CAS/GRS New Course Proposal Form

This form is to be used when proposing a new CAS or GRS course.

This form should be submitted to Senior Academic Administrator Peter Law (617-353-7243) as a PDF file to pgl@bu.edu. For further information or assistance, contact Associate Dean Susan Jackson (617-353-2410; sjackson@bu.edu) about CAS courses or Associate Dean Jeffrey Hughes (617-353-2690; hughes@bu.edu) about GRS courses.

DEPARTMENT OR PROGRAM: CAS EARTH & ENVIRONMENT

DATE SUBMITTED: 8/12/15

COURSE NUMBER: CAS GE 270

COURSE TITLE: Data, Models, and Analysis in Earth and Environment

INSTRUCTOR(S): Lucy Hutryra, Ian Sue Wing

TO BE FIRST OFFERED: Sem./Year: Fall / 2017

SHORT TITLE: The “short title” appears in the course inventory, on the Link University Class Schedule, and on student transcripts and must be 15 characters maximum including spaces. It should be as clear as possible.

COURSE DESCRIPTION: This is the description that appears in the CAS and/or GRS Bulletin and is the first guide that students have as to what the course is about. The description can contain no more than 40 words.

Introduces key questions, types and sources of data, and analytical methods in earth and environment, and introduces students to an array of quantitative methods from both the natural- and social-science disciplines.

PREREQUISITES: Indicate “None” or list all elements of the prerequisites, clearly indicating “AND” or “OR” where appropriate. Here are three examples: “Junior standing or CAS ZN300 or consent of instructor”; “CAS ZN108 and CAS ZN203 and CAS PQ206; or consent of instructor”; “For SED students only.”

1. State the prerequisites:

   Required:
   • CAS ES 107 (Introduction to Climate and Earth System Science (new course)) AND
   • CAS GE 100 (or equivalent) (Environmental Change and Sustainability (new name))

2. Explain the need for these prerequisites:
ES 107 and GE 100 are introductory level courses that will be required of all majors within the department. Their inclusion as prerequisites ensures that GE 270 students will have the base of fundamental knowledge in both the natural and social sciences necessary to understand the earth science and environmental questions, models and types of data presented in the course.

CREDITS: (check one)
- □ Half course: 2 credits
- □ Full course: 4 credits
- □ Variable: Please describe.
- □ Other: Please describe.

Provide a rationale for this number of credits, bearing in mind that for a CAS or GRS course to carry 4 credits, 1) it must normally be scheduled to meet at least 150 minutes/week, AND 2) combined instruction and assignments, as detailed in the attached course syllabus, must anticipate at least 12 total hours/week of student effort to achieve course objectives.

The course will meet on for one hour per class on a MWF schedule, includes a separate 2-hour weekly lab section, regular homework (10 lab assignments), and a final group project (8-10 page report and presentation). Class readings, lab preparation and studying for midterm exam are anticipated to require 5 hours per week over weeks 1-11. Assignments are anticipated to require 3 hours per week. Project conceptualization, calculations, creation of presentation and write up are anticipated to require 40 hours per team member over weeks 12-14. The course meets/exceeds the CAS standards for a 4-credit course.

DIVISIONAL STUDIES CREDIT: Is this course intended to fulfill Divisional Studies requirements?
- □ No
- □ Yes. If yes, please indicate which division _________________ and explain why the course should qualify for Divisional Studies credit. Refer to criteria listed here and specify whether this course is intended for “short” or “expanded” divisional list.

HOW FREQUENTLY WILL THE COURSE BE OFFERED?
- □ Every semester  □ Once a year, fall  □ Once a year, spring  □ Every other year
- □ Other: Explain:

NEED FOR THE COURSE: Explain the need for the course and its intended impact. How will it strengthen your overall curriculum? Will it be required or fulfill a requirement for degrees/majors/minors offered by your department/program or for degrees in other departments/school/colleges? Which students are most likely to be served by this course? How will it contribute to program learning outcomes for those students? If you see the course as being of “possible” or “likely” interest to students in another departments/program, please consult directly with colleagues in that unit. (You must attach appropriate cognate comments using cognate
As part of the Department’s new core curriculum, GE 270 will be a required course for majors (and minors) in Environmental Analysis & Policy (EAP), Earth & Environmental Sciences (E&ES) (paperwork submitted) and a forthcoming major in Global Change & Sustainability. It will provide many benefits to both the students and the department. It will:

- Promote all learning objectives associated with the majors, and provide a foundational understanding of the learning objectives associated with 1) methods and tools, 2) argument and analysis, and 3) application to enhance the students’ depth of understanding in upper level courses.
- Provide students with a practical, hands-on introduction to thinking about questions relevant to their major, and playing with, and analyzing, data in pursuit of answers.
- Provide students in different disciplines with a more cohesive, cohort experience
- Ensure a standardized base of knowledge for all student majors and minors, which will in turn, facilitate development and re-design of upper level courses to integrate more in-depth training in, and application of, statistics.

GE 270 is intended to provide an in-house alternative to the current statistics requirement for the EAP major: CAS MA 213 (Basic Statistics and Probability). The new course deliberately focuses less on the teaching of fundamental mathematical techniques in their own right than on giving E&E’s majors and minors a practical and intuitive working knowledge of the range of questions, data and types of analyses that they are likely to encounter in Earth & Environment. This is accomplished through a syllabus that draws on questions, datasets and methods of analysis from the peer-reviewed research of faculty members across the department, in both the natural and social sciences. Our hope is that by first providing this important background and context to knowledge acquisition, we will motivate departmental majors and minors to both think about and play with data in new ways, and thereby enable them to take better advantage of the mathematical and statistical content of upper-division courses, in which the relevant detail and mechanics can be accentuated.

ENROLLMENT: How many undergraduate and/or graduate students do you expect to enroll in the initial offering of this course?

An initial cohort of 35-45 students with enrollment increasing to and stabilizing around 50 students each semester. Anticipated growth in the major and inclusion of GE 270 as a requirement of a third major within our department (Global Change & Sustainability) could increase cohort size to 65-70 students per course offering. Such an increase would also require an increase in TF allotment from 1.0 TF per course to 2.0 TF per course.

CROSS-LISTING: Is this course to be cross-listed or taught with another course? If so, specify. Chairs/directors of all cross-listing units must co-sign this proposal on the signature line below.

OVERLAP:

1. Are there courses in the Course Inventory (CC00) with the same number and/or title as this course
   - No.
   - Yes. If yes, any active course(s) with the same number or title as the proposed course will be phased out upon approval of this proposal.
NOTE: A course number cannot be reused if a different course by that number has been offered in the past five years.

2. Relationship to other courses in your program or others: Is there any significant overlap between this course and others offered by your department/program or by others? (You must attach appropriate cognate comments using cognate comment form if this course might be perceived as overlapping with courses in another department/program. See FURTHER INFORMATION below.)

GE 270’s methodological content contains elements that span several courses in statistics: CAS MA 113 (Elementary Statistics), CAS MA 115 (Statistics I), CAS MA 116 (Statistics II), CAS MA 213 (Basic Statistics and Probability), CAS MA 214 (Applied Statistics). In order to introduce majors and minors to the breadth of data analysis methods employed in the department, while continuing to rely on the Mathematics dept. to teach this material, it would have been necessary for our concentrators to take several of these courses, which is not possible given curricular constraints.

There are three key characteristics of the niche that GE 270 fills. First, as illustrated by the sheer number of statistics offerings above, no one course in this slate is able to provide the necessary methodological components. Second, while the statistics courses all focus on the supply side of the pedagogic balance sheet (fundamental mathematical properties and analytical skills), GE 270 focuses on the demand side (questions, models and data) to provide cohorts of diverse students with a feel for data and the motivation for learning statistical concepts and techniques, leveraging examples that are grounded in the students’ disciplinary domains of interest. Third, by exposing natural science students to social science questions, data and models—and vice versa—GE 270 fosters interdisciplinary curricular integration in a way that external courses cannot, by building cohort identity among undergraduate majors in departmental concentrations that are distinct but nonetheless fundamentally related by the intertwined physical and human aspects of the environment.

Even given this rationale, for the sake of continuity and curricular flexibility we plan to retain MA 213 as an alternative to GE 270 in the required mathematical courses for the EAP major. We also expect that EAP and EES majors will be motivated to take additional courses in statistics, econometrics, or computer science.

FACILITIES AND EQUIPMENT: What, if any, are the new or special facilities or equipment needs of the course (e.g., laboratory, library, instructional technology, consumables)? Are currently available facilities, equipment, and other resources adequate for the proposed course? (NOTE: Approval of proposed course does not imply commitment to new resources to support the course on the part of CAS.)

GE 270 will require a computer lab each semester for 2 lab sections (the lecture section will not require special facilities). Currently available lab space in rooms CAS 327 and CAS 435 will provide adequate space to meet the course’s lab needs.

STAFFING: How will the staffing of this course, in terms of faculty and, where relevant, teaching fellows, affect staffing support for other courses? For example, are there other courses that will not be taught as often as now? Is the staffing of this course the result of recent or expected expansion of faculty? (NOTE: Approval of proposed course does not imply commitment to new resources to support the course on the part of CAS.)
GE 270 will be taught every Fall and Spring and require 1.0 Teaching Fellow (TF) each semester (for a total of 2.0 TF a year). The course will be team taught both semesters by Associate Professor Lucy Hutyra and Associate Professor Ian Sue Wing. Their current teaching loads will be adjusted as follows:

• Prof. Hutyra currently teaches GE 456/656 and GE 475/675 every Fall and Spring, respectively. These courses will now be offered on an alternating schedule in the (Fall/Spring) semester. Neither course is required for completion of the EES or EAP undergraduate degrees, and both courses fulfill the same role as major electives.

• Prof. Sue Wing will continue to teach GE 420 every Fall and GE 425 every Spring. His third course requirement, which is usually bought out, will now be fulfilled by GE 270.

To accommodate the required teaching fellow allotments for this and our other new core course, ES 107 (which will require, in the beginning, 2.0 TFs per year with a likely expansion to 4.0 TFs in the coming years), the Department will no longer offer ES 140 and GE 101 in the Fall semester, which will free up 4.0 TFs and cover the new teaching fellow needs for the foreseeable future. Future adjustments to the Department’s curriculum will be made as these courses grow and the TF needs expand. These adjustments will likely take the form of reduced enrollments and reduced offerings of our non-core 100-level courses.

BUDGET AND COST: What, if any, are the other new budgetary needs or implications related to the start-up or continued offering of this course? If start-up or continuation of the course will entail costs not already discussed, identify them and how you expect to cover them. (NOTE: Approval of proposed course does not imply commitment to new resources to support the course on the part of CAS.)

Start-up:
We will require 100% summer support for one graduate student (Summer 2017) to assist with the design, implementation and testing of the laboratory component of this course. We anticipate supporting this effort out of departmental funds.

EXTERNAL PROGRAMS: If this course is being offered at an external program/campus, please provide a brief description of that program and attach a CV for the proposed instructor.

FURTHER INFORMATION THAT MUST BE ATTACHED IN ORDER FOR THIS PROPOSAL TO BE CONSIDERED:

A complete week-by-week SYLLABUS with student learning objectives, readings, and assignments that reflects the specifications of the course described in this proposal; that is, appropriate level, credits, etc. (See guidelines on “Writing a Syllabus” on the Center for Excellence & Innovation in Teaching website.) Be sure that syllabus includes your expectations for academic honesty, with URL for pertinent undergraduate or GRS academic conduct code(s).

Cognate comment from chairs or directors of relevant departments and/or programs. Use the form here under “Curriculum Review & Modification.” You can consult with Susan Jackson (CAS) or Jeffrey Hughes (GRS) to determine which departments or programs inside and outside of CAS would be appropriate.

DEPARTMENT CONTACT NAME AND POSITION: David Marchant, Chair; Ian Sue Wing, Associate Prof.,
DEPARTMENT CONTACT EMAIL AND PHONE: marchant@bu.edu, 617-353-3236; isw@bu.edu
DEPARTMENT APPROVAL: ___________________________________________  Department Chair  ________________________

__________________________________________  Date  ________________________

Other Department Chair(s) (for cross-listed courses)  ________________________

DEAN’S OFFICE CURRICULUM ADMINISTRATOR USE ONLY

CAS/GRS CURRICULUM COMMITTEE APPROVAL:

☐ Approved  Date: ________________________
☐ Tabled  Date: ________________________
☐ Not Approved  Date: ________________________

Divisional Studies Credit:

☐ Endorsed

☐ HU  ☐ MCS  ☐ NS  ☐ SS

☐ Not endorsed

__________________________________________  Curriculum Committee Chair Signature and Date

Comments:

PROVISIONAL APPROVAL REQUESTED for Semester/Year  ________________________

__________________________________________  Dean of Arts & Sciences Signature and Date

Comments:

CAS FACULTY:  Faculty Meeting Date:  ________________________  ☐ Approved  ☐ Not Approved
Cognate Approval of New Course CAS GE 270

On 10/2/15 8:12 AM, "Marchant, David R" <marchant@bu.edu> wrote:

Hi Tasso,

Thanks for reading through all the documents and for your thoughtful comments. I forwarded your recommendation to Ian Sue Wing and Lucy Hutyra. Both agree to change the text as you suggest in the section entitled NEED FOR COURSE. The change to "in which deeper analytical and practical understandings of the statistical techniques may be acquired and in which more powerful statistical methods may be learned" makes perfect sense.

Thanks also for your cognate approval of our proposed major and minor in Earth & Environmental Sciences. And finally, the more courses in math and statistics our students take, the better. So, if some students take GE 270, MA 213 and/or MA 214 (and potentially others) then that would be a win-win situation.

Best,
Dave

-----Original Message-----
From: Tasso Kaper [mailto:tasso@math.bu.edu]
Sent: Tuesday, September 29, 2015 4:52 PM
To: Marchant, David R
Cc: Jackson, Susan K; Tasso Kaper
Subject: Request for cognate approval of new course GE 270

Hi Dave,

With this email, I am happy to give you our cognate comments about the proposed new course GE270.

We are pleased to see your department offer this new course for your majors. We think that it is very important for everyone --statisticians, other scientists, and engineers-- to understand the basic scientific problems for which techniques of statistics and data science, more broadly, can be used. We understand your need to make this type of an introductory course available for your students and support your offering it.

In terms of statistics methods, we think that the overlap in GE270 is more with the fundamental methods taught in MA115-6 than in MA213. This
assessment is based on the list of statistics-type topics in the proposed course syllabus (experimental design, data organization, sampling, linear regression analysis, and some numerical techniques), as well as in the proposed book.

We are also pleased to see that your majors will still have the option to take MA213 instead of GE270 to fulfill the requirement. While we are sanguine about the likelihood that few might chose this option, we think that it will be extremely useful for some (many?) of the students who do take GE270 to also take MA213 and/or MA214. So, we hope that taking GE270 won't preclude anyone from taking MA213, in particular, eg as an elective. Students who are interested in really understanding the theory behind the methods used in both GE270 and MA213 and in developing a solid foundation on which to pursue more advanced courses will benefit from taking both.

One small note: We strongly recommend that, in the course proposal, in the section on NEED FOR THE COURSE, in the paragraph that starts with 'GE270 is intended...', last line: please replace the words 'in which the relevant detail and mechanics can be accentuated.' with something more accurate and informative, such as 'in which deeper analytical and practical understandings of the statistical techniques may be acquired and in which more powerful statistical methods may be learned.' Upper-divisional courses at the 300-level and 400-level definitely offer more advanced techniques than what is planned for coverage in GE270. Thanks in advance for making this small, but important, tweak.

Sincerely,

Tasso
CAS GE 270
Data, Models, and Analysis in Earth & Environment
Fall 2017
Lecture: Monday, Wednesday, Friday TBD
Lab: TBD (2 hours)

Instructors
Professor: Lucy Hutyra, CAS 439C, 617-353-5743
E-mail: lhrutyra@bu.edu
Office Hours: TBD

Professor: Ian Sue Wing, STO 461, 617-353-5741
E-mail: isw@bu.edu
Office Hours: TBD

Teaching Fellow
TBD

Location
TBD

Prerequisites
Required: ES 107 and GE 100 (or equivalent)

Course description
Data is all around us, pervading virtually every element of environmental inquiry. Competency in quantitative methods is essential for both basic science and applied dimensions of Earth and environmental sciences. The course will introduce students to an array of quantitative methods from both the natural- and social-science disciplines that make up Earth and Environment. The specific goals of the course are: (1) to introduce students to the ways in which natural and social science disciplines use different kinds of data to explain environmental phenomena and elucidate their workings, and (2) to develop basic literacy in the methods used to analyze such information. Students will be introduced to common paradigms that are used to develop hypotheses, principles of experimental design and data organization, statistical sampling, numerical simulation, and statistical regression analysis. Example problems, with accompanying data, from the fields of economics, sociology, ecology, geology, remote sensing, and geography applied to the environment will be explored in class and in the labs, and most datasets will be based on research published by Earth & Environment faculty. Excel will be the primary tool for analysis, but students will be introduced to the use of other data analysis software, including the GNU Regression Econometrics and Time-series Library (GRETl).

Required Text
Ramsey, F. and D. Schafer (2012) *The Statistical Sleuth: A Course in Methods of Data Analysis.* Cengage Learning, 784 pp. (Note, we will attempt to obtain rights for using only the first few chapters at a lower cost).
Labs and Problem Sets
There will be a lab and associated problem set every week of the semester, except the last two, which will be reserved for term project work. These labs will be held in the Earth and Environment computing lab, will be “hands-on” using Microsoft Excel, and are designed to illustrate the core concepts discussed in class each week. To this end, each lab exercise will be devoted to analyzing real data sets related to phenomena from both the natural- and social-science disciplines that make up Earth and Environment.

Term Project
Building from the methods and analyses that will be performed in lab, students, working in teams of 2-3, will develop a research question, and design and implement a research project that extends an analysis that was performed in lab to test a specific hypothesis and draw scientific inference(s). As part of this requirement, each team will present their results to the class, and, incorporating feedback from peers and instructors, write up their results as a group final research paper (8-10 pages in length). The team will collectively draft and sign a statement specifying their contributions to the project (based on a template that the instructors will provide). This statement will form the basis for individual team members’ grades for the project write up. Presentations will be structured so that each team member presents his or her contribution to the project. The quality and clarity of these presentations will form the basis for individual team members’ grades for the project presentation.

Due Dates, Make-Ups and Absences
All assignments are required to be submitted on time. LATE WORK WILL BE ACCEPTED UP TO 1 WEEK BEYOND THE DUE DATE, BUT THE GRADE FOR THAT ASSIGNMENT WILL BE REDUCED BY 50%. No assignments will be accepted more than 1 week beyond this grace period. Attending lectures, labs and presentations is mandatory. Participation is strongly encouraged and attendance will be taken. Chronic absences or lateness will incur a substantial penalty to the participation component of the overall grade.

Academic Conduct, Collaboration and Originality of Work
Assignments and exam responses must be completed without collaboration unless explicitly directed otherwise by instructors. The term project is explicitly collaborative, but all other graded work must be completed individually. All work prepared for this course must be written in the students’ own words and prepared specifically for this course. Copying phrases, sentences, or paragraphs in written work from ANY source (including the internet) without quotation and specific attribution is plagiarism. Providing answers to, or receiving answers from, other students is cheating. Such behavior will be treated as academic misconduct and will be referred to the Dean’s Office. It is your responsibility to know and understand the provisions of the CAS Academic Conduct Code. See http://www.bu.edu/academics/policies/academic-conduct-code/ for conduct information for undergraduates and http://www.bu.edu/cas/students/graduate/forms-policies-procedures/academic-discipline-procedures/ for graduate student conduct requirements.

Assessment
Grades will be assigned based on the student's performance on the following:

- 20% - Midterm Exam (in-class exam that will include a combination of multiple choice, numeric problems, short answer problems)
- 50% - Problem Sets (weekly assignments)
- 10% - Term Project (15%) & presentation (5%)
- 10% - Participation
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<thead>
<tr>
<th>Week Beginning</th>
<th>Topic</th>
<th>Reading</th>
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<tbody>
<tr>
<td>31 Aug</td>
<td>Introduction to environmental data</td>
<td>Text: Ch. 1</td>
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<td></td>
<td>No Lab</td>
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<tr>
<td>7 Sept</td>
<td>Data types, experimental design, and sampling methods</td>
<td>Text: Ch. 1</td>
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<td><em>Lab 1: Organizing, importing, exporting data; plotting data</em></td>
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<td></td>
<td><em>Discussion based on Raciti et al. (2012) [Soil chemistry]</em></td>
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<tr>
<td>14 Sept</td>
<td>Experiments, natural experiments, hypotheses and falsification</td>
<td>Text: Ch. 1</td>
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<td><em>Lab 2: Graphic analysis &amp; data visualization</em></td>
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<td>21 Sept</td>
<td>Introduction to probability distributions</td>
<td>Text: Ch. 2</td>
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<td><em>Lab 3: Sampling from a population, summary statistics</em></td>
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<td><em>Discussion based on Raciti et al. (2012) [Soil chemistry]</em></td>
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<tr>
<td>28 Sept</td>
<td>Hypotheses and the basics of hypothesis testing</td>
<td>Text: Ch. 2</td>
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<td><em>Lab 4: Tests of the means of 1 or 2 samples; type I and type II errors</em></td>
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<td><em>Discussion based on Raciti et al. (2012) [Soil chemistry]</em></td>
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<tr>
<td>5 Oct</td>
<td>Alternatives to t-tests</td>
<td>Text: Ch. 4</td>
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<td><em>Lab 5: Rank sums, sign tests, and permutation tests</em></td>
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<td><em>Discussion based on Templer et al. (2015) [residential management &amp; biogeochemistry]</em></td>
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<tr>
<td>12 Oct</td>
<td>Midterm exam</td>
<td>No reading</td>
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<tr>
<td>19 Oct</td>
<td>Comparisons among multiple groups: ANOVA</td>
<td>Text: Ch. 5</td>
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<td><em>Lab 6: ANOVA</em></td>
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<td><em>Discussion based on Kittridge et al. (2015) [Conservation Awareness]</em></td>
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<tr>
<td>26 Oct</td>
<td>Linear combinations and multiple comparisons</td>
<td>Text: Ch. 6</td>
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<td><em>Lab 7: Linear combinations of groups</em></td>
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<td><em>Discussion based on Harrison and Rubinfeld (1978) [NOx and house prices]</em></td>
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<td>2 Nov</td>
<td>Correlation and simple linear regression</td>
<td>Text: Ch. 7</td>
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<td><em>Lab 8: Linear Regression</em></td>
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<td><em>Discussion based on Harrison and Rubinfeld (1978) [NOx and house prices]</em></td>
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<tr>
<td>9 Nov</td>
<td>Linear regression</td>
<td>Text: Ch. 7, 8</td>
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<td><em>Lab 9: Linear Regression continued</em></td>
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<td><em>Discussion based on Blue Hills Observatory climate data [Temperature]</em></td>
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<tr>
<td>16 Nov</td>
<td>Multiple regression</td>
<td>Text: Ch. 9</td>
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<td><em>Lab 10: Constructing explanatory variables</em></td>
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<td><em>Discussion based on Friedl et al. 2014 [remote sensing]</em></td>
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<tr>
<td>23 Nov</td>
<td>No Lecture: class time and lab time will be devoted to 1:1 tutoring in support of term projects</td>
<td>No Reading</td>
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<tr>
<td>30 Nov</td>
<td>Student Presentations</td>
<td>No Reading</td>
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<tr>
<td>7 Dec</td>
<td>Student Presentations</td>
<td>No Reading</td>
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<tr>
<td>11 Dec</td>
<td>Project Reports Due</td>
<td>No Reading</td>
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Additional Lab Readings
Templer, P.H., Toll, J., Hutyra, L.R., Raciti, S.M., Nitrogen and Carbon Export from Urban Areas Through Removal and Export of Litterfall. Environmental Pollution, in press.