

Syllabus

Kursbeschreibung

Titel der Lehrveranstaltung	Experimental methods and data analysis in Agricultural and Environmental Research
Code der Lehrveranstaltung	46095
Zusätzlicher Titel der Lehrveranstaltung	
Wissenschaftlich-disziplinärer Bereich	NN
Sprache	Englisch
Studiengang	Doktoratsstudium in Mountain Environment and Agriculture (Alpine Umwelt und Landwirtschaft) - Studienzweig Nachhaltige Landwirtschaftliche Produktionssysteme
Andere Studiengänge (gem. Lehrveranstaltung)	PhD MEA -
Dozenten/Dozentinnen	<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, Federico.Ferraccioli@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/49979</p> <p>dr. Massimiliano Calvia, Massimiliano.Calvia@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/50382</p> <p>dr. Fiona Jane White, FionaJane.White@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/50468</p>
Wissensch. Mitarbeiter/Mitarbeiterin	
Semester	Nicht definiert
Studienjahr/e	1
KP	5
Vorlesungsstunden	31
Laboratoriumsstunden	19
Stunden für individuelles Studium	75
Vorgesehene Sprechzeiten	15
Inhaltsangabe	<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</p>

	<p>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 (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)</p>
Themen der Lehrveranstaltung	<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</p>

	panel data analysis.
Stichwörter	Experimental designs, data exploration, data analysis
Empfohlene Voraussetzungen	Descriptive statistics Basic knowledge of R
Propädeutische Lehrveranstaltungen	
Unterrichtsform	frontal lessons and exercises
Anwesenheitspflicht	Compulsory
Spezifische Bildungsziele und erwartete Lernergebnisse	<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>
Spezifisches Bildungsziel und erwartete Lernergebnisse (zusätzliche	

Informationen)	
Art der Prüfung	Students must complete class assignments on teaching modules, which will prove the students' command on statistical procedures using R.
Bewertungskriterien	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
Pfichtliteratur	Handouts of the material presented and R scripts made available to the students.
Weiterführende Literatur	<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>
Weitere Informationen	<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>
Ziele für nachhaltige Entwicklung (SDGs)	Hochwertige Bildung