Data Analysis and Modelling in Environmental Science

Title	Data Analysis and Modelling in Environmental Science
Semester	E2024
Master programme in	Environmental Science
Type of activity	Course
Teaching language	English
Study regulation	Read about the Master Programme and find the Study Regulations at [ruc.dk](ruc.dk) Læs mere om uddannelsen og find din studieordning på [ruc.dk](ruc.dk)

REGISTRATION AND STUDY ADMINISTRATIVE

Registration	Sign up for study activities at STADS Online Student Service within the announced registration period, as you can see on the Study administration homepage. When signing up for study activities, please be aware of potential conflicts between study activities or exam dates. The planning of activities at Roskilde University is based on the recommended study programs which do not overlap. However, if you choose optional courses and/or study plans that goes beyond the recommended study programs, an overlap of lectures or exam dates may occur depending on which courses you choose.
Number of participants	
ECTS	5
Responsible for the activity	Morten Foldager Pedersen (mfp@ruc.dk)
Head of study	Per Meyer Jepsen (pmjepsen@ruc.dk)
Teachers	
Study administration	INM Registration & Exams (inm-exams@ruc.dk)
Exam code(s)	U60093

ACADEMIC CONTENT

Overall objective	This is a theoretical and practical course (including lectures, class-room exercises and a mini-project) that will train students in the design of

	environmental surveys and impact studies, and to statistically analyse and evaluate data from such investigations. Focus will be on statistical techniques needed to evaluate temporal changes in environmental variables (i.e., time-series analyses) and on impact assessment. The course introduces further students to the design, construction and use of simple dynamic models (i.e., 'predictive models') used for environmental analysis and evaluation.
Detailed description of content	This is a theoretical and practical course (including lectures, class-room exercises and a mini-project). The first two thirds of the course focus on statistical methods commonly used in Environmental science, while the last third of the course focus on the application of dynamic modeling in environmental assessments. The course relies to a large extent on "hands-on" practice and the intention is to train students in the design of environmental surveys and impact studies, and to statistically analyse and evaluate data from such investigations. Focus will be on statistical techniques needed to conduct impact assessments (e.g. ANOVA) and methods used to analyze temporal changes in environmental variables such as changes in population size or changes in physical-chemical variables (i.e. time-series analyses). The course introduces further students to the design, construction and use of simple dynamic models (i.e. 'predictive models') used for environmental analysis and evaluation.
Course material and Reading list	There is no formal text-books in this course. The curriculum consists of: ● Power Point presentations from the lectures, ● Two compendia with selected chapters from various text books, texts authored by the teacher(s) and guides for the exercises including R-scripts etc. All material will be freely available from the course Moodle folder.
Overall plan and expected work effort	The course consists of ca. 20 lectures/exercises, each 2 hours (=2*45 minutes). The course is a 5 ETCS credit course, corresponding to an expected student work-load of ca. 135 hours divided between; ● lectures and supervised exercises: ca. 40 hours. ● preparation, independent work with exercises and report writing ca. 95 hours. About 75% of the lectures will be practical exercises where students will analyze data (or design and construct a dynamic model) in small groups and under supervision from the teacher. Students must expect to meet and finish some of the exercises outside ordinary class hours as part of their preparation (i.e. without supervision from the teacher).
Format	
Evaluation and feedback	The course includes formative evaluation based on dialogue between the students and the teacher(s).

Students are expected to provide constructive critique, feedback and viewpoints during the course if it is needed for the course to have better quality. Every other year at the end of the course, there will also be an evaluation through a questionnaire in SurveyXact. The Study Board will handle all evaluations along with any comments from the course responsible teacher.

Furthermore, students can, in accordance with RUCs 'feel free to state your views' strategy through their representatives at the study board, send evaluations, comments or insights form the course to the study board during or after the course.

Programme

The program consists of ca. 20 lectures (each 2 hours) over a 8 week period. Note that the exact program may change slightly from year to year depending on needs.

The major topics are:

- An introduction to Quantitative Methods in Environmental Science (2 hrs).
- Environmental sampling strategies and student presentations (2 hrs).
- A statistical brush up for non-statisticans (4 hrs).
- Impact Assessments using ANOVA and BACI designs (6 hrs).
- Environmental Monitoring - analyzing temporal changes using ANOVA and Shewart Charts (4 hrs).
- Environmental Monitoring - analyzing temporal changes using Time Series Analysis (8 hrs).
- Environmental assessment using Dynamic Ecological Modelling (14 hrs).

ASSESSMENT

Overall learning outcomes

Having completed the course, students will be able to:

- demonstrate knowledge and critically select the most commonly used designs of environmental surveys (time-series) and impact studies
- identify environmental and monitoring data (with a special focus on temporal data and impact studies)
- demonstrate knowledge of common statistical methods and simple mathematical (simulation) models used to evaluate such data and to recommend suitable methods
- design survey programs to collect and analyse data that can be used to evaluate the state of the environment
- identify, select (prioritize) and apply appropriate relevant statistical methods in order to analyse data on environmental changes and impact effects
- construct and apply simple mathematical simulation models to evaluate temporal changes in environmental variables and/or predict the consequences of environmental impacts
- interpret and critically evaluate the results from the above-mentioned statistical analyses and modeling sessions
- formulate, present and discuss results and conclusions from the above-mentioned statistical analyses or modeling sessions in an academically competent manner
- initiate, plan and conduct own statistical analyses (or model simulations) on new environmental data sets using the strongest possible method (based on data quality) and subsequently, evaluate and communicate the results in an understandable, but academically competent way.

Form of examination	Portfolio written in a group or individually
	Permitted group size: 2-4 students. Examples of written products are exercise responses, talking points for presentations, written feedback, reflections, written assignments. The preparation of the products may be subject to time limits. The content of the portfolio must be individualised.
	The character limits of the portfolio are :
	For 1 student: 12,000-72,000 characters, including spaces.
	For 2 students: 12,000-72,000 characters, including spaces.
	For 3 students: 12,000-72,000 characters, including spaces.
	For 4 students: 12,000-72,000 characters, including spaces.
	The character limits include the cover, table of contents, bibliography, figures and other illustrations, but exclude any appendices.
	The portfolio's specific products and the (if relevant) recommended size (character limits) for the individual products are made public on study.ruc.dk before the course begins.
	The entire portfolio must be handed in at the same time (uploaded to eksamen.ruc.dk). Handing in the portfolio or parts of the portfolio to the supervisor for feedback, cannot replace the upload to eksamen.ruc.dk. The submission deadline will be announced on study.ruc.dk before the course begins.
	Assessment: Pass/Fail
Form of Re-examination	Samme som ordinær eksamen / same form as ordinary exam
Type of examination in special cases	
Examination and assessment criteria	Students will be assessed by their ability to:

- Design simple survey programs to collect data that can be used to evaluate the state of the environment and subsequently select and apply appropriate relevant statistical methods in order to analyse such data.
- Construct and apply simple mathematical simulation models to evaluate temporal changes in environmental variables and/ or predict the consequences of environmental impacts
- Interpret and critically evaluate the results from the above-mentioned statistical analyses and modeling sessions and present and discuss such results in an academically competent manner.

Exam code(s)	Exam code(s) : U60093