

Montserrat 105N – Analyzing Environmental Data  
Syllabus – Spring 2020

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and by appointment

Course Homepage: <http://mathcs.holycross.edu/~little/Mont201920/Spring20.html>

This year, the Natural World cluster will explore the fundamental question, “How natural is our world?” If we define nature as “untouched by humans,” then it turns out that nature has completely disappeared from the world around us. Wildernesses are managed. Animals that had been eradicated earlier by humans, such as wolves, have later been reintroduced into their former habitats by humans. Humans modify their food genetically. Humans have even started to manipulate themselves, for instance by seeking cures for human diseases through genetic therapies. The news of a Chinese scientist editing the genes of twins was met with outrage from many. And yet we also know that humans gravitate toward “natural” places and “natural” things. We like our parks and river walks, and we pay a premium for “natural” and organic food. So what’s natural? And what’s unnatural? Or if everything is already unnatural, then what’s too unnatural? Together, we will explore why and how humans try to separate the physical world into parts that we label as “natural” and “unnatural,” and if this binary is even productive. Seminars will consider the ever-changing boundary between these two categories from conceptual, ethical, moral, philosophical, creative, historical, scientific, and quantitative perspectives.

Natural World Cluster Events (Required)

- Mindfulness Exercise at Joyce Contemplative Center, and dinner – February 2,3,4 (which seminars will go which day is still to be determined)
- Performance by *Las Cafeteras*, March 24, 7:00pm – location TBA

Natural World Seminars

NATURALLY UNNATURAL  
Professor Teresa Fenichel  
(fall) Reason & Self-Mastery  
(spring) Freedom & Self-Creation

ENVIRONMENTAL JUSTICE  
Professor Kendy Hess  
(fall) Justice in Theory  
(spring) Justice in Practice

ENVIRONMENTAL MATHEMATICS  
Professor John Little  
(fall) Modeling the Environment  
(spring) Analyzing Environmental Data

THE STORY OF HERE  
Professor Sarah Luria  
(fall) Mapping Nature at Holy Cross  
(spring) Mapping Change in Worcester

#### WHY AREN'T WE ALL FROGS?

Professor Julia Paxson

(fall) What is the Nature of Embryos?  
(spring) Can Embryos Become Unnatural?

#### HABITAT EXPLORATIONS

Professor Sylvia Schmitz-Burgard

(fall) Germany's Greening  
(spring) Bauhaus: Design for Democracy

Montserrat Student Ambassadors

Rebecca Henion

Jacqueline McCarthy

Natural World Cluster Librarian

Barbara Merolli

O'Callahan Science Library

508-793-2643

bmerolli@holycross.edu

#### WRITING/READING PLACE

Professor Stephanie Reents

(fall) 13 Ways of Writing Nature  
(spring) The Myth of the Frontier

#### (UN)NATURAL FOOD IN AMERICA

Professor Christopher Staysniak

(fall) The Rise of Modern Food  
(spring) A More Natural Food System

#### *General Description*

This course is a part of the Natural World Cluster of the Montserrat program. This means that at various times we will be addressing one or several of the following:

- The general aims of Montserrat – continued development of your thinking, writing, and communication skills, and the connection of living, learning and doing in college education,
- The theme of the Natural World Cluster (see cover page for this syllabus), and
- The specific subject matter of this seminar – mathematical techniques used for modeling and understanding our natural environment.

#### *Some groundrules*

Many class meetings will be devoted to discussions, oral presentations, or work in smaller groups, so your active participation will be important for the success of what we do.

- Unless specifically directed otherwise, please *turn off* all cell phones, pagers, I-phones, I-pads, computers and other similar electronic devices for the duration of each class meeting – your full attention will be required.
- No distracting or “provocative” clothing, headgear, or other personal items in class, please.

- In on-campus events, off-campus trips, etc. you are representing this seminar, the Montserrat program, and by extension, Holy Cross in a wider community. Take responsibility and regulate your behavior accordingly.
- In discussions, there may be times that you disagree with Prof. Little or with a classmate. Please feel free to express that and be prepared to say why and back up your ideas. But please keep the conversation civil and respectful.

### *This seminar*

At the start of this third decade of the 21st century, humans are grappling with a number of tough decisions concerning the effects we have had on the natural world. The effects of climate change are becoming ever more visible and severe. Through December, 2019 and January, 2020, for example, virtually the whole continent of Australia has been in the grip of a terrible heat wave with essentially uncontrollable wild fires. Humans have lost homes and had their lives severely disrupted in many ways. Some estimates place the number of associated animal deaths over one billion as I am writing this (January 8).

Our ability to develop plans to address this ongoing crisis and to understand the political, economic and social issues involved depends on being able to deal with *quantitative information* and infer patterns from data and measurements of the state of the world. This semester, our mathematical study will focus on some basics of *statistics and data analysis*. We will also see ways these topics can be applied to study environmental issues.

More specifically, we will study the following topics. Our major mathematical topic for the semester will be techniques for analyzing and understanding the patterns present in data:

- The starting point: Statistics for describing the “shape” of a data set – measures of central tendency such as means and medians, measures of spread such as interquartile ranges, the standard deviation, graphical ways to represent all of this
- Measurement as sampling from a population,
- Discrete and continuous probability distributions,
- Parameter estimation
- Statistical inference techniques – how scientists and statisticians demonstrate evidence for the existence of patterns in populations

We will not make use of any calculus or mathematics more advanced than ideas about functions, graphs, algebra, some geometry, etc. So everyone should have seen all the mathematical prerequisites and some of the basic ideas behind material we study may be familiar from mathematics courses you took in high school. What will probably be different, though, is the consistently applied and environmental focus of everything we do.

### *Earth Lab*

Our seminar will be participating in the cluster-wide *Earth Lab Project*, whose goals are to:

- highlight the ongoing climate crisis,
- educate the Holy Cross community about the issues involved,
- continue the work begun by the College administration and staff to address these issues in concrete ways on campus, and
- (possibly) to join in actions by local groups to address these issues in the wider Worcester community (or even more widely).

*Nothing quite like this has been tried before as a cluster-wide project in the Montserrat program. This means that we are all in unfamiliar territory. However, based on your responses to the second essay assignment last fall, I think that there is sufficient “buy-in” for these ideas to make this a successful effort(!) I still anticipate this will require a great deal of flexibility and improvisation as this spring semester progresses. Please be aware in particular that this means the course schedule posted on the course home page will probably change several times and the timing of assignments will have to be figured out as we go through the semester.*

Our first activity in the spring (immediately after we return from the semester break) will involve an “audit” of the use of various resources by the residents of Brooks-Mulledy—things such as:

- water usage for toilets, showers, etc.
- total travel by individuals, teams, etc.
- total energy usage for heating, lighting, electronics, etc.
- total generation of trash and other waste from food packaging, drink containers, waste paper, etc.
- total energy cost of the food consumed by residents based on dietary choices, etc.

The goal there will be simply to get a clearer picture of how we are using resources and what our total carbon footprint is.

When we have gathered and analyzed the results, then we will try to identify whether things can or should be changed, what we can agree to, and what we might want to propose to the campus and the administration. Given the topics our class has studied and will study in the spring, one clear role for us would be to lead in analyzing the data collected by the “audit” mentioned above and then communicate our findings to the Cluster and then the campus community.

### *Course Objectives*

The major objectives of the seminar will be:

1. To participate in and contribute to the common activities of the Natural World Cluster of the Montserrat program, most specifically the *Earth Lab* project.

2. To acquaint you with, and develop your skill in applying, various techniques of *data analysis and statistics*. The data from our environmental impact audit will be a primary resource here.
3. To study ways that these mathematical ideas can be used to address larger environmental questions
4. To further your development as speakers and writers, especially as we develop ways to engage and educate the campus community through the *Earth Lab* project.
5. To create a group atmosphere where civil and constructive conversations can take place concerning difficult questions. Many of the topics we discuss will have controversial aspects and reasonable people can have very different viewpoints on them. Recognizing that, everyone (including Prof. Little, of course) should listen carefully and seek to understand where others are coming from, especially when your first inclination might be to disagree. (Good academic *writing* can also be seen as a conversation between the writer and others who have thought about similar questions. So this way of doing things will carry over into the way we approach writing assignments as well.)

### *Texts*

The texts for the course are:

- 1) Little, J. *Modeling and Data Analysis – An Introduction with Environmental Applications*, American Mathematical Society, 2019 – (I will again post the preliminary version on Moodle)
- 2) Several readings to be distributed in electronic form from the course homepage. (I will indicate these on the day-by-day course schedule.)

### *Course Schedule*

A detailed day-by-day course schedule and listing of required and suggested outside events will be maintained on the course homepage (and will be accessible through the Moodle course management system). *Even more than usually, as noted above, that listing is a tentative schedule that will evolve and change as we proceed through the semester. You will probably want to refer to it frequently in order to keep up to date on what is happening in class. Any important changes will also be announced in class as far in advance as possible.*

### *Assignments and Grading*

- 1) *Midterm exam* – 20 % of course grade. Tentative date: Friday, March 13.
- 2) *Individual problem sets* (about 7 through the semester) – 10 % of course grade
- 3) *Writeups from group project days* (about 5 assignments) – 10 % of course grade
- 4) *Two roughly 3 page papers* (information and guidelines to be distributed later) – 20 % of course grade
- 5) *Final Project* – A larger assignment over the second half of the semester leading to a research paper of about 15 pages, and an oral presentation. (This might be part of the Academic

Conference as we discussed last fall, or to some group of seminars from the cluster.) *Note:* The project will take the place of a final exam so there will not be a scheduled final for this class. Breakdown of grading:

- Paper – 20% of course grade
- Presentation – 10% of course grade

- 6) *News Journals:* Obtain *two notebooks* for this class: one for your daily notes and workspace for the problem sets and other assignments, and a second where you will write short summaries of or comments about news articles about some environmental topic you have read (these can be the same one you used last semester). Some suggestions for places to look will be maintained on the course homepage. Aim for one or two of these entries per week. *Start now and keep up with this!* (10% of course grade)

I will be keeping your course average in numerical form throughout the semester, and only converting to a letter for the final course grade. The course grade will be assigned according to the following conversion table (also see Note below):

- A – 94 and above
- A- – 90 - 93
- B+ – 87 - 89
- B – 84 - 86
- B- – 80 - 83
- C+ – 77 - 79
- C – 74 - 76
- C- – 70 - 73
- D+ – 67 - 69
- D – 60 - 66
- F – 59 and below.

Note: Depending on how the class as a whole is doing, some downward adjustments of the above letter grade boundaries may be made. No upward adjustments will be made, however. (This means, for instance, that an 85 course average would never convert to a letter grade of B- or below, although it might be a B+ in some circumstances.) If you ever have a question about the grading policy or your standing in the course, don't hesitate to ask me.

#### *Advice On How To Succeed In This Class*

**A good “work ethic” is key.** As you should be able to tell from the course description above, you do not need to be a “math genius” to do well in this course. But you will need to put in a consistent effort and keep up with the reading and assignments.

**Come to class.** Unless you are deathly ill, have a genuine family emergency, are away at a game or meet of a college athletic team, etc. plan on showing up here at 9:00 am every Monday, Wednesday,

and Friday this semester. Many of the class meetings will be structured around discussions or student presentations. Your participation is expected and needed for the success of the course!

**Take notes and use them.** This may seem obvious, but it is worth saying! Used intelligently, your notes can be a valuable resource as you work on problem sets and prepare for an exam.

**Use the texts and class notes actively.** Reading about mathematics is not like reading a novel. You will probably need to read and think over things more than once. You may want to work through examples to understand some of the topics that we do.

**Set up a regular study schedule and work at a steady pace.** It's not easy to play catch-up in a mathematics course (even when the course is part of a first-year program with additional goals beyond the mathematics). You should expect to budget at least 6 hours in a typical week for work outside of class. The best way to use your time is to do a few problems, some reading from the books, and reviewing of class notes every day.

**Most importantly, if you are having difficulty learning something, get help as soon as possible.** You can do this by asking questions during class (any time something isn't clear), or seeing me during office hours.

#### *Statement on Academic Integrity*

All education is a cooperative enterprise between teachers and students. This cooperation works well only when there is trust and mutual respect between everyone involved. To become an engaged and advanced learner, you must be able to think and work both independently and in concert with your peers. The College academic honesty policy states: "As an institution devoted to teaching, learning, and intellectual inquiry, Holy Cross expects all members of the College community to abide by the highest standards of academic integrity. Any violation of academic honesty undermines the student-teacher relationship, thereby wounding the whole community. The principal violations of academic honesty are plagiarism, cheating, and collusion.

Plagiarism is the act of taking the words, ideas, data, illustrative material, or statements of someone else, without full and proper acknowledgment, and presenting them as one's own.

Cheating is the use of improper means or subterfuge to gain credit or advantage. Forms of cheating include the use, attempted use, or improper possession of unauthorized aids in any examination or other academic exercise submitted for evaluation; the fabrication or falsification of data; misrepresentation of academic or extracurricular credentials; and deceitful performance on placement examinations. It is also cheating to submit the same work for credit in more than one course, except as authorized in advance by the course instructors.

Collusion is assisting or attempting to assist another student in an act of academic dishonesty."

The full statement on Academic Integrity in the College Catalog is available at

[https://www.holycross.edu/sites/default/files/files/registrar/academic-integrity\\_policy\\_0.pdf](https://www.holycross.edu/sites/default/files/files/registrar/academic-integrity_policy_0.pdf)

The temptation to engage in an act of academic dishonesty will almost certainly arise, but the

chance to possibly enhance a single grade is not worth the loss of your personal integrity. NOTE: If in doubt about what you plan to do or write violates academic honesty policy, please ask Prof. Little for guidance before acting.

#### *Specific Guidelines for this Course*

In this course, the midterm examination will be closed-book. No sharing of information with other students in any form will be permitted during that. On group discussion write-ups, close collaboration with the other members of your group is expected. On the individual problem sets, discussion of the questions with other students in the class and with me during office hours is allowed, *even encouraged*. However, your final problem solutions should be prepared individually and the wording and organization of your final problem solutions should be entirely your own work. Moreover, if you do take advantage of any of the above options for discussion of problems with others, you will be required to state that fact in a footnote accompanying the problem solution. Failure to follow this rule will be treated as a violation of the College's Academic Integrity policy. For the papers, if you do consult a source other than the course texts, include a full reference in a bibliography section at the end of your paper, and identify any direct quotations. Information about the acceptable formats for doing this will be distributed with the paper assignments.

#### *Policy on Excused Absences*

This is available at:

[http://www.holycross.edu/sites/default/files/files/registrar/excused\\_absence\\_policy.pdf](http://www.holycross.edu/sites/default/files/files/registrar/excused_absence_policy.pdf)

#### *Disability Statement*

Any student who feels the need for accommodation based on the impact of a disability should contact the Office of Disability Services to discuss support services available. Once the office receives documentation supporting the request for accommodation, the student would meet privately with Disability Services to discuss reasonable and appropriate accommodations. The office can be reached by calling 508-793-3693 or by visiting Hogan Campus Center, room 215A.

#### *Statement on Diversity and Inclusion*

It is my intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally, or for other students or student groups.