COURSE OF STUDY *International Master degree in Innovation Development In Agrifood Systems (IDEAS) - (LM69)*

ACADEMIC YEAR *2023-2024*

ACADEMIC SUBJECT *Advanced data analysis methods for sustainable agronomic and environmental management*

General information	
Year of the course	*First year*
Academic calendar (starting and ending date)	*Second semester (26th February 2024 - 14th June 2024)*
Credits (CFU/ETCS):	6
SSD	*Agronomy and crop science – AGR/02*
Language	*English*
Mode of attendance	*Not mandatory but recommended*

Professor/ Lecturer	
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Virtual room	*TEAMS platform: annamaria.stellacci@uniba.it*
Office Hours (and modalities: e.g., by appointment, on line, etc.)	*Tutoring will take place during official visiting days and hours (Monday-Friday; 8.30-13.30), according to appointments to be arranged in advance by e-mail. Tutoring could also take place on e-learning platforms (Teams).*

Work schedule			
Hours			
Total	Lectures	Hands-on (on-class exercises, seminars by experts in the topic studied, working groups)	Out-of-class study hours/ Self-study hours
150	*32*	*28*	*90*
CFU/ETCS			
6	*4*	*2*	

Learning Objectives	Provide knowledge and understanding to: ○ plan and analyze traditional and innovative experimental designs for agronomic research and environmental monitoring; ○ interpret the results of advanced data analysis methodologies such as analysis of covariance and statistical methods for the analysis of repeated measures data in time and space to ensure a sustainable management of agronomic techniques and an efficient use of natural resources.
Course prerequisites	Prerequisites for the access to the Master degree; basic knowledge on descriptive statistics.

Teaching strategies	Learning activities will consist in theoretical lectures and applied activities including exercises on statistical procedures studied, study case analysis,

	seminars and lessons from experts in the studied disciplines. Oral lessons will be supported by Power Point presentations, the use of the blackboard and by documents prepared by the teacher. Exercises on data analysis will be performed also by means of statistical softwares (such as SAS and R). E-learning through public platforms (e.g. Teams) can be used, on demand.
Expected learning outcomes in terms of	
Knowledge and understanding on:	○ Knowledge of the principles of planning and analysis of traditional and innovative experimental designs for agronomic and environmental research. Basic knowledge of the principles of advanced data analysis methodologies such as analysis of covariance and statistical methods for the analysis of repeated measures data in time and space. ○ Correctly understanding and interpreting data analysis results. Understanding, through the case study approach, the meaning and the importance of complex data analysis methods to ensure a sustainable management of agronomic techniques and an efficient use of natural resources.
Applying knowledge and understanding on:	○ Ability to plan an experimental design for research in agriculture; ability to apply methodologies studied; ability to understand results of more complex data analyses techniques.
Soft skills	• *Making informed judgments and choices* ○ Ability to select the most appropriate methodologies for planning an experimental design, analysing the data collected and understanding results obtained. • *Communicating knowledge and understanding* ○ Ability to present the results of the research activity; ○ Ability to transfer the theoretical and applied knowledge acquired from the scientific world to the agrifood sector. • *Capacities to continue learning* ○ Ability to further deepen advanced techniques for data analysis (analysis of spatial and temporal data; multivariate data analysis; planning of more complex hierarchical designs). Expected learning outcomes, as knowledge and ability, are reported in the Didactic Regulation of the course in IDEAS (expressed by European Descriptors).
Syllabus	
Content knowledge	Students will acquire basic theoretical and applied knowledge with regard to: •planning and analysis of traditional and innovative experimental designs for agronomic research and environmental monitoring; •main univariate and bivariate parametric analysis techniques and overview of non-parametric approaches; •analysis of covariance and its role in agronomic and environmental research; •basic knowledge on assessment of temporal and spatial variability of observations and residuals. In addition, through the analysis of case studies, the students will understand the meaning and the importance of complex data analysis methods to ensure a sustainable management of agronomic techniques and an efficient use of natural resources. Contents: Recall of traditional methods of data analysis (test of hypothesis, main parametric methods for univariate and bivariate analysis - analysis of variance, linear correlation and regression); basic understanding of main univariate and bivariate non-parametric analysis techniques. Planning and analysis of traditional and innovative experimental designs for one-

	factor and factorial experiments in non-hierarchical and hierarchical schemes. Analysis of covariance and use of auxiliary information, deriving also from proximal sensors, to improve the estimation of soil and crop variables. Basic understanding of statistical methods for the analysis of repeated measures data in time and space (different approaches, modeling the covariance structure of the residuals). Linear mixed effects models taking into account temporal and spatial correlation of soil and crop properties. Analysis and discussion of case studies will focus on: analysis of long-term field experiments (LTEs) data; identification of management zones (MZ) for agro-environmental applications (precision application of water and nutrient inputs); collection and analysis of proximal sensing information to estimate soil (TOC, SWC) and crop properties.
Texts and readings	Lecture notes and teaching material made available during the course. • Littell R.C., Milliken G.A., Stroup W.W., Wolfinger R.D., Schabenberger O., 2006. SAS for Mixed Models, Second Edition. Cary, NC: SAS Institute Inc. • Gomez K.A., Gomez A.A., 1984. Statistical procedures in agricultural research. New York, Chichester, etc.: Wiley, 2nd edition. • Quinn G.P., Keough M.J., 2002. Experimental Design and Data Analysis for Biologists. Cambridge. • France J., Thornley J.H.M., 1984. Mathematical Models in agriculture. Butterworths, London. • Camussi et al. Metodi Statistici Per la Sperimentazione Biologica. Zanichelli Bologna.
Notes, additional materials	Additional readings • Scientific papers provided by the teacher. Further material will be provided by the teacher on request.
Repository	

Assessment	
Assessment methods	The final exam consists of an oral test with questions related to the lectures, exercises and laboratory classes and a written exam focused on the analysis of variance for a factorial experiment (under a hierarchical or non-hierarchical experimental design) and on the analysis of covariance. The first part of the written exam can be carried out as intermediary exam (*esonero*). The evaluation of the student is based on criteria previously fixed as reported in the Academic Regulations for the Master Degree in Innovation Development in Agrifood Systems and in the study plan.

Assessment criteria	• *Knowledge and understanding*
	  ○ The student is able to plan traditional or innovative experimental designs. The student is able to understand and use the main methodologies studied for data analysis (analysis of covariance; statistical methods for the analysis of repeated measures data).
	• *Applying knowledge and understanding*
	  ○ Ability to apply the acquired knowledge to solve case studies.
	• *Making informed judgements and choices*
	  ○ Ability to select the most appropriate methodologies and correctly interpret the results of the statistics tests studied.
	• *Communicating knowledge and understanding*
	  ○ Ability to present the results of the research activity.
	• *Communication skills*
	  ○ Ability to organize the acquired knowledge in form of didactic presentation and to articulate it for didactic purposes.

	○ Ability to transfer the theoretical and applied knowledge acquired from the scientific world to the agrifood sector. • *Capacities to continue learning* ○ Ability to further deepen advanced techniques for data analysis (analysis of spatial and temporal data; multivariate analysis; planning of more complex hierarchical designs).
Final exam and grading criteria	The final score is within 18/30 to 30/30. The exam is considered passed if a final score of at least 18/30 is reached.
Further information	