Syllabus

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Titul dl curs	Computer application in food sciences
Codesc dl curs	44741
Titul suplementar	
SSD	NN
Lingaz	Inglese
Curs de laurea	Corso di laurea magistrale in Scienze degli alimenti per l'innovazione e l'autenticità
D'autri cursc de laurea (cursc deberieda)	
Dozenc	prof. Matteo Mario Scampicchio, matteo.scampicchio@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30226
Assistent didatich	
Semester	Primo semestre
Ann/Agn de stude	1st
Credic universitars	3
Ores de ensegnament	0
Ores de laboratore	30
Ores de stude individual	45
Ores de receviment prevedudes	9
Ressumé di contegnus	• Experimental data organization • Data variability and reproducibility • Quantitative modelling • Prediction from models • Uncertainty in decision-making
Argomenc dl curs	The course introduces the use of R for the organization, analysis, modelling, and interpretation of experimental data in food science.

	By the end of the course, students should be able to: 1. Organize and summarize datasets using reproducible R scripts. 2. Recognize the different sources of variability, such as repetition, replication, reproducibility. 3. Develop empirical models to fit data. 4. Predict future responses from fitted models. 5. Evaluate model performance based on uncertainty
Paroles clef	R programming; Experimental data; Variability; Empirical modelling; Uncertainty
Prerecuisic aconsiés	The course does not require previous programming experience or previous knowledge of R. The following prior knowledge is recommended: 1. Basic math: percentages, logarithms, simple equations, and graphical representation of functions. 2. Basic stat: mean and standard deviation. However, these concepts are reviewed during the course. 3. Basic computer skills: manage files, create folders, download and install software, open and save files, and perform basic editing operations. Previous experience with Excel or other spreadsheet software may be useful, although it is not required.
Cursc propedeutics	None
Modalité de ensegnament	Each lecture starts with a short presentation followed by guided hands-on exercises in R and RStudio. Students are expected to bring their own laptop computer running macOS, Windows, or Linux and capable of installing and running the current versions of R and RStudio Desktop. No specific operating-system version is required, provided that the software can be installed and operated correctly. Students who do not have access to a suitable personal computer may request a laptop from the University Library for the day of the

	lecture, subject to availability. The first part of the course introduces the R environment, data structures, data import, filtering, basic calculations, and graphical representation. The second part is organized around an individual experimental dataset assigned to each student. During each lecture, a specific quantitative concept is introduced and immediately applied to the dataset using base R. The activities progressively cover data organization, variability, empirical modelling, prediction, and uncertainty. All analyses are performed through reproducible R scripts. Advanced automation and more complex R procedures are offered as optional activities for students with stronger programming skills.
Oblianza de frecuenza	No
Obietifs formatifs y competenzes da arjonje	Knowledge and understanding: Knowledge of analytical methods for determining the authenticity, functionality, and microbiological safety of food products, as well as the related methodological tools for risk assessment. These knowledge areas will be developed through an educational program that integrates theoretical teaching activities with practical activities, such as laboratory exercises, computer simulations, simulations of food processes using pilot plants, and company visits. Ability to apply knowledge and understanding: Ability to solve problems related to the organization of production, logistics, and management of agri-food chains. Making judgements: Independent judgement is developed through a training programme designed to stimulate critical analysis in students. This includes the use of case studies, simulations using spreadsheets and videos, the reading and critical discussion of scientific articles, as well as specialist seminars held by experts in the food sector. The assessment of the independent judgement acquired by students is entrusted to the individual teachers responsible for the

	training activities, who will assess it through oral and/or written reports on specific topics and/or through exams. Communication skills: Use of the English language, both written and spoken, at a B2 level, with a command of technical and scientific vocabulary related to food science. Structure and draft scientific and technical documentation describing project activities; Prepare and present technical reports in English on specialist topics. Learning skills: The degree course provides graduates with the cognitive skills, logical tools and familiarity with new information technologies necessary to ensure continuous updating of knowledge, both in their specific professional field and in the field of scientific research.
Obietifs formatifs y competenzes da arjonje (informazions suplementares)	Students should understand: 1. what is an observation and what is an experimental unit; 2. what is the meaning of analytical repetition, process replication, and reproducibility; 3. what is the origin of experimental variability; 4. what is the meaning of model parameters; 5. what is the difference between observed, fitted, and predicted values; 6. what is the role of residuals in model fitting; 7. what is the difference between uncertainty, confidence intervals, and prediction intervals.
Sort de ejam	Assessment consists of two components: A) Course assignments (up to 21 points): B) Final examination (up to 9 points): In details: A) Course assignments (up to 21 points): Each student receives an individual experimental dataset at the beginning of the course. During the lectures, students progressively apply the concepts and R procedures introduced in class to their own dataset and submit the corresponding analyses

	and answers. Assignment scores remain valid for subsequent examination sessions within the same academic year. Students who do not complete the course assignments may recover the full assignment component through an additional individual practical assessment performed during the final examination. Students who complete only part of the assignments, or obtain only part of the 21 available points, may also recover the missing points through an additional practical assessment covering only the uncompleted or insufficiently assessed assignment components during the final examination session. The recovery assessment is based on a new dataset equivalent to those assessed during the course assignments. B) Final examination (up to 9 points): The final examination consists of an oral interview supported by the use of R and RStudio. It includes three questions of increasing difficulty, each related to the student's individual dataset. The three questions may address the following topics, in order of increasing difficulty: 1) Basic data description (3 points) Students are required to select and filter the appropriate data, produce a simple graphical representation, and quantify variability using appropriate measures such as standard deviation, range, relative standard deviation, and confidence intervals. 2) Model fitting (3 points): Students are required to select the appropriate subset of data, summarize the observations, fit a linear regression model, identify and interpret the intercept and slope, and evaluate the fitted relationship graphically. 3) Prediction (3 points): Students are required to use a fitted model to predict the response at a specified value of the explanatory variable, calculate an appropriate confidence or prediction interval, and interpret the predicted value together with its uncertainty. Final grade The final grade is calculated as the sum of the course-assignment

	score, including any recovered points, and the final-examination score: Course assignments: maximum 21 points Final examination: maximum 9 points Total: maximum 30/30 The examination is passed with a final grade of at least 18/30. Advanced Award and cum laude Students who achieve 30/30 may optionally complete an Advanced Award task during the final examination. This may include advanced tasks such as: - automating analyses across multiple experimental conditions; - using advanced functions such as split(), sapply(), or developing user-defined functions; - applying nonlinear regression with nls(); - developing a fully reproducible automated analysis workflow. The Advanced Award does not replace any component of the standard assessment and is not required to achieve the maximum standard grade of 30/30. Students who achieve 30/30 and successfully complete the Advanced Award may be considered for 30/30 cum laude.
Criters de valutazion	The examination assesses the ability to select an appropriate analytical approach, apply R commands correctly, interpret model outputs, and justify the conclusions on the basis of the dataset. The final grade is calculated as the sum of the assignment score, including any recovered points, and the oral examination score, for a maximum of 30 points. During the final oral examination, Students who achieve the maximum grade of 30/30 may optionally complete an advanced R assignment based on their individual dataset. The Advanced Award may include tasks such as: - automating analyses across multiple experimental conditions; - using functions such as split(), sapply(), or user-defined

	functions; - applying nonlinear regression; - performing resampling or simulation; - producing a fully reproducible automated analysis workflow. The Advanced Award does not replace any component of the standard assessment and is not required to achieve the maximum standard grade. Students who achieve the maximum grade of 30/30 and successfully complete the Advanced Award may be considered for 30/30 cum laude Passing criteria: pass with at least 18/30.
Bibliografia obligatora	**Course handouts, R scripts, datasets, and exercises provided by the Lecturer.** **R Core Team.** *R: A Language and Environment for Statistical Computing.* R Foundation for Statistical Computing. **NIST/SEMATECH.** *e-Handbook of Statistical Methods.* Selected sections on descriptive statistics, regression, model fitting, prediction, and uncertainty.
Bibliografia aconsieda	**Miller, J.N., & Miller, J.C. (2018).** *Statistics and Chemometrics for Analytical Chemistry* (7th ed.). Pearson. Recommended for descriptive statistics, precision, regression, confidence intervals, and interpretation of analytical data. **Kabacoff, R.I. (2015).** *R in Action: Data Analysis and Graphics with R* (2nd ed.). Manning Publications. Recommended as an accessible practical introduction to data handling, descriptive statistics, graphics, regression, and statistical modelling in R. **Eurachem.** *The Fitness for Purpose of Analytical Methods: A Laboratory Guide to Method Validation and Related Topics.*

	Recommended for precision, repeatability, reproducibility, calibration, and interpretation of analytical measurements. **Eurachem/CITAC.** *Quantifying Uncertainty in Analytical Measurement.* Recommended for measurement uncertainty and reporting of quantitative results. **ISO 5725 series.** *Accuracy (trueness and precision) of measurement methods and results.* Reference for precision, repeatability, intermediate precision, and reproducibility.
Deplù informazions	Students are expected to bring a laptop computer with R and RStudio installed for all lectures. The course uses base R only; no additional R packages are required for the core activities
OSS	Istruzione di qualità, Parità di genere, Ridurre le disuguaglianze, Innovazione e infrastrutture, Buona occupazione e crescita economica