

## Syllabus for 61.364\* Analysis of Ecological Relationships

### Instructors:

	phone	e-mail	office	office hours
Brett Goodwin	520-2600 X8797	bgoodwin@ccs.carleton.ca	Tory 136	Mon. 9:30-11:00
Kringen Henein	520-2600 X3852	khenein@ccs.carleton.ca	Tory 156	Wed. 10:00-11:30

Since Dr. Henein won't be on campus every day the best way to contact her outside of her office hours will be through e-mail.

We will each be teaching half the topics in the course, so it would be best to speak to the instructor that presented the material if you need clarification or help. The schedule will indicate who will be teaching which class.

### Teaching Assistants:

There will be 2 TAs for each section (total of 4 TAs). A primary TA will be present in each lab and will have regularly scheduled office hours. The secondary TAs will share the marking of their section's assignments, but will not attend labs or have office hours. Therefore, questions relating to the lab material should be addressed to the primary TAs, either in the lab or during their office hours. Questions relating to previously marked assignments will have to be addressed by the TA who has marked them. Contact primary TAs during their office hours. Contact secondary TAs by e-mail or phone to set up an appointment.

#### Tuesday TAs

	phone	e-mail	office	office hours
Tom Contreras	520-2600 X3853	tcontrer@ccs.carleton.ca	Tory 162	Mon. 11:00-12:00
Kelley Kissner	520-2600 X3862	kkissner@ccs.carleton.ca	Tory 388	

#### Wednesday TAs

	phone	e-mail	office	office hours
Julie Brennan	520-2600 X8797	jbrennan@ccs.carleton.ca	Tory 136	Tues. 11:00-12:00
Brett Goodwin	520-2600 X8797	bgoodwin@ccs.carleton.ca	Tory 136	

All of the TAs will be happy to schedule appointments with you if you can not meet with them during their office hours.

### Course Objectives:

The purpose of this course is to provide you with an introduction to statistical analysis of ecological data. In the ecological and environmental fields the use and interpretation of statistics is unavoidable. Understanding statistics will help you critically evaluate scientific papers. Understanding statistics is imperative for designing and interpreting any ecological or environmental study you might be involved in (e.g., honours thesis).

The approach is hands-on, with all assignments based on real data sets that were collected to address real ecological questions since the best way to learn statistics is to apply them to real data sets. In this course you will develop skills in hypothesis testing. This includes learning about several different statistical methods, learning how to decide which method(s) is/are appropriate for testing a hypothesis, learning how to interpret the results of statistical tests, and learning how to report statistical results effectively. At completion of the course you should have a working knowledge of many of the most useful statistical methods and you should have the grounding necessary to learn about methods not covered in the course. This course will help you to critically evaluate the scientific basis for ecological and environmental relationships. In addition, you will have been introduced to SAS, a very commonly used and powerful computer package for statistical analyses which is available on the Carleton computer network.

At Carleton, right now, one of the best ways to do statistics is using SAS. At times during this course you may feel that you are learning more about programming in SAS than about analyzing data, however there is a side benefit to learning SAS. It is probably the most popular statistical package in both the environmental and ecological fields and therefore any exposure to it will look good on your resume when you are looking for work.

**Structure of the course:**

Each weekly four hour session will begin with a lecture on the topic for that week. To prepare for that lecture you must read the appropriate section from the class notes and the representative journal article assigned. These articles have been selected to give you an example of the use of particular statistics in scientific studies. Articles will be available in the photocopier room on the 5th floor of Tory (TB 536). In reading these papers we want you to focus on the introduction (to figure out what question the researcher is asking) and the methods and results (to see how they used the statistics to answer the question). Also, we have provided reading questions at the back of the class notes that you should try to answer before class based on reading the class notes. These questions, and your answers, will give you a better idea of how well you understood the material you read. The answers to the reading questions will be posted on the course newsgroup (carleton.courses.61364ab).

After the lecture, the remainder of the time should be spent in the computer lab working on the assignment. It is strongly urged that you use this time for doing your assignment. Your TA will be present, and this is your opportunity to ask questions and to benefit from the answers to questions posed by your classmates. TA's do not have the time to individually instruct each student outside of lab time. If you are not present for the entire lab the TA's can refuse to answer your questions at other times.

The attached tables outline the topics to be covered, the associated readings and the due dates for the assignments.

**Marking Scheme:**

9 assignments, 7% each: ..... 63%

Test, February 10,11: .....	7%
Final Exam: .....	30%
Bonus experimental design assignment.....	4%

The majority of the course centres around assignments we will ask you to do that involve analyzing datasets we provide using SAS. Late reports will not be accepted for any reason. Reports are due at the **beginning** of the lecture for the day you are registered for. If a report is not handed in, or the test is not written, your final exam will be worth 7% more. For example, if you do not hand in 2 reports, your final exam will be worth 44% of your final mark instead of 30%. If you do not hand in any reports or write the test, your final exam will be worth 100% of your mark.

The concepts and methods introduced in this course are not exceptionally difficult. However, it is extremely important that you keep up with the work since each assignment builds on the previous ones. Skipping assignments will impair your ability to do future ones. Also, marks on assignments are typically higher than the final exam mark, so it will be to your advantage to complete the assignments on time (i.e., have them count towards your grade).

All reports are expected to have two parts: 1) a textual portion that describes the statistics you performed, the results you obtained and answers to any additional questions in the assignment, and 2) supporting tables and figures. The TAs will mark assignments by reading the textual portion and only look at tables and figures if they are referred to in the text. SAS produces a lot of output from which you must glean the important information that allows you to describe the statistics well or answer the question posed. TAs are not responsible for wading through an unorganized report or a pile of SAS output looking for the necessary information for an assignment. It is incumbent upon you to ensure that the report you hand in effectively communicates the results you got using SAS to analyze the dataset we provided you. SAS programming for assignments may be done in groups but each person must answer the questions themselves and hand in a separate report. Plagiarism on assignments (textual portion) will not be tolerated; a first offense will result in a 0 on the assignment and the second offence will result in a 0 in the course.

The test and final exam will be open-book. You will be allowed to take written materials with you, including class notes, readings and assignments.

**Supplementary Reference List:**

There is no required textbook for this course. However, additional information on the topics covered can be found in biostatistics and statistics books in the library such as:

Ambrose, H.W. & K.P. Ambrose. 1987. A handbook of biological investigations. Hunter Textbooks Inc., Winston-Salem.

Gilbert, N. 1989. Biometrical interpretations. Oxford University Press, Oxford.

Green, R.H. 1979. Sampling design and statistical methods for environmental biologists. John Wiley and Sons, Rexdale, ON, Canada.

Hicks, C.R. 1982. Fundamental concepts in the design of experiments. Holt, Rinehart and Winston, Toronto.

Krebs, C.J. 1989. Ecological methodology. Harper and Row, New York, NY, USA.

Ludwig, J.A. & J.F. Reynolds. 1988. Statistical ecology: a primer on methods and computing. John Wiley and Sons, Rexdale, ON, Canada.

McCullagh, P. & J.A. Nelder. 1989. Generalized linear models. Chapman and Hall, New York, NY, USA.

Scheiner, S.M. & J. Gurevitch (eds.) 1993. Design and analysis of ecological experiments. Chapman and Hall, New York, NY, USA.

Sokal, R.R. and R.J. Rohlf. 1987. Introduction to biostatistics. W.H. Freeman and Co., New York, NY, USA.

Sokal, R.R. & R.J. Rohlf. 1981. Biometry. W.H. Freeman and Co., New York, NY, USA.

Zar, J.H. 1996. Biostatistical analysis, 3rd ed. Prentice-Hall, Upper Saddle River, NJ, USA. (An excellent reference book that you might consider buying for future reference.)

Zolman, J.F. 1993. Biostatistics. Oxford University Press, Oxford.

## Topics and Readings

week of	topic	readings (class notes, journal article)	inst. <sup>1</sup>
Jan. 6	simple statistics, confidence intervals, t-test	Ch. 1,2	both
Jan. 13	simple linear regression analysis	Ch. 3.1-3.8, (Johnson 1988)	KH
Jan. 20	polynomial regression analysis	Ch. 3.9-3.10, (Gustafson 1992)	BG
Jan. 27	multiple regression analysis	Ch. 3.11-3.15, (Fralish 1994)	BG
Feb. 3	ANOVA with class variables	Ch. 4, (Viskari et al. 1997)	KH
Feb. 10	classical linear models	Ch. 5, (Broadley & Willey 1997)	BG
Feb. 17	TEST	Ch. 1-4	both
Feb. 24	READING WEEK		
Mar. 3	non-parametric tests	Ch. 6, (Merrington et al. 1997)	KH
Mar. 10	tests of independence	Ch. 7, (Merriam & Lanoue 1990)	KH
Mar. 17	logistic regression analysis	Ch. 8, (Verboom et al. 1990)	BG
Mar. 24	experimental design	hand out	both
Mar. 31	REVIEW		both
TBA	FINAL EXAM	Ch. 1-8	both

<sup>1</sup> instructor responsible for that topic; KH=Kringen Henein, BG=Brett Goodwin

### References

- Broadley, M.R. and N.J. Willey. 1997. Differences in root uptake of radiocaesium by 30 plant taxa. *Environmental Pollution* 97:11-15.
- Fralish, J.S. 1994. The effect of site environment on forest productivity in the Illinois Shawnee hills. *Ecological Applications* 4:134-143.
- Gustafson, E.J. & G.R. Parker. 1992. Relationships between landcover proportion and indices of landscape spatial pattern. *Landscape Ecology* 7:101-110.
- Johnson, W.C. 1988. Estimating dispersability of *Acer*, *Fraxinus* and *Tilia* in fragmented landscapes from patterns of seeding establishment. *Landscape Ecology* 1:175-187.
- Merriam, G. & A. Lanoue. 1990. Corridor use by small mammals: field measurement for three experimental types of *Peromyscus leucopus*. *Landscape Ecology* 4:123-131
- Merrington, G., L. Winder & I. Green. 1997. The uptake of cadmium and zinc by the bird-cherry oat aphid *Rhopalosiphum padi* (Homoptera: Aphididae) feeding on wheat grown on sewage sludge amended agricultural soil. *Environmental Pollution* 96:111-114.
- Verboom, B. & R. van Appledorn. 1990. Effects of habitat fragmentation on the red squirrel, *Sciurus vulgaris* L. *Landscape Ecology* 4:171-176.

## Assignments

#	date	topic	assignment due
1	Jan. 6, 7	simple statistics, confidence intervals, t-test	Jan. 13, 14
2	Jan. 13, 14	simple linear regression analysis	Jan. 20, 21
3	Jan. 20, 21	polynomial regression analysis	Jan 27, 28
4	Jan. 27, 28	multiple regression analysis	Feb. 3, 4
5	Feb. 3, 4	ANOVA with class variables	Feb. 10, 11
6	Feb. 10, 11	classical linear models	Mar. 3, 4
7	Mar. 3, 4	non-parametric tests	Mar. 10, 11
8	Mar. 10, 11	tests of independence	Mar. 17, 18
9	Mar. 17, 18	logistic regression analysis	Mar. 24, 25
bonus	Mar. 24, 25	experimental design	in class