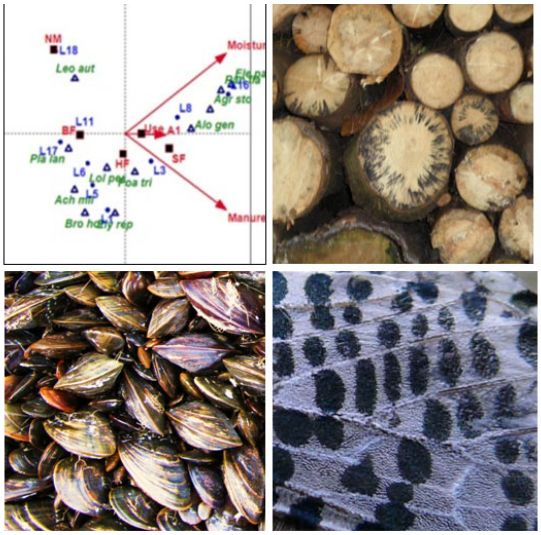
Course Guide

Ecological methods 1

WEC 31806



Version: July 2022

Wildlife Ecology and Conservation Group

WAGENINGEN UNIVERSITY
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Components:	Classroom lectures Tutorials/Instruction Intensive practical training Self-study
Period:	Period 1 (September-October)
Contact person(s)	dr WF de Boer (WEC) (fred.deboer@wur.nl)
Lecturer(s)	dr WF de Boer (WEC) dr ir F van Langevelde (WEC) dr ir IMA Heitkönig (WEC) dr. H. de Knegt and other staff from WEC and FEM
Examiner(s)	dr WF de Boer (WEC)

Language of instruction and examination: English

Assumed prerequisite knowledge:
Basic knowledge of statistics.

Profile of the course:
Students learn how to analyse hypothesis-centred ecological field research projects on plants, animals, and their environment, with emphasis on the appropriate choice and application of statistical techniques for the analysis of ecological data. The study aims at providing the necessary statistical skills for the data analysis of BSc and MSc thesis projects and will enable the students to be able to understand and critically evaluate the analysis of ecological projects, such as described in scientific publications.

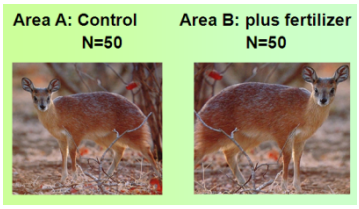
The main target student groups (restricted optional) are students from BBI, BBN, and MFN, complemented with students from other programmes (e.g., MBI, MAS, MES, MIL), and with PhD students who take this as a refresher course.

Learning outcomes:
After successful completion of this course, students are expected to be able to:

- formulate appropriate null hypotheses for ecological research questions;
- outline the possibilities, limitations and constraints of the different univariate and multivariate statistical tests, and are able to identify alternative solutions;
- select the best statistical tool to test the ecological data at hand;
- analyse ecological data using appropriate statistical procedures;
- interpret the statistical results in an ecologically meaningful sense;
- perform both univariate and multivariate analyses.

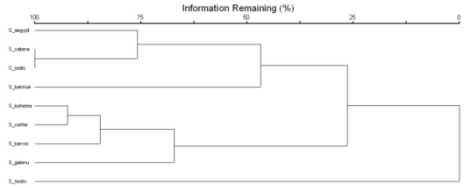
Learning materials and resources:
No statistical books are required. The course heavily relies on its own website, comprising:

- course lay-out and calendar
- all assignments, explanations, and tutorials, ordered by day
- all answers to questions (made available at the end of the day)
- links to large datasets and background information used in the last week of the course
- digital background information
- links to statistical tables and useful statistical websites
- Websites and Apps to facilitate the selection of the correct statistical test
- suggestions for further readings
- all hand-outs and recordings of classroom lectures
- a full set of example exam questions - and answers



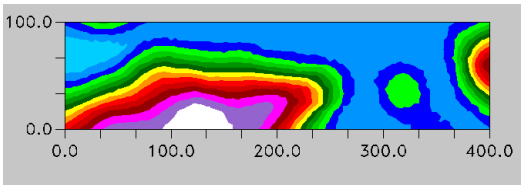
Educational activities:

- This course deals with the choice and application of univariate and multivariate statistical techniques and tests, for the interpretation of ecological field data. The choice of appropriate test will be given attention in relation to the type of data under investigation. Attention will be paid to the sequence: hypothesis, choice of tests, interpretation of statistical results, and ecological meaning of outcome with respect to the hypothesis. Students are expected to have a basic statistical background, and a working knowledge of Excel. Software like R, Canoco, and several other statistical packages for the analysis of ecological data will be used. Websites and Apps are available to guide the student in making the correct choices among statistical tests.



- Students will attend lectures explaining the general approach of formulating and testing hypotheses, and each of the main statistical techniques. Emphasis will be placed on the use of data from plants, animals, and their field or laboratory environment.
- Introductory lectures will be followed by computer-based exercises to practice the application of statistical techniques to ecological data. Students will work in pairs or singletons in the first weeks, and in larger groups in the last week. Staff is available for consultation. Each practical session ends with an interactive discussion by staff with the entire classroom on that session's topics, and correct answers to that session's exercises will be made available then.
- The 5th week of the course is reserved for applied statistics: cluster analysis, survival analysis, species distribution modelling,

species richness analysis, geo-statistics, and capture-recapture data analysis.



- Three interim tests enable the students to obtain partial exemption from the exam (see below).
- In the 6th and last week, student groups will each analyse a large, real-life dataset, selecting and applying both univariate and multivariate statistical techniques to obtain an ecological interpretation. The ecological datasets are supplied by the lecturers of the course, and cover plant, forestry, and animal topics.

Examination:

- The exam consist of four parts that will be marked separately; three deal with univariate, multivariate and applied statistical techniques respectively, and the fourth part consists of the analysis, presentation and defence of the large data set.
- The final exam in week 8 of the course consists of three parts that will be marked separately; exemption for the first three parts of this exam can be obtained by passing three respective (individual) tests during the course on the knowledge, understanding and application of:
    - Univariate statistical tests
    - Multivariate statistical techniques
    - Applied statistical techniques
- The results of the analyses of the large ecological dataset will be presented in a plenary session using PowerPoint. The presentation will be evaluated based on:
    - Quality of group work (and individual differences)
    - Justification of the hypotheses
    - Choice and justification of statistical tests
    - Interpretation of statistical results
    - Ecological interpretation of test results
    - Lay-out and presentation skills
- Each of the four marks should be ≥5.5, and contributes equally to the final mark.

Principle themes of course content:
The course uses ecological datasets and examples from plant and animal ecology and forestry to illustrate the use, application and constraints of statistical tests. The course aims at explaining the choice, use, constraints and interpretations of the different analysis techniques, but not at explaining the mathematical details of those techniques.
The course consists of 4 major components.

- Univariate analysis, comprising group analysis tests (e.g., Anova, t-test, Mann-Whitney U tests, GLM, GLMM) and trend analysis tests (e.g., correlation, regression, logistic regression),

together with general analysis techniques (transformations) and background of statistical testing (hypotheses formulation, errors and data distributions)

- Multivariate analysis, comprising techniques such as ordination (Polar Ordination, Correspondence Analysis, Principal Component Analysis), and the analysis of the influence of environmental factors on the ordination (Redundancy Analysis and Canonical Correspondence Analysis).
- The Applied Statistics component consists of 6 days with 6 different topics:
    - Cluster analysis (dendrograms)
    - Analysis of mark-recapture data
    - Species distribution modelling
    - Geo-spatial analysis
    - Survival analysis
    - Analysis of species richness and diversity data
- The last week consists of group work, where student groups analyse a large real-life data set, collected from ecological studies on plants, animals and forests. The analysis includes formulating appropriate hypotheses, choosing the correct statistical methods, statistically analysing and ecologically interpreting the dataset. The approach, test choice, results and conclusions will be summarized in a PowerPoint presentation that will be presented and defended during a plenary session at the last day of the course.

Outline and schedule of the programme:
For the first 3 components of the course, on each day different statistical techniques are explained, starting with a general classroom lecture, an explanation of how the tests are carried out using appropriate software (e.g., R and Canoco), and followed by several hours of intensive practical studies where students train themselves in the applications of these techniques, supervised by staff. The last 30 minutes of the morning is reserved for explanations and questions, where the answers to several questions will be discussed in depth with the students in a plenary session.

Week 1	Date	Contents
Monday		Introduction, Data distribution
Tuesday		T-tests
Wednesday		Non-parametric tests & transformations
Thursday		One-way Anova & multiple comparison
Friday		Anova: two way & interactions
Week 2		
Monday		Chi-square, correlation
Tuesday		Regression 1
Wednesday		Regression 2
Thursday		Multiple regression
Friday		Test choice
Week 3		
Monday		LMM: Random factors
Tuesday		Test 1: Univariate
Wednesday		Polar Ordination
Thursday		Correspondence Analysis
Friday		Canonical Correspondence Analysis
Week 4		
Monday		Principal Component Analysis
Tuesday		General MVA consultation
Wednesday		Test 2: Multivariate
Thursday		Clustering
Friday		Mark-recapture analysis
Week 5		
Monday		Species distribution modelling
Tuesday		Geostatistical analysis
Wednesday		Survival analysis
Thursday		Diversity and richness analysis
Friday		Data analysis
Week 6		
Monday		Test 3, Applied
		Data analysis
Tuesday		Data analysis
Wednesday		Data analysis
Thursday		Data analysis
Friday		Presentations data analysis

Continuation courses:
Ecological Design for Ecology (WEC 32306), Animal Ecology (WEC-30306), Disease Ecology (WEC-33306); Wildlife Ecology and Conservation (WEC32806); Thesis FEM, PEN, WEC.

Assessment strategy (“Toetsplan”)

WEC 31806, Ecological Methods 1

Assessment strategy (Toetsplan)

	Learning outcomes\where assessed	Exam part 1-Unvariate	Exam part 2-Multivariate	Exam part 3-Applied stats	Presentation	Exam part 1-3
1	Formulate appropriate null hypotheses for ecological research questions	x	x	x	x	x
2	Outline the possibilities, limitations and constraints of univariate statistical tests, and be able to identify alternative solutions	x		x	x	x
3	Outline the possibilities, limitations and constraints of multivariate statistical tests, and be able to identify alternative solutions		x		x	x
4	Select the best statistical tool to test the ecological data at hand	x	x	x	x	x
5	Analyse ecological data using appropriate statistical procedures	x	x	x	x	x
6	Interpret the statistical results in an ecologically meaningful sense	x	x		x	x
7	Perform both univariate and multivariate analyses	x	x		x	x
	Contribution to final mark (%)	25	25	25	25	(75)*
	Type of questions/examination					
	Multiple choice	x	x	x		x
	Others criteria (explained during lecture)				x	
	Assessed by:					
	Fred de Boer	x	x	x	x	x
	Frank van Langevelde	x		x	x	x
	Ignas Heitkönig		x	x	x	x
	Henjo de Knegt		x	x		
	Other WEC and FEM staff members				x	
	Time Schedule, week nr	3	5	6	6	8

*The exam comprises three different parts

*Exemption from final exam can be obtained by passing the respective partial tests

Marks of Exam parts will be available within 2 weeks after test-date.

Presentation marks will be available within 2 days after presentation

The marks of the individual parts will remain valid for 3 academic years

Access to tests and exam (parts) can only be obtained if the compulsory attendance conditions (explained in lecture) have been fulfilled

Minimum mark of all components: 5.5