Experimental and Observational Study Design and Analysis for Environmental Scientists

EVPP 991 – Fall 2020

Syllabus

Instructor: Diego Valderrama
Assistant Professor, Environmental Science and Policy
3033 David King Hall
dvalder@gmu.edu

Classroom: Innovation Hall 338.

Class Meetings: Wednesdays, 7:20 PM to 9:10 PM.

Office Hours: Fridays, 2 to 4 PM, or by appointment.

Course Description and Goals

The topic of this seminar is "Experimental and Observational Study Design and Analysis for Environmental Scientists". The goals of the course are: (1) to learn the principles of experimental and observational study design; (2) to apply these principles to a critical examination of scientific papers and to students' own research proposals; and (3) to give students practice in synthesizing material from diverse sources and making oral and written presentations.

Course Content, Instructional Methods and Evaluation of Student Performance

The course content is laid out by week in the syllabus.

Most weeks, class will start with a 45-50 minute lecture on the topic of the week. This will be followed by a group activity or discussion led by one student. These will be assigned on a week-by-week basis. Students are required to attend class and participate in discussions. Students should inform the instructor in advance via e-mail of an unavoidable absence or in the case of a last-minute problem, as soon as possible after class. Taken together, the weekly exercises/discussions will account for 40% of the grade.

Each student is responsible for developing a research proposal following the procedures discussed in the first 2/3 of the class. This may be their own actual research proposal or a

hypothetical proposal on a topic of interest. The proposal will have a budget in addition to Introduction/Literature Review/Hypotheses/Experimental Design/Methods. If a student already has a research proposal approved, they will submit a critique of it using the principles learned in the class. Students may also elect to submit an NSF-type grant proposal based on their research proposal, again applying the concepts of the course. The Research Proposal should be 20-30 pages double-spaced. This will account for 40% of the grade and be due at the end of the semester.

Near the end of the semester, each student will present their proposal to the class (20-min PowerPoint presentation) in the context of material learned in the class. This will be worth 20% of the grade.

Principal Texts:

(F) Ford, E.D. 2000. *Scientific Method for Ecological Research*. Cambridge University Press. 564 pp.

(G&E) Gotelli, N.J. and A.M. Ellison. 2004. *A Primer of Ecological Statistics*. Sinauer. 510 pp.

(G) Green, R.H. 1979. *Sampling Design and Statistical Methods for Environmental Biologists*. Wiley-Interscience. 257 pp.

(T) Townend, J. 2002. *Practical Statistics for Environmental and Biological Scientists*. 276 pp.

(V) Valiela, I. 2009. *Doing Science: Design, analysis, and communication of scientific research*. 2nd edition. Oxford University Press. 333 pp.

TENTATIVE CLASS SCHEDULE: Subject to changes.

Date	Topic	Reading
Aug 26	Research Formulation: Defining and proofing research questions. Conceptual and Propositional Analysis: concepts, axioms, postulates, laws, and hypotheses.	F, Ch. 1-3
Sep 2	Research Plan Development, research questions, relationship to theory, art of measurement, hypothetic-deductive method and falsification	F, Ch. 4-7; G&E, Ch. 4; G, Ch. 2
Sep 9	Assessment of Postulates, Properties of Data	F, Ch. 8; V, Ch. 2; T, Ch.2; G&M, Ch. 1-3
Sep 16	Study designs and statistical methods for experimental studies	G&E, Ch. 5-8, 10; T, Ch. 3-4; V, Ch. 3-4
Sep 23	Study designs and statistical methods for experimental studies - continued	G&E, Ch. 5-8, 10; T, Ch. 3-4; V, Ch. 3-4
Sep 30	Study designs and statistical methods for observational studies	G&E, Ch. 5-9; G, Ch. 2&4
Oct 7	Exploratory Data Analysis; Multivariate Analysis	T, Ch. 5-6, 14-15; G&E, Ch. 12
Oct 14	Writing a research proposal. Introduction/Literature Review	V, Ch. 5-6
Oct 21	DRAFT of Intro/Lit Review Due Writing a research proposal. Hypotheses/Research Design/Methods	V, Ch. 5-6
Oct 28	DRAFT of Intro/Lit Review returned. DRAFT of Hypotheses/Research Design/Methods DUE. Presenting the results of research in text, tables and figures.	V, Ch. 8-10
Nov 4	Discussion and Conclusions in a paper or thesis. DRAFT of Hypotheses/Research Design/Methods Returned.	
Nov 11	Disseminating your work. Social process of science.	F, Ch. 13-14; V, Ch. 6-7
Nov 18	Students present final research proposal to class.	
Nov 25	NO CLASS – THANKSGIVING BREAK	
Dec 2	Students turn in written proposal to instructor.	