

## HU3900 – Inquiry Seminar: Numbers and Socio-ecological Change

C Term 2019 / M 8:00 – 9:50

SL226

Professor: William San Martín  
Preferred Pronouns: He, Him, His  
[Email: wsanmartin@wpi.edu](mailto:wsanmartin@wpi.edu)

Office Hours: T&F: 10:00-11:00 or by appointment  
Office: SL 008

### **Seminar Description:**

This seminar examines the history of quantification in modern environmental sciences and policy. We will study the process by which numbers and other quantitative mechanisms to collect, process, and predict data have monopolized our understanding of ecological change. We will pay particular attention to the social, economic, and political dimensions of the role of numbers, models, and metrics assessing socio-environmental change locally and globally.

This seminar will integrate the history of earth and planetary sciences, quantification, and computing to think about how methods and technologies shape our understanding and decisions about our relation with the environment. Some of the topics this seminar will address are mathematical climate models, quantification and objectivity, predictors and risk, computer models and simulations, toxicity and human health, economics and economic models, and the role of evidence and expertise in neoliberal democracies.

### **Seminar Outcome:**

This inquiry seminar serves as the culmination of the Humanities and Arts Requirement. All Inquiry Seminars have two primary goals: 1) to foster independence of thought through self-directed research and writing, and 2) to encourage a cooperative approach to learning through open exchanges with peers in a small seminar setting. Students will learn how to frame questions and to research and write about a self-chosen topic related to the theme of this seminar.

The title and abstract of this work will appear on your transcript. They should provide a professional summary of your work that you will be proud to see on the transcript.

### **Learning Outcomes:**

Each student who completes this inquiry seminar will:

- Frame and investigate a significant research question in a thematic area
- Identify appropriate scholarship using the library and other resources
- Evaluate which sources are the most reliable and authoritative
- Develop their own argument about the research question using relevant evidence
- Discuss the work of other students in the seminar in a spirit of openness, cooperation, and dialogue

### **Expectations & Policies:**

- Students are expected to think critically and independently about an area that requires research and investigation, communicate their thoughts effectively, and participate in a

collaborative community of learning. Please see participation rubric below.

- Independent research begins with the ability to define a topic, survey work relevant to your subject, and develop a bibliography. But diligent research is merely the first step towards writing a good paper in a scholarly manner. You should also demonstrate the ability to organize, analyze, and integrate the material into a novel argument. Even experienced scholars find this a challenge. Developing an innovative argument and good writing require several sessions researching, rewriting, peer-reviewing, and revising. Plan accordingly and ask for assistance.
- This 1/3 unit (3-credit hour) course requires 2 hours of classroom instruction and 16-20 hours of out-of-class student work each week. Out-of-class work may include but is not limited to required reading, research, and writing assignments.
- All students are expected to do the required weekly reading which will form the basis for seminar discussion.
- Attendance is mandatory.
- Plagiarism will result in disciplinary action. For details on what constitutes plagiarism and academic integrity please visit: <https://www.wpi.edu/about/policies/academic-integrity>
- Use of electronic devices in the classroom must be limited to purposes related to class work.

### Participation Rubric:

Class Participation	Excellent	Good	Acceptable	Unacceptable
<b>Answering Questions</b>	Nearly all classes; answers directly refer to materials under consideration, & reflect a careful reading of material.	Most classes; answers indirectly refer to materials, or refer to them in a general manner.	Some classes; answers connected to general discussion if not to specific materials.	Never answer questions
<b>Posing Questions</b>	Nearly all classes; poses questions that are connected to a careful reading of materials.	Most classes; poses questions broadly connected to class materials.	Some classes; poses questions about assignments or materials.	Never poses questions
<b>Responding to Peer Observations</b>	Nearly all classes; engages comments of peers with questions or responses addressed to peer; respectful disagreement.	Most classes; engages discussion with class in general by posing or answering questions; respectful disagreement.	Some classes; asks related questions, supplies additional related observations; engage respectfully.	Disrespectfully responses or failure to respond to peer comments.
<b>Attendance</b>	Never missed a class meeting.	One missed class meeting.	Two missed class meetings.	Three or more missed class meetings.
<b>Extra-Classroom Participation</b>	Engages online & after class discussion; poses questions.	Asks or answers questions online.	Completes mandatory online assignments	Incomplete online assignments; ignores online discussion.

## Requirements & Grading:

Participation (Including group and student-led discussions): 25%

Research Process (Proposal and drafts): 25%

Final Research Paper (6000-8000 words, excluding notes and bibliography): 50%

The WPI Faculty has endorsed the following grading criteria for qualifying projects (HUA, IQP and MQP).

- Developed effective or creative goals or approaches
- Demonstrated initiative and originality
- Showed depth and critical thought in analysis
- Produced high quality results
- Took the lead in discussion, planning, and analysis
- Produced a clear, professional-level report with excellent drafts along the way
- Anticipated work that needed to be done and completed it in a timely manner
- Worked to advance the success of the students in the inquiry seminar

The available grades are:

- **A** grade denotes *excellent work* that attains all of the project goals and learning outcomes. The product and process of the work meet all of the expectations and *exceed* them in several areas.
- **B** grade denotes a *consistently good work* that attains the project goals and learning outcomes. The product and process of this work *meet but generally to not exceed* all of the expectations.
- **C** grade denotes *acceptable work* that partially attains the project goals and learning outcomes. The product and process of this work *meet some but not all* expectations. The work may be satisfactory, but the quality is less than anticipated.
- **NR** grade denotes work that did not attain the project goals or learning outcomes and is *insufficient for registered credit*. Both product and process were inconsistent with acceptable project work at WPI as outlined above.

WPI holds a competition for the Class of 1879 Prize to recognize the best Inquiry Seminar projects from the previous calendar year. Plan to research, write, and revise well enough to win one of these awards. I will be happy to provide advice and support your application.

## WPI Resources:

### Writing Center

Located on the second floor of Salisbury Labs (SL 233), the Writing Center is a valuable resource for helping you improve as a writer. Writing Center tutors are your peers (other undergraduate and graduate students at WPI) who are experienced writers themselves and who enjoy helping others tackle writing challenges. Although a single tutoring session should never be seen as a quick fix for any writing difficulty, these sessions can help you identify your strengths and weaknesses, and teach you strategies for organizing, revising, and editing your course papers, projects, and presentations. Writing Center services are free and open to all WPI

students in all classes, and tutors will happily work with you at any stage of the writing process (early brainstorming, revising a draft, polishing sentences in a final draft). Visit the Writing Center website <[wpi.edu/+writing](http://wpi.edu/+writing)> to make a 45 minute appointment.

### **Office of Disability Services**

The Office of Disability Services (ODS) coordinates accommodation service and provides advocacy and support to assist students with documented physical, learning, sensory, psychological, developmental, and other disabilities in achieving their full potential. The office strives to foster an environment that supports and encourages self-advocacy, independence, and personal growth. Visit <https://www.wpi.edu/student-experience/resources/disability-services> for more information

### **Gordon Library**

The research librarians at Gordon Library can assist you with a variety of research questions related to locating and citing sources. There is an online chat service on the library webpage. You may also schedule a research meeting with a librarian by visiting [tinyurl.com/wpilibrary](http://tinyurl.com/wpilibrary) or writing to [library@wpi.edu](mailto:library@wpi.edu)

### **Research, Citation, and Style Guides**

For an overview of the research and writing process, from formulating questions, reading critically, building arguments, and revising drafts, consult: <https://www.wpi.edu/library/research/citation-tools>. It includes information on citation styles. History papers generally follow the Chicago style, but you may use another system such as MLA or APA as long as you follow it consistently.

### **Seminar Schedule:**

- Jan. 9: Readings:
- Whitney, K., and Kiechle, M. (2017). Introduction: Counting on Nature, *Science as Culture*, 26:1.
  - Pine, K. and Liboiron, M. (2015). The Politics of Measurement and Action. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. Seoul, Republic of Korea — April 18 - 23, 2015
  - Edwards, P. (2010). *A vast machine. Computer models, climate data, and the politics of global warming*. MIT Press. [Introduction]

Please come to the first class with a list of discussion questions about these readings and a list of potential research topics. These will not necessarily be your final research projects but they should stimulate further ideas.

- Jan. 14:
- Research Questions: please bring to class two or three possible topics. For each, include a short description (200-300 words) and three or four research

questions. This requires preliminary research and identify potential sources (books and scholarly articles). Use the list of relevant readings (next page) to find initial topics and materials. I am available to meet and discuss potential topics.

Jan. 28:

- Paper Proposals. Please bring a printed copy of your proposal. Paper proposals should include the following:

**Project Summary:** Each proposal must contain a summary of the proposed project (500-800 words). The Project Summary consists of an overview, a statement on the intellectual merit of the proposed research, and a statement on its broader impacts.

The overview includes a description of the research topic and a statement of objectives and methods to be employed. The statement on intellectual merit should describe the potential of the proposed activity to advance knowledge. The statement on broader impacts should describe the potential of the proposed research to benefit society and contribute to the achievement of specific, desired societal outcomes.

The Project Summary should be informative to other persons working in the same or related fields, and, understandable to a scientifically or technically literate lay reader.

**Bibliography:** a preliminary list of sources that you plan to use. A good bibliography at this point should have at least ten scholarly sources.

**Proposed outline:** A general outline of three or four main sections for the paper (this is the broad scope of the paper, not a detailed outline.)

Feb. 4:

- First draft due (2000 words)
- Student-led discussion I\*

Feb. 11:

- Second draft due (4000 words)
- Student-led discussion II

Feb. 18:

- Full draft due (6000-8000 words)
- Student-led discussion III

Feb. 25:

- Submission of final papers

\* Student-led discussions will be based on one article/chapter (15-30 pages) from the list of relevant readings or one different article/chapter (15-30 pages) related to your research topic. All

students must turn a quote and a question from the readings 24 hours before class meet. Discussion leaders are responsible for selecting and posting materials a week in advance. Discussion leaders might also bring complementary materials (written or audiovisual) related to the readings and themes of that session.

### **List of relevant readings**

#### **Quantification, Knowledge, and Objectivity:**

Whitney, K., and Kiechle, M. 2017. Introduction: Counting on Nature, *Science as Culture*, 26:1.

Miller, C. A. 2005. New Civic Epistemologies of Quantification: Making Sense of Indicators of Local and Global Sustainability. *Science, Technology, & Human Values*, 30(3).

Galison, P. (2015). "The Journalist, the Scientist, and Objectivity." In Padovani, F., Richardson, A., and Tsou, J. (Eds.) *Objectivity in Science. New Perspectives from Science and Technology Studies*. Springer

Porter, T. (1995). *Trust in Numbers. The Pursuit of Objectivity in Science and Public Life*. Princeton University Press.

Porter, T. (1994). Objectivity as Standardization: The Rhetoric of Impersonality in Measurement, Statistics and Cost-benefit Analysis. In Megill, A. (Ed.) *Rethinking Objectivity*. Duke University Press.

Porter, T. (1990). *The Rise of Statistical Thinking, 1820-1900*. Princeton University Press.

Bowker, G., and Leigh S. (1999). *Sorting Things Out: Classification and its Consequences*. MIT Press.

Hacking, I. (1990) *The Taming of Chance*. Cambridge University Press.

Hacking, I. (1982). Biopower and the Avalanche of Printed Numbers. *Humanities in Society* 5.

Ambrose, M. L. (2014). Lessons from the avalanche of numbers: Big data in historical perspective. *I/S: A Journal of Law and Policy for the Information Society*. 11(2).

Camic, C. and Xie, Yu. (1994). The Statistical Turn in American Social Science: Columbia University, 1890 to 1915. *American Sociological Review* 59: 773-805.

Stigler, S. (1986). *The History of Statistics: The Measurement of Uncertainty Before 1900*. Harvard University Press.

Taper, M. and Lele, Subhash. (2004). *The Nature of Scientific Evidence: Statistical, Philosophical, and Empirical Considerations*. Chicago University Press.

### **Computer Simulations and Models:**

Pine, K. and Liboiron, M. 2015. The Politics of Measurement and Action. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. Seoul, Republic of Korea — April 18 - 23, 2015

Turkle, S. (2009). *Simulation and its discontents*. MIT Press.

Laubichler, M. and Müller, G. 2007. *Modeling biology. Structures, behaviors, evolution*. MIT Press.

Sismondo, S. (1999). Models, Simulations, and Their Objects. *Science in Context* 12.

### **Nature, Climate, and Ecology:**

Randalls, S. (2010). History of the 2°C climate target. *Wiley Interdisciplinary Reviews: Climate Change*. Vol. 1 (4): 598-605.

Edwards, P. (2010). *A vast machine. Computer models, climate data, and the politics of global warming*. MIT Press.

Harper, K. (2008). *Weather by the numbers. The genesis of modern meteorology*. MIT Press.

Laura J. Martin, “Mathematizing nature’s messiness: graphical representations of variation in ecology, 1930-present,” *Environmental Humanities* 7 (2015): 59-88.

Eliot, C. (2111). The Legend of Order and Chaos: Communities and Early Community Ecology. *Handbook of the Philosophy of Science* 11.

Brecking, B., and Q. Dong. “Uncertainty in Ecology and Ecological Modeling.” In *Handbook of Ecosystem Theories and Management*, edited by S. E. Jorgensen and Muller Felix, 51-74. Boca Raton: CRC Press, 2000.

Kohler, R. (2002). *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology* University of Chicago Press.

Lynch, M. (1988). The Externalized Retina: Selection and Mathematization in the Visual Documentation of Objects in the Life Sciences. *Human Studies* 11.

Worster, D. (1977). *Nature’s Economy: A History of Ecological Ideas*. Cambridge University Press.

Palladino, P. (1991). Defining Ecology: Ecological Theories, Mathematical Models, and Applied Biology in the 1960s and 1970s. *Journal of the History of Biology* 24.

Kingsland, S. (1995). *Modeling Nature: Episodes in the History of Population Ecology*. University of Chicago Press.

### **Risk:**

Jasanoff, S. (1999). The Songlines of Risk. *Environmental Values*. 8 (2).

Boudia, S, Jas, N. (2007) Introduction: Risk and “Risk Society” in Historical Perspective. *History & Technology*. 23(4).

Boudia, S. (2007). Global Regulation: Controlling and Accepting Radioactivity Risks. *History and Technology*. 23 (4):389-406

Elliott, R. (2017). Who Pays for the Next Wave? The American Welfare State and Responsibility for Flood Risk. *Politics & Society*. 45 (3).

Elliot. R. (2018). ‘Scarier than another storm’: values at risk in the mapping and insuring of US floodplains. *British Journal of Sociology*.

Fortun, K. (2004). From Bhopal to the Informing of Environmentalism: Risk Communication in Historical Perspective. *Osiris*. 2nd Series, Vol. 19, Landscapes of Exposure: Knowledge and Illness in Modern Environments.

Whiteside, K. (2006). *Precautionary politics: principle and practice in confronting environmental risk*. MIT Press.

### **Toxicity and Human Health:**

Boudia, S., and Jas, N., (Eds). (2013). *Toxicants, Health and Regulation since 1945*. Routledge.

Boudia, S., and Jas, N., (Eds). (2014). *Powerless Science?: Science and Politics in a Toxic World*. Bergham Books.

Langston, N. (2010). *Toxic Bodies: Hormone Disruptors and the Legacy of DES*. Yale University Press.

Brown, K. (2013). *Plutopia. Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters*. Oxford University Press.

Walker, B. L., (2010). *Toxic Archipelago. A History of Industrial Disease in Japan*. University of Washington Press.



Nash, L. (2006). *Inescapable Ecologies. A History of Environment, Disease, and Knowledge*. University of California Press.

Murphy, M. (2006). *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers*. Duke University Press.

Frieckel, S. (2004). *Chemical Consequences: Environmental Mutagens, Scientist Activism, and the Rise of Genetic Toxicology*. Rutgers University Press.

Mansfield, B. (2012). Gendered Biopolitics of Public Health: Regulation and Discipline in Seafood Consumption Advisories. *Environment and Planning D: Society and Space*, 30(4).

Shostak, S. (2013). *Exposed Science. Genes, the Environment, and the Politics of Population Health*. University of California Press.

Roberts, J. and Nancy L. (2008). Toxic Bodies/Toxic Environments: An Interdisciplinary Forum. *Environmental History* 13.

Liboiron, M. Tironi, M. and Calvillo, N. (2018). Toxic politics: Acting in a permanently polluted world. *Social Studies of Science*, Vol. 48(3).

### **Democracy, Evidence, and Expertise:**

Brown, M. B. (2009). *Science in democracy. Expertise, institutions, and representation*. MIT Press.

Brown, P. (1992). Popular Epidemiology and Toxic Waste Contamination: Lay and Professional Ways of Knowing. *J Health Soc Behav*. 33(3).

Ottinger, G. (2013). *Refining Expertise. How Responsible Engineers Subvert Environmental Justice Challenges*. NYU Press.

Jasanoff, S. (1991). Acceptable Evidence in a Pluralistic Society. In Mayo and Hollander (Eds.) *Acceptable Evidence: Science and Values in Risk Management*. Oxford University Press.

### **Economics and Economic Models:**

Den Butter, F. and Morgan, N. (2000). *Empirical models and Policy Making: Interaction and Institutions*. Routledge.

Morgan, M. (2012). *The world in the model. How economists work and think*. Cambridge University Press.

MacKenzie, D. (2006). *An engine, not a camera. How financial models shape markets*. MIT Press.

Hood, K. (2017). The science of value: Economic expertise and the valuation of human life in US federal regulatory agencies. *Social Studies of Science*. 47 (4).

Evans, R. (1999). Economic Models and Policy Advice: Theory Choice or Moral Choice? *Science in Context* 12.

Van den Bogaard, A. (1999). The Cultural Origins of the Dutch Economic Modeling Practice. *Science in Context* 12.

### **Science and Neoliberalism:**

Lave, R. (2012). *Fields and Streams: Stream Restoration, Neoliberalism, and the Future of Environmental Science*. University of Georgia Press.

Barandiarán, J. (2018). *Science and Environment in Chile. The politics of expert advice in a neoliberal democracy*. MIT Press.

Tironi, M. and Barandiarán, J. (2014). "Neoliberalism as Political Technology: Expertise, Energy, and Democracy in Chile." In Medina, Eden., et al. (eds.) *Beyond Imported Magic. Essays on Science, Technology, and Society in Latin America*. MIT Press.