Quantitative Methods in Paleoecology

Seminar: GEOG 607, Winter 2018; Prof. Dan Gavin, dgavin@uoregon.edu
Fridays 11–1:40, Room: Knight Library 41

Ecology is the study of the processes affecting the distribution of species in space and time; paleoecology addresses the same questions using data derived from natural archives, thus spanning periods longer than direct observations. Paleo-data present challenges due to their inherent biases (for example, some species are better represented than others) and uncertainties (for example, temporal error from dating sediments). Some methods are derived from community ecology while other methods are unique to paleoecological data.

In this seminar, we tackle a range of analysis problems in reconstructing past environments. Students will undertake a data-analysis project using their own data or data available through online data bases. The class format will be a combination of student-led presentations of papers and demonstration of analyses. The R computing language will be used in most cases. Parameteric, maximum likelihood, and resampling methods will be introduced. Readings will be from important early papers, journal articles of recent applications, and review papers. We will also use chapters from Birks et al. 2012, a free e-book in the UO Library.

Birks, H. J. B., A. F. Lotter, S. Juggins, and J. P. Smol, editors. 2012. Tracking Environmental Change Using Lake Sediments. Volume 5. Data Handling and Numerical Techniques. Springer Netherlands, Dordrecht.

Copyrighted PDFs will be posted on Canvas (so they are not viewable by the world) and all resources and examples will be posted on geog.uoregon.edu/gavin/courses/Geog607w18 (so they are available later if you want them).

Class format:

First hour: Lecture by instructor.
Second hour: Presentation of case studies by students (1 or 2 students per day). Along with lunch.
Remainder of class: Preview of material for next week.

Please bring a laptop to class. Please install R software. There are also laptops for use in the classroom (Knight Library 41) with R software installed.

Assignments:

Case studies: A presentation to the class of a research question and a proposed (or partially completed) study design involving quantitative analyses. The presentation should be about 20 minutes and the class may spend 30-45 minutes in total on the topic. Please view the class schedule and in week 1 (or week 2) choose a topic through consultation with Dan Gavin. Please do not choose a published paper and present what was done in the paper. Rather, choose a topic that interests you and then choose which data sources and analytical techniques are needed to address the question.

Project: Your class project will be an analysis of data, including the proper write-up of methods and results. In other words, it will be the guts of a scientific paper. Data may come from available data bases or from your own work. Analyses must include 1) data summarization and presentation, which likely will involve pre-treatment of complicated raw data, and 2) presentation of at least one statistical test.

It is acceptable for your case study to evolve into your class project. Your topic must address paleoecology: the study of ecological questions on time scales longer than may be observed in one human lifespan. Human-environment interactions fall under this topic if the topic is involving reconstructing past environments and (possibly) human influences on those environments.

Effort in the class and grading:

I expect effort to be apportioned roughly in thirds for 1) preparation for weekly classes (readings, practicing using R examples or other software); 2) preparation for your case study presentation, and 3) your final class project. A passing grade will involve 1) evidence of preparing for class and participating/asking questions in class, 2) a well-researched presentation of a case study, and 3) a project that demonstrates understanding of data sources, concise data summarization, and application of statistical tests following the guidance given above. Further guidance will likely be forthcoming during class.

See separate outlines (online) for detailed information for each class day. Readings where pages are given are chapters from the Birks et al. 2012 book. Note that the table below will be updated on the class website: http://geog.uoregon.edu/gavin/courses/geog607

Jan 12	**Class overview** **Chronology:** Dating methods; developing a site chronology **(No case-study presentations on this day)**	Blaauw & Heegaard (pages 379-413); Trachsel & Telford 2017 **Software:** Calib; Oxcal; Clam (modified); Bacon; & custom code. **In-class examples:** radiocarbon calibration, chronology, simple R function for a randomization test **R tutorials:** R-intro.pdf
Jan 19	**Stratigraphical data** Accumulation rates versus relative frequencies. Data handling. Compositing.	Maher et al. (pages 143-166) Dunnette et al. 2014 Marlon et al. 2008 **Software:** Tilia; **`rioja`**; **`paleofire`** and GCD code. Custom code for superposed epoch analysis
Jan 26	**Peak-over-threshold methods** **Change-point detection**	Higuera et al. 2010 To-be-determined Software: CharAnalysis;
Feb 2	**Assessing synchrony** Bivariate event analysis	Blaauw et al. 2007; Blaauw 2012. Gavin et al. 2006 **Software:** K1D
Feb 9	**Detecting species range limits** **Estimating times of extinctions** **Paleo-diversity**	Herring et al. 2018 Saltré et al. 2015 Colombaroli et al. 2015 (van der Knapp 2009 for background)
Feb 16	Multivariate (species assemblage) data: **Clustering, Zonation; Rates-of-change**	Legendre and Birks (pages 167-200) Birks (pages 358-365; 369-372); Gavin et al. 2015.
Feb 23	**Modern analog techniques** **Analogue matching**	Overpeck et al. 1985 Simpson (pages 495-522) Software: `vegan`; `Analogue`
Mar 2	Multivariate data (cont.): **Ordination; Correspondence analysis**	Legendre and Birks (pages 201-248)
Mar 9	**Climate transfer functions**	Juggins and Birks (pages 431-494).
Mar 16	**Biogeographic analyses** **Geostatistics** **Time-slice mapping**	Blois et al. 2010