MES SPRING 2016

Research Design and Quantitative Methods (RDQM)

Syllabus

**Faculty:** Peter Dorman, Lab I 3015, 360-867-8699, dormanp@evergreen.edu

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**Faculty Office Hours:** By appointment.

**Class times and locations:** Tues. & Thurs., 6 – 10 PM; Sem II A1105; 3105, 3107, 3109;

For labs: CAL East on Tuesdays and CAL West on Thursdays for all computer labs.

**Teaching Assistant:** Rebekah (Reb) Korenowsky, [korreb13@evergreen.edu](https://webmail.evergreen.edu/owa/redir.aspx?SURL=GNpXPP6EeRn2Em0vtbvp4NOwODV0tbzBT34x9JCw-TLBsZbkDFjTCG0AYQBpAGwAdABvADoAawBvAHIAcgBlAGIAMQAzAEAAZQB2AGUAcgBnAHIAZQBlAG4ALgBlAGQAdQA.&URL=mailto%3akorreb13%40evergreen.edu)

**Teaching Assistant Office Hours**: Wednesday 5 – 7 pm and Thursday 4 – 6 pm, Lab I 3016

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**Course objectives:**

To understand: (1) the role of statistics across fields of science, with emphasis on the ecological, environmental and social sciences, (2) the use of statistical methods to help us answer questions about the world we observe, (3) the mutual dependence between data collection and analysis, (4) research design methodologies, including how to develop a study and articulate data collection methodology and statistical analyses, and (5) what makes a good grant proposal and how to collaborate with a peer(s) to complete a competitive grant proposal.

**Approach:**

The above components of a scientific study need to be considered together rather than separately; design and analysis aspects will be taught together in this course. Emphasis will be on application, and will include data analyses on personal or lab computers. Important points regarding your understanding of research design, analysis and reporting of statistical methods will be reinforced by computer labs, homework assignments, peer-reviewed literature, and exams.

**Required Textbooks**:

Whitlock and Schluter. *The analysis of biological data.* (2015). ISBN: 9781936221486

Abelson. *Statistics as Principled Argument* (1995). ISBN: 9780805805284

*Texts will be supplemented with additional readings.*

**Required Software:**

We will primarily use Microsoft Excel and SAS JMP (“Jump”) to perform data management and analysis. These programs are available for both the Windows and Mac operating systems; Excel is a commonly used spreadsheet program, and JMP is a popular statistical program with an excellent user interface. Some labs may use the MS Excel Resampling Stats plug-in which only works on Windows. We may also explore the use of PC-ORD which is also only available for Windows. All the software required for labs is available on campus in both the CAL and Academic Computing Center. Students can obtain a one year license of JMP (Windows and Mac). You should plan to spend considerable time outside class working in the CAL or on your laptop to complete your lab assignments and your grant proposal project.

We strongly advise students to consider using a personal computer and to install JMP. The JMP installer is available through

[\\Orca\Programs\research-design\Handouts\Software-SaS-JMP](https://webmail.evergreen.edu/owa/redir.aspx?SURL=uKQdfkUQDLqgiLIh6lHzAHHGnAxGudd8Zx1o9ddab6QCQvnqWVfTCGYAaQBsAGUAOgAvAC8ALwBcAFwATwByAGMAYQBcAFAAcgBvAGcAcgBhAG0AcwBcAHIAZQBzAGUAYQByAGMAaAAtAGQAZQBzAGkAZwBuAFwASABhAG4AZABvAHUAdABzAFwAUwBvAGYAdAB3AGEAcgBlAC0AUwBhAFMALQBKAE0AUAA.&URL=file%3a%2f%2f%2f%5c%5cOrca%5cPrograms%5cresearch-design%5cHandouts%5cSoftware-SaS-JMP)

If you have difficulties, contact the support staff in the CAL.

**Optional Software**:

Because of the increasing frequency of the use of the free data analysis software/programming language known as “R”, we can provide students with the scripts to use R for the statistical tests we examine in this program. We decided to not use R as our primary platform because it is a programming language rather than ready-to-use software, requiring that students unfamiliar with it would need to learn this language in addition to the research design and statistical concepts covered in this class. Because this may be excessive for some of you, we are encouraging most students to use JMP. However, students with past experience using R, or those who are up for a challenge, are welcome to use R instead of JMP for their homework and labs.

**Assessment Activities:**

1. **Labs:** As mentioned above, we will be having hands-on computer labs that walk students through the software (JMP) and techniques required for each of the statistical tests examined in this program. Labs are intended to be a collaborative learning environment, with students helping each other and not solely relying on faculty. It is inevitable that some will finish earlier than others. We ask that you stay however long it takes for you to complete the lab. If you find yourself being on the slower end, do not be discouraged—it is natural for students to work at different paces through the lab. If you find yourself working more quickly, we encourage (but do not require) you to stay and help your peers complete the assignment. Completed labs are due one week after the original in-class lab was conducted (i.e., a Thursday lab is due the following Thursday). Labs will be assessed based on **degree of completion**.
2. **Homework:** We will assign problem sets for the various statistical tests we examine to reinforce the concepts learned in lecture and labs. Most problems will come from Whitlock and Schluter, but we will draw on additional texts as needed. Problems will be posted on Monday of each week on Canvas, and they will be due by the following Tuesday (i.e., 8 days later). Homework **will** be graded.
3. **In-Class Problem Sets:** We will regularly work on problems during class time. These will often differ from homework assignments by being more open-ended and thought-provoking. Assessment will be based on active participation in problem-solving groups.
4. **Weekly Check-In Paragraphs: It is imperative** that you keep on top of the material in this class and that you do not fall behind. As such, we are going to be acquiring feedback weekly from each student in the form of a short paragraph that will be uploaded on to canvas. Please describe the concepts that are most clear in your mind, as well as concepts that are still fuzzy. Post these paragraphs to Canvas. We have built time in class to revisit some of these concepts, and will be relying on this feedback to do so.
5. **Exams:** To further reinforce key concepts, we will have a mid-term and a final exam. The mid-term will be a **take-home** exam, with open-notes and open-books. The final will be taken **in class**, covering material presented since the mid-term (i.e., it will not be cumulative). For the final, students will receive a handout containing all formulas needed for completing the exam.
6. **Final project: Research Grant Proposal** (See Handout for details.) A common activity for professionals in environmental and other fields is pursuing grants from donors like the National Science Foundation, the National Institutes of Health and the many private foundations that fund research. This is normally a two-step process. In the first stage you submit a relatively short (1-2 page) proposal that sketches the research you want to conduct and makes a case for why it’s important. If this idea catches the eye of the funder, you will be invited to submit a much more detailed second-round proposal. Your final project in RDQM this quarter will be preparing a *hypothetical second-round proposal* for research of interest to you/your group.

**Credit and Evaluation:**

Expectations are outlined in the RDQM covenant. Partial credit is not awarded in the MES Program. Full credit will be awarded based on attendance, punctuality, participation, and timely submission of all assignments. To be excused due to illness, religious holidays, conference attendance, etc., contact your faculty as soon as you know that you will have a problem meeting these expectations. Depending upon the reason, you may or may not be excused. We also expect students to satisfactorily complete lab assignments, homework, midterm and final exams, and the grant proposal research project with student team member(s). Credit will be jeopardized if there are unexcused absences, a pattern of tardiness, lack of participation on a regular basis, and failure to submit all assignments on time. Because each day’s material typically builds on the previous material, in most cases**, late work will not be accepted.**

All students are **required** to participate in an evaluation conference with their faculty during the evaluation week (June 6-9), and to bring with them a paper copy of their draft self-evaluation. Students also are **required** to write an evaluation of each faculty member in RDQM and post it to Canvas.

Weekly Schedule:

| **Week** | **Date** | **Activity** | **Reading** |
| --- | --- | --- | --- |
| 1 | Tuesday March 29 | **Introduction to Class**: Syllabus; Introduction to Group Project.  **Describing Data**: Defining and classifying data; Variables vs parameters; Quantitative vs qualitative; Units of observation; Formatting data | Review Whitlock and Schluter, Ch. 1;  Abelson, Ch. 1 |
| Thursday March 31 | **Obtaining data**: Measurement choices; Units of measurement; Validation of measurement (and measurement error); Proxies; Error in data from external sources; Dealing with missing data/imputation; Outliers  **Brainstorm Session for Group Projects** | Abelson, pp. 78 - 88 |
| 2 | Tuesday April 5 | **Obtaining Data (continued) and Research Design**: Lab experiments, field experiments, natural experiments; Case study issues (spanning for external validity, comparative cases); Sampling, population and sample frames; Selection bias; Introduction to the concept of test power and sample size  **Finalize teams and subject for Group Project** | Whitlock and Schluter, Ch. 14;  Abelson, Chs. 2, 7 |
| Thursday April 7 | **Understanding Data**: Descriptive statistics; Graphing distributions of data; Precision; Data transformations  **Computer Lab**: Finding the right denominator; Learning your way around JMP; Data transformations | Whitlock and Schluter, Ch. 3, 13.3;  Abelson, Ch. 3. |
| 3 | Tuesday April 12 | **Distributions and Hypothesis Testing**: Hypotheses (null vs alternative); Multiple/Competing hypotheses; Introducing the concept of p – values  Review questions from Week 2 Computer Lab  ***Due: 1-2 page pre-proposal for Grant Project*** | Whitlock and Schluter, Ch. 6, 10, and p. 366; Abelson, Ch. 4 |
| Thursday April 14 | **Evaluating significance**: Confidence Intervals; Type I and II Error; Power of a Test | Whitlock and Schluter, Sections 4.3, 6.3, 6.4 |
| 4 | Tuesday April 19 | **Assessing normality and differences between means**: z-tests and t-tests and non-parametric equivalence.  **Computer Lab:** z- and t- tests  **Grant proposal overview returned** | Whitlock and Schluter, Sections 11.1, 11.3, and 11.4, Ch. 12, Sections 13.4 – 13.6 |
| Thursday April 21 | **Rachel Carson Forum – Attendance Required**  **Mid Term Exam (take home) handed out** |  |
| 5 | Tuesday April 26 | **Discuss Rachel Carson Forum**  **Assessing Relationships Between Independent and Dependent Variables:** Correlation and Simple Linear Regression  Review questions from Week 4 z- and t- test Computer Lab  **Computer Lab:** Correlation and Simple Linear Regression  ***Due: Five annotated sources for grant proposal*** | Whitlock and Schluter, p. 201, Chs. 16 and 17 |
| Thursday April 28 | **Assessing Relationships Between Independent and Dependent Variables:** Multiple Regression*;* What’s a good model?  Review questions from Correlation and Simple Regression Lab  **Computer Lab:** Multiple Regression |  |
| 6 | Tuesday May 3 | **Working with Frequency Data:** Chi Squared and Contingency Tables  **Working with survey data (In class exercise)**  Review questions from Week 5 Multiple Regression Lab  ***Due: Outline of research methods, including a description of data to be collected for your project.*** | Whitlock and Schluter, Chs. 8 and 9 |
| Thursday May 5 | **Assessing Differences Between More than Two Means**: ANOVA  **Computer Lab:** ANOVA | Whitlock and Schluter, Ch. 15 |
| 7 | Tuesday May 10 | **Catch Up Day:** Meet with faculty regarding grant proposal projects questions and progress  Review questions on Week 6 ANOVA Computer Lab  **Look ahead to next year:** Thesis Work  **Outlines returned** |  |
| Thursday May 12 | **Constructing, Testing, and Selecting Models:** Transforming data; Discussion of R2; Parametric vs. non-parametric testing and models | Abelson, Ch. 5 |
| 8 | Tuesday May 17 | **Guest Lecture:** Analyzing Patterns in Data |  |
| Thursday May 19 | **Meaning and Importance of Data:** How interesting are data; social significance of data; Pure vs applied research; Critiques of p-values, null hypothesis testing | Have finished Abelson |
| 9 | Tuesday May 24 | **Misc. Topics:** Pseudo replication (Natural Science)/Clustering; Error propagation, Surveys  **Turn in written grant proposal** | Whitlock and Schluter, p. 115 |
| Thursday May 26 | **IN CLASS FINAL EXAM** |  |
| 10 | Tuesday May 31 | Student presentations – Research Grant Proposal |  |
| Thursday June 2 | Student presentations – Research Grant Proposal |  |
| 11 | June 6-9 | Evaluations; Graduation June 10th! |  |