 27 October. Since this is a group project, writing should be shared equitably among all members of the group. Many of you will find working in a group like this unexpectedly time-consuming and challenging, but it is important experience since many proposals are prepared by groups of scientists. We will spend one or two class periods discussing these projects.

C. *Complete Individual Proposal*

The major writing assignment will be an individual research proposal on a topic of your own choosing. For those of you who have already written a proposal for your advisor or thesis committee, your proposal for this class must be on a different topic. It may be related to your main research interests, or completely different. Please talk with me early about the suitability of your topic.

This will be a complete proposal, including introduction with significance statement and review of relevant background information, clear statement and justification of hypotheses and predictions, thorough description of research design, field or laboratory methods, and statistics, discussion of potential results and how you will interpret those results, and references. You should use the guidelines for format and page limits of NSF doctoral dissertation research proposals which are liberal enough to allow you to make a detailed description of your project but stringent enough to discourage wordiness. We will discuss as a class the first drafts of each proposal, and then you will submit a final draft in which you address these comments as well as detailed reviews by me and one other class member.

D. *Review*

Finally, each of you will prepare a written review of another student’s individual proposal. This should be no more than 3 double-spaced pages in length. Students responsible for written reviews of the individual proposals will lead discussions of the proposals they will review.
Due Dates and Grading

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<thead>
<tr>
<th>Assignment</th>
<th>Due Date</th>
<th>Percent of Total Grade</th>
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</thead>
<tbody>
<tr>
<td>Research question (WebCampus postings)</td>
<td>1-8 September</td>
<td>7%</td>
</tr>
<tr>
<td>Significance statement</td>
<td>21 September (Monday)</td>
<td>13%</td>
</tr>
<tr>
<td>Objectives &amp; hypotheses (WebCampus postings)</td>
<td>29 September - 6 October</td>
<td>7%</td>
</tr>
<tr>
<td>Experimental design (group project)</td>
<td>27 October</td>
<td>13%</td>
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<tr>
<td>First draft of individual proposal</td>
<td>19 November</td>
<td>8%</td>
</tr>
<tr>
<td>Written review of proposal</td>
<td>1 December</td>
<td>8%</td>
</tr>
<tr>
<td>Final draft of individual proposal</td>
<td>10 December</td>
<td>22%</td>
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<tr>
<td>Class participation (may include some take-home assignments)</td>
<td>throughout semester</td>
<td>22%</td>
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Disability Statement

Any student with a disability needing academic adjustments or accommodations is requested to contact both the instructor and the Disability Resource Center (Thompson Building - 107), as soon as possible to arrange for appropriate accommodations.

Academic Dishonesty Statement

Academic dishonesty (e.g., cheating on exams or homework, plagiarism) is a serious offense. All work that you submit in this class must be your own. Each student is responsible for being familiar with UNR’s policies on academic dishonesty. Any student engaging in academic dishonesty in this course will receive a 0 on the assignment in question. In more severe cases, e.g., extensive plagiarism of work by other people, the case may be turned over to the proper University authorities for disciplinary action.

Plagiarism is defined as presenting someone else’s work as your own. Plagiarism does not just mean copying whole papers or articles from another source. It includes any information, ideas, sentences, phrases, photographs, graphics, audio, video or other material copied from another source, whether that be a paper or assignment submitted by another current or past student at UNR or elsewhere, a published book or article, a Web site, or an unpublished document by another author. These must be properly acknowledged by providing citations in your text and a bibliography giving complete publication information for all sources used in your paper. Even if you paraphrase someone else’s ideas and do not quote them directly, you still must acknowledge your source. Citations should also be given for little-known facts and statistics. Ignorance is not an excuse for plagiarism. If you are not sure whether you need to provide a source for a piece of information or how to cite a source, ask me. Dartmouth College has an excellent discussion of the ethics and practice of citing sources.
Some of these will be covered in lab sessions, some in discussions, some in both. We may add or subtract topics depending on time available and your interests and we may rearrange topics if appropriate.

Tentative Topic Outline

1. Choosing a research problem
2. Overview of research design in ecology: observational studies, comparative studies, natural "experiments", quasi-experiments, manipulative experiments
3. The method of multiple working hypotheses; logical trees
4. Complex patterns of causation
5. Classical experimental design
   a. controls
   b. independence, replication, and pseudoreplication
   c. factorial designs
   d. blocking, complex treatment structures
   e. nested designs, repeated measurements of the same individuals
   f. multiple comparisons
   g. multiple regression
6. Power analysis
7. Correlation, causation, and path analysis
8. Model selection and multi-model inference
9. Randomization tests
10. Causal explanations at different levels in biology
11. The comparative method revisited?
12. Meta-analysis?

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1Some of these will be covered in lab sessions, some in discussions, some in both. We may add or subtract topics depending on time available and your interests and we may rearrange topics if appropriate.