

Syllabus

Descrizione corso

Titolo insegnamento	Experimental methods and data analysis in Agricultural and Environmental Research
Codice insegnamento	46095
Titolo aggiuntivo	
Settore Scientifico-Disciplinare	NN
Lingua	Inglese
Corso di Studio	Corso di Dottorato di ricerca in Mountain Environment and Agriculture (Agricoltura e ambiente montano) - curriculum in Sistemi di produzione agraria sostenibile
Altri Corsi di Studio (mutuati)	PhD MEA -
Docenti	<p>prof. Massimo Tagliavini, Massimo.Tagliavini@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/209</p> <p>prof. Damiano Zanotelli, Damiano.Zanotelli@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/18696</p> <p>prof. Luigimaria Vittorio Borruso, luigimaria.borruso@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30124</p> <p>prof. dr. Camilla Wellstein, Camilla.Wellstein@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/33786</p> <p>dr. Maria Dolores Asensio Abella, MariaDolores.AsensioAbella@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/45187</p> <p>dr. phd. Federico Ferraccioli,</p>

	<p>Federico.Ferraccioli@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/49979 dr. Massimiliano Calvia, Massimiliano.Calvia@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/50382 dr. Fiona Jane White, FionaJane.White@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/50468</p>
Assistente	
Semestre	Non definito
Anno/i di corso	1
CFU	5
Ore didattica frontale	31
Ore di laboratorio	19
Ore di studio individuale	75
Ore di ricevimento previste	15
Sintesi contenuti	<p>Introduction to the course; Data distribution. Error types. Dependent and independent variables; quantitative and qualitative factors; fixed and random factors; Experimental designs for agricultural sciences. Introduction to R. Data exploration. Data representation. Student's t Test; Student's t Test; Introduction to linear models; one- and two-ways ANOVA: assumptions, data transformation. Post-hoc test for multiple comparisons. Linear mixed models: Analysis of repeated measurements in time and space. Analysis of split-plot designs and nested models. Analysis of Covariance. Simple linear regression and correlation, multiple regression, breaking point analysis. Penalized models: loss plus penalty framework, bias–variance trade-off, cross-validation. Ridge and lasso regression. Generalized additive models and spatial smoothing. Introduction to machine learning: prediction vs inference; random forests and boosting; variable importance; spatial cross-validation. Experimental designs for environmental sciences. Non-parametric test and non-parametric post-hoc tests. Principal component analysis of communities. Alpha, beta and gamma diversity. Cluster analysis. Principal Coordinate Analysis</p>

	(PCA). Principal component analysis of communities (PCoA). Non-metric Multi Dimensional Scaling (NMDS). Permutational multivariate ANOVA (PERMANOVA). Introduction into the statistical analysis of non-experimental data (e.g., surveys). Introduction into advanced regression and related analysis (e.g., structural equation modelling, propensity score matching)
Argomenti dell'insegnamento	<p>Module 1 - Introduction to the course; Data distribution. Error types. Dependent and independent variables; quantitative and qualitative factors; fixed and random factors; Experimental designs for agricultural sciences.</p> <p>Module 2 - Introduction to R. Data exploration. Data representation.</p> <p>Module 3 - Student's t Test; Introduction to lineal models; ANOVA: assumptions, data transformation, one- and two-ways. Post-hoc test. for multiple comparisons. Missing data. Linear mixed models: Analysis of repeated measurements in time and space. Analysis of split-plot designs and nested models. Introduction to the analysis of covariance.</p> <p>Module 4 - Least-squares linear regression; coefficient of determination and correlation; F-statistic and p-value; breakpoint analysis; linear model diagnostics; multiple linear regression.</p> <p>Module 5 - Penalized models: loss plus penalty framework, bias–variance trade-off, choice of the penalty by cross-validation. Ridge and lasso regression. Generalized additive models (GAM) and spatial models.</p> <p>Module 6 - Introduction to machine learning: prediction vs inference. Regression trees, random forests and boosting. Variable importance. Spatial cross-validation.</p> <p>Module 7 - Experimental designs for environmental sciences. Nonparametric test and non-parametric post-hoc tests.</p> <p>Module 8 - Alpha, beta and gamma diversity. Cluster analysis. Principal Coordinate Analysis (PCA). Principal component analysis of communities (PCoA). Non-metric Multi Dimensional Scaling (NMDS). Permutational multivariate ANOVA (PERMANOVA).</p> <p>Module 9 - Introduction into the statistical analysis of nonexperimental data (e.g., surveys): cross-sections, time series and panel data analysis.</p>
Parole chiave	Experimental designs, data exploration, data analysis

Prerequisiti	Descriptive statistics Basic knowledge of R
Insegnamenti propedeutici	
Modalità di insegnamento	frontal lessons and exercises
Obbligo di frequenza	Compulsory
Obiettivi formativi specifici e risultati di apprendimento attesi	<p>Knowledge and understanding</p> <p>Knowledge and understanding of main concepts and statistical methods for agricultural and environmental research.</p> <p>Applying knowledge and understanding</p> <p>Ability to choose the most suitable statistical approach to be used for tackling statistical problems in agricultural and environmental sciences. Ability to check the requisites a dataset should possess to become suitable for statistical analysis.</p> <p>Making judgements</p> <p>Ability to choose the most suitable statistical approach to be used for tackling statistical problems.</p> <p>Communication skills</p> <p>Ability to prepare graphs and tables using outcomes from statistical analysis.</p> <p>Learning skills.</p> <p>Ability to autonomously adapt the methods and tools to tackle novel statistical questions also taking advantage of the open-source software "R".</p>
Obiettivi formativi specifici e risultati di apprendimento attesi (ulteriori info.)	
Modalità di esame	Students must complete class assignments on teaching modules, which will prove the students' command on statistical procedures using R.

Criteri di valutazione	Skills in critical thinking. Ability to choose suitable statistical approaches. Ability to correctly choose the statistical model and to understand the results of a statistical analysis
Bibliografia obbligatoria	Handouts of the material presented and R scripts made available to the students.
Bibliografia facoltativa	<p>Gomez, K.A. and Gomez, A.A. (1984) Statistical Procedures for Agricultural Research. 2nd Edition, John Wiley and Sons, New York, 680 p.</p> <p>Onofri A. 2025. Field Research methods in Agriculture An introduction with R. Springer</p> <p><i>James, G., Witten, D., Hastie, T. and Tibshirani, R. (2021) An Introduction to Statistical Learning with Applications in R. 2nd Edition, Springer, New York, 607 p. freely available online at https://www.statlearning.com/</i></p>
Altre informazioni	<p>Students are required to install Rstudio software on their computer RStudio (https://posit.co/download/rstudio-desktop/).</p> <p>R ("The R Project for Statistical Computing" at https://www.rproject.org</p>
Obiettivi di Sviluppo Sostenibile (SDGs)	Istruzione di qualità