**Research Design and Quantitative Methods (RDQM) SPRING 2021 Syllabus**

**Faculty:** John Kirkpatrick kirkpatj@evergreen.edu

Kathleen Saul saulk@evergreen.edu

**Faculty Office Hours:** Some virtual office hours, at specific times, will be announced during the quarter. Otherwise please contact faculty to set up a phone or video conference.

**Virtual Class Times:** Tuesday & Thursdays, 6–10 PM

**Class Location:** Classes will be held remotely (via Canvas and Zoom) for the duration of this class, in order to minimize the spread of COVID-19. Please check Canvas regularly including to find the web links to our virtual Zoom lectures and seminar.

**Teaching Assistants (TAs):**

Adam Martin, [randall.a.martin@gmail.com](https://mail.google.com/mail/?view=cm&fs=1&tf=1&to=randall.a.martin@gmail.com)

Robyn Cloughley, [clorob14@evergreen.edu](https://mail.google.com/mail/?view=cm&fs=1&tf=1&to=clorob14@evergreen.edu)

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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 interdependence of research design, data collection and analysis,

(4) research design methodologies, including how to develop a study and articulate data collection and analysis methodologies, and

(5) how to write a compelling grant proposal, that a funding source of the value of your proposed research.

**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, data analysis and reporting of statistical results will be reinforced by computer labs, homework assignments, reading and discussing peer-reviewed literature, and take-home and in-class exams.

**Required Textbooks (**Additional required readings will be provided on Canvas):

Gotelli, Nicholas J. and Aaron M. Ellison, *A Primer of Ecological Statistics*. 2nd edition (2018). Sinauer Associates, Inc., Sunderland, MA. ISBN978-1-60535-064-6

Booth et al., *The Craft of Research*. 4th edition (2016). University of Chicago Press, Chicago, IL. ISBN: 978-0226239736 (previous editions OK to use).

**Optional Textbooks\*:**

Allison, Paul D. *Multiple Regression: A Primer*. (1999). Pine Forge Press, Thousand Oaks, CA. ISBN: 9780761985334

Corder, Gregory W. and D. I. Foreman. *Nonparametric Statistics for Non-Statisticians: A Step-by-Step Approach.* (2009). John Wiley & Sons, Hoboken, NJ. ISBN: 978-0470454619

Creswell, John W. and J. David Creswell. (2017). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches Fifth Edition.* Sage Publications. ISBN: 978-1506386706

\*The Corder & Foreman book can be downloaded as a .pdf: go to library.evergreen.edu and use your student login. Then search for *Nonparametric Statistics for Non-Statisticians.*

**Statistical software for labs:**

Students can choose between two software options to perform data management and analysis for labs: either SAS JMP (“Jump”) or the free software/programming language known as “R”. Additionally, everyone will need access to Microsoft Excel. You should plan to spend considerable time working in JMP or R to complete your labs, some homework, and some take-home exam assignments. We will work with you to resolve any technical software issues that arise. In a normal quarter we typically spend up to 2 hours in the CAL together on the day labs are assigned. While teaching remotely, we will answer your questions during class time (if you are working on labs then) and have specific virtual office hours to answer questions outside of class time.

***JMP*** is a popular statistical program with an excellent user interface. Students can obtain a one-year license of JMP (Windows and Mac). Students will need to install JMP on their own computer - we will forward instructions as soon as we know that the installation and license is updated and working properly.

***R:*** because of the growing use of the free, open source data analysis software/programming language known as “R”, we have written up all of the assigned labs in both JMP and R versions. R is a programming language rather than ready-to-use software, requiring that students unfamiliar with it will need to learn this language in addition to the research design and statistical concepts covered in this class. The latest version (R version 3.6.3) is available from <https://www.r-project.org/>. For an enhanced user-friendly working environment, many people use the open-source “RStudio”, which we highly recommend (download from <https://www.rstudio.com/>. For additional support see the page ‘Resources & Tips for R’ on the RDQM Canvas site.)

**Assessment Activities:**

1. **Labs:** We will assign computer labs that walk students through the software (your choice, JMP or R) and techniques required for each of the statistical approaches and tests. Labs are intended to be a collaborative learning environment, with students learning from each other and the RDQM teaching assistant. This will be more difficult due to the COVID-19 restrictions, but we encourage you to help each other (as long as you’re using the same software), consult Canvas for additional tips and online Q&A, and reach out to faculty as needed. Completed labs are typically due one week after the original in-class lab was conducted. Labs will be assessed based on **degree of completion**, with feedback provided by the TA and faculty on your interpretation of the results.
2. **Homework:** We will assign problem sets for additional practice and to reinforce the concepts learned in lecture and labs. Homework **will** **be assessed** as complete or incomplete, with an emphasis on providing feedback that you can use to improve your understanding of the statistical tests and concepts.
3. **Activities and Seminar:** RDQM is not a typical MES/Evergreen program, and we will have only a limited number of discussion-based seminars. However, you will regularly work in small groups on short assignments during class time (*even virtually, for those that can join us remotely during class times, by Zoom or by phone)*. These will often be more open-ended than homework assignments. For students who may already have a full understanding of basic concepts or tests, this will be an opportunity to share your knowledge with your classmates.
4. **Exams:** To reinforce key concepts, we will have a mid-term and a final exam. The mid-term will be a **take-home** exam, open- notes and books, but must be completed **by each student on their own**. The final will cover material from the entire course, but emphasizes material presented after the mid-term. We will not expect you to memorize formulae or constants needed for completing the exam (those will be provided on the exam). Like the midterm, this exam will also be conducted remotely. After the mid-term, we will provide more specifics about the format and types of questions on the final.
5. **Grant Proposal:** Individuals and organizations need to write grants requesting funding from agencies or foundations. For example, conservation groups write grants to fund land acquisition, management of property, and restoration endeavors. Teachers and administrators write grants to fund educational projects. Artists, filmmakers and writers write grants for materials and to pay for leases on galleries. Staff of nonprofit organizations write grants to fund community development projects, relief efforts, health initiatives, and other activities. In science, most researchers require funding to carry out their investigations. Getting funds requires being able to craft grants that catch the funders’ attention and make them want to part with their money. No matter what you imagine as your eventual career, grant-writing skills are valuable ones to develop.

Writing successful grant proposals relies on your:

* understanding of the field,
* ability to identify the critical unanswered questions in that field,
* logical and problem-solving abilities,
* skill at scientific research design,
* ability to write persuasively and clearly, and
* ability to be well-organized and plan the pieces of the study you propose, and the grant that you write.

You will be asked to complete a number of assignments that will help you craft a grant proposal as the final, summative project for RDQM. More details about the specifics of the assignments will be forthcoming.

**Credit and Evaluation:**

Expectations are outlined in the RDQM Community Agreement. Partial credit is not awarded in the MES Program. Full credit will be awarded based on engagement and timely submission of assignments. *Please note: we are well aware of the multiple demands on your time, disruptions to your daily schedule, and increased difficulty of completing school work without in-person classes and direct access to faculty and TAs. We are experiencing many of these challenges on our end as well.* Please contact your faculty as soon as you know if you having concerns about a deadline, are having difficulty with particular concepts, or will have a problem meeting course expectations. With our support, we will expect students to complete lab assignments, homework, midterm and final exams, and the mini-prospectus assignment with adequate quality, to the faculty’s satisfaction.

All students are **required** to participate in an evaluation conference with their faculty during the evaluation week (June 8-12), and to produce a self-evaluation of their work throughout the quarter. Students also are **required** to write an evaluation of each faculty member in RDQM and post it to my.evergreen.edu. At the end of the quarter, you will also be asked to take an anonymous evaluation of the RDQM program and faculty.

Your faculty evaluator will be assigned based on the topic of your mini-prospectus. Throughout the quarter all faculty and the RDQM TA will provide specific feedback on labs, homework assignments, and specific test questions.

**Choose Your Own RDQM Adventure:**

***NOTE:*** *The following section reflects our typical, pre-COVID-19 statement about optional ‘Tracks’ in RDQM. We MAY be able to offer advanced material later in the quarter, but in order to be as flexible as possible the information below is subject to change.. The language about optional final exam questions – if you are able to pursue any of the optional tracks – will still apply.*

RDQM is a rigorous program. To provide meaningful content across this range of student preparation and backgrounds, in certain class periods (especially later in the quarter) you will be given the choice of learning more advanced material. In certain circumstances, a student may be required to repeat a lab or homework assignment in order to demonstrate competence in core concepts and applications prior to moving on to more advanced work.

Content up to non-parametric statistics (Tuesday of Week 7) is required of everyone for credit. Beyond that, students will be able to choose between reviewing past material or learning new material.

**Tracks:** In Weeks 7 and 8, different RDQM faculty will either lead a review of previous material (with additional practice problems) or provide additional, more-advanced material. Students can choose either to review previous material or move on to more advanced topics. There will be *optional* exam questions based on the material presented in each track. There is no ‘penalty’ (in your final evaluation) for attending and trying to answer questions based on a track – if you don’t demonstrate an understanding of the optional advanced material, we just won’t mention it in your evaluation. Each students’ competencies will be reflected in the course description and evaluation.

**Weekly Schedule** (*Please check for updates to schedule on Canvas announcements and updated syllabus versions, if any*)

| **Week** | **Date** | **Activity** | **Readings** |
| --- | --- | --- | --- |
| 1 | Tuesday March 30 | **Introduction to RDQM**: Introduction, Expectations, Course Assignments, Online Teaching Technology & Resources  **Review of Probability**: the frequentist approach, independence and mutually exclusive outcomes, Bayes Theorem, types of variables, the Normal Distribution | Gotelli & Ellison Ch. 1 and 2 |
| Thursday April 1 | **The Research Question & Study Design:**  **Review:** Writing a researchable question  **Brainstorming Grant Proposal Topics**  **Computer Lab**: Learning your way around JMP or R | Booth et al. Ch. 3, “From Topics to Questions” |
| 2 | Tuesday April 6 | **Getting Started on Experimental Design**  **Finalize teams and topics for the grant proposal project** | Gotelli & Ellison, Ch. 6 |
| Thursday April 8 | **Understanding Data**: Summary statistics and measures of location; graphing distributions of data; parameters; data transformations  **Computer Lab**: Graphing your data; Summary Statistics; Normality | Gotelli & Ellison Ch. 2 cont’d. & Ch. 3 |
| 3 | Tuesday April 13 | **Hypothesis Testing and Evaluating Significance:** Hypotheses (null vs alternative); Multiple/Competing hypotheses; Confidence Intervals (from Ch. 3); Type I and II Error; Sample size and power of a test; p-values  **Seminar:** Evaluating Significance  **DUE:** Homework #1 | Gotelli & Ellison, Ch. 3 cont’d. & Ch. 4 |
| Thursday April 15 | **Assessing normality and differences between means**: t-tests (one-sample, paired, and two-sample) *Shawn leads*  **Computer Lab:** t- tests  **DUE: 1 –2 page pre-proposal overview for grant project** |  |
| 4 | Tuesday April 20 | **More on Research Design**  **Review material to date** (including labs to date, hypothesis-testing, and t-tests)  *Each instructor leads session* | Gotelli & Ellison, Ch. 7  Review previous material |
| Thursday April 22 | **Assessing Relationships Between Dependent and Independent Variables:** Correlation and Simple Linear Regression *Zita leads*  **Computer Lab:** Correlation and Simple Linear Regression  **Mid Term Exam** posted by 6 pm today  **DUE:** Homework #2  **Kathleen on Furlough** | Gotelli & Ellison, Ch. 9, pp. 239 - 263 |
| 5 | Tuesday April 27 | **DUE:** Mid-term Exam – turn in by 6 pm  **Midterm Review**  **Webinar: An Overview of Tribal Perspectives on Climate Change (7 – 8:30 PM)**  **DUE: Five annotated sources for grant proposal project** |  |
| Thursday April 29 | **Buffer Day**  **Meaning and Importance of Analysis:** Types of replication; Publication bias, social significance of data  **Student meetings with faculty** |  |
| 6 | Tuesday May 4 | **Ethics in Research:** role play  **Working with Frequency Data:** Chi Squared and Contingency Tables  **Computer Lab:** Contingency Tables  **DUE:** Homework #3  **DUE: Outline of research design, including a description of data to be collected for your project.** | Gotelli & Ellison Ch. 11 |
| Thursday May 6 | **Assessing Differences Between More than Two Means**: ANOVA (1-way, post-hoc tests)  **Computer Lab:** ANOVA | Gotelli & Ellison Ch. 10 |
| 7 | Tuesday May 11 | **Non-parametric statistics:** Overview of assumptions, specific alternatives to parametric tests  **Computer lab:** Non-parametric stats in JMP or R |  |
| Thursday May 13 | * Guest speaker: Grant Writing * **Green track:** Review & practice problems * **Blue track: Multiple Linear Regression w/ Computer Lab** | Gotelli & Ellison, Ch. 9, pg. 275 - 279  *Blue Track:* Allison Ch. 1 & 2 (pp. 1-48) *on Canvas* |
| 8 | Tuesday May 18 | **Peer review of grant proposals**  **DUE: Draft grant proposal for peer review** |  |
| Thursday May 20 | * **Green track:** Review & practice problems * **Blue track:** Ordination (multivariate analyses, with lab) Using regression for nonlinear relationships   **DUE:** Homework #4 | Ordination: Gotelli & Ellison Ch. 12, pp. 406 - 428 |
| 9 | Tuesday May 25 | **Buffer Day**  **ALL:** Review & practice problems  **Group project time in class for discussion and last tasks** |  |
| Thursday May 27 | **DUE: Complete grant proposal**  **Final Exam Posted at 6pm**  Optional: Review Session / Catch Up |  |
| 10 | Tuesday June 1 | **FINAL EXAM HANDED IN PRIOR TO 6PM**  Q&A and go over final exam |  |
| Thursday June 3 | **Grant proposal presentations** |  |
| 11 | June 7 -11 | **Evaluation Conferences**  MES Graduation Saturday June 12th |  |