COURSE OF STUDY *Master degree in Plant Medicine (LM69)*

ACADEMIC YEAR *2023-2024*

ACADEMIC SUBJECT *Statistical procedures for agricultural research and agrometeorology*

General information	
Year of the course	*First year*
Academic calendar (starting and ending date)	*First semester (September 25th 2023 - January 19th 2024)*
Credits (CFU/ETCS):	6
SSD	*Agronomy and crop science – AGR/02*
Language	*Italian*
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 studied disciplines, laboratory exercises, 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 on: ○ principles of experimental design and planning; main parametric methods for univariate and bivariate analysis; ○ theoretical and practical aspects of agrometeorology and agricultural modelling.
Course prerequisites	Prerequisites for the access to the Master degree; basic knowledge on descriptive statistics and general agronomy.

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 on the principles at the basis of an experimental design; knowledge on the main parametric methods for univariate and bivariate analysis (analysis of variance for the main experimental designs used in agriculture for one factor or more than one factor (factorial experiments); comparison between two samples means for paired and unpaired samples; linear correlation and regression analysis); ○ Knowledge on theoretical and practical aspects of agrometeorology and on the principles of modelling and models for sustainable crop management.
Applying knowledge and understanding on:	○ Ability to plan an experimental design for research in agriculture; Ability to apply basic techniques for univariate (comparison between two sample means; analysis of variance) and bivariate (regression and correlation) parametric analysis; ○ Ability to understand the relationships among environment and agriculture.
Soft skills	• *Making informed judgments and choices* ○ Ability to correctly interpret the results of basis statistics tests for the assessment of the effects of one-factor or factorial experiments; ○ Critic evaluation of the topics related to the climatic variability, and the current and predictable climatic effects on the environment and agriculture through mathematical models. • *Communicating knowledge and understanding* ○ Ability to present the results of the research activity; ○ Ability to summarize the results of the interaction among climatic variables, plants, sustainable crop management. • *Capacities to continue learning* ○ Ability to further deepen advanced techniques for data analysis (hierarchical designs with more than two factors; multivariate analysis; analysis of covariance) and models for the management of plant, environment, pathogen interaction. Expected learning outcomes, as knowledge and ability, are reported in the annex A of the Didactic Regulation of the course in Plant Medicine (expressed by European Descriptors).
Syllabus	
Content knowledge	Statistics in agricultural research. Population and samples, parameters and statistics. Frequency distributions. Descriptive statistics. Measures of central tendency and location: mean, median, mode; quantiles. Measures of variability: sum of squares (SS), mean squares (MS), standard deviation (RMS), coefficient of variation, standard error of the mean. Measures of shape: skewness and kurtosis. Probability distributions. Normal distribution, standard normal distribution. Hypothesis testing; type I and type II errors; protection and power of the statistical tests. Testing of the assumptions for parametric data analysis. Experiment planning. Elements of experimentation. Experimental unit, experimental error, replication and randomization, sample size assessment, experimental design. Comparison of two population means. Independent or unpaired samples and paired samples. Student t test. Analysis of variance. Experimental designs: completely randomized design (CRD), randomized complete block design (RCBD), latin square design (LSD), split-plot and strip plot (split-block) designs.

	Comparison between treatment means; post-hoc tests for mean comparison. Analysis of the relationships between two series of data. Linear regression and correlation analysis. Definitions of meteorology, agrometeorology, climatology and agroclimatology. Agrometeorological parameters. Solar radiation, radiation parameters and laws (Planck, Wien, Stefan-Boltzmann). Energy balance. Methods and units of measures; numerical applications (e.g. conversion of measure units; energy associated to a photon mole; expression of the radiation flux density into equivalent evaporation). Eliophany and estimation of solar radiation. Effects of solar radiation on crops. Temperature and heat. Temperature parameters. Thermal sum. Air temperature. Soil temperature. Effects on crops. Measure instruments. Temperature and agronomical techniques. Relative air humidity. Definitions and general aspects. Dew-point temperature. Effects on the crops. Measure instruments. Precipitations. Definitions and general aspects. Precipitation characteristics: amount, distribution, frequency, intensity, duration. Measure of the rainfall. Probability of rainfall. Importance of the rainfall for agriculture crops. Wind. Intensity and direction. Measure of wind speed. Effects on crops. Evaporation and evapotranspiration. Definition and general aspects. Methods of measure and estimate of the ET. Empirical equations and micro-climatic methods. Mathematical models. Definitions, classification and general aspects. Choice and application of models. Calibration, validation and analysis of sensitivity. Applications of agrometeorology.
Texts and readings	Notes of the lectures and teaching material distributed during the course • Camussi et al., 1995. Metodi statistici per la sperimentazione biologica. Zanichelli Bologna. • Gomez K.A., Gomez A.A., 1984. Statistical procedures in agricultural research. New York, Chichester, etc.: Wiley, 2nd edition • Ceccon P., Borin M., 1995 - Elementi di agrometeorologia e agroclimatologia. Imprimitur.
Notes, additional materials	Additional readings • 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. • Benincasa F., Maracchi G., Rossi P., 1991 – Agrometeorologia. Patron, Bologna. • 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. An intermediary written exam will be also performed, including three exercises [Student t test for unpaired data; regression and correlation analysis; one-factor analysis of variance for a latin square design]. The evaluation of the student is based on criteria previously fixed such as those reported in the Annex A of the Didactic Regulation of the Master Course in Plant Medicine and is expressed in thirtieths.
Assessment criteria	• *Knowledge and understanding*

	○ The student is able to plan an experimental design for agricultural research; ○ The student is able to use the main parametric univariate and bivariate methods of data analysis (analysis of variance for the main experimental designs used in agriculture for one factor or factorial experiments; comparison between two sample means; bivariate analysis: correlation and linear regression); ○ The student knows the main theoretical and practical aspects of agrometeorology and principles of mathematical modelling in agriculture. • *Applying knowledge and understanding* ○ Ability to plan an experimental design for agricultural research; ○ Ability to apply basic parametric analysis techniques for univariate and bivariate datasets; ○ Ability to study the relationships among environment and agriculture. • *Making informed judgements and choices* ○ Ability to correctly interpret the results of statistics tests for the assessment of the effect of one-factor or more than one factor under study evaluated at the same or different hierarchical level. ○ Critical evaluation of the topics related to the climatic variability, and the current and predictable climatic effects on the environment and agriculture through mathematical models. • *Communicating knowledge and understanding* ○ Ability to present the results of the research activities. ○ Ability to summarize the results of the interaction among climatic variables, plants and sustainable management of agronomic and phytosanitary techniques. • *Communication skills* ○ ability to organize the acquired knowledge in form of didactic presentation. • *Capacities to continue learning* ○ Ability to further deepen and understand advanced techniques for data analysis (hierarchical design with more than two factors; multivariate analysis; analysis of covariance) and models for the management of plant-pathogen interaction.
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	