COURSE DETAILS
"DIGITAL MAPPING, GEOSPATIAL STATISTICS AND DECISION SUPPORT"

DEGREE PROGRAMME: PRECISION LIVESTOCK FARMING

ACADEMIC YEAR 2025/26

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: GIULIANO LANGELLA
PHONE: 0812532136
EMAIL: GIULIANO.LANGELLA@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): DIGITAL MAPPING AND PRECISION IRRIGATION
MODULE (IF APPLICABLE): DIGITAL MAPPING, GEOSPATIAL STATISTICS AND DECISION SUPPORT
SSD OF THE MODULE (IF APPLICABLE): AGR/14
TEACHING LANGUAGE:
CHANNEL (IF APPLICABLE):
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II, ANNUAL): I
CFU: 5

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None.

PREREQUISITES (IF APPLICABLE)

Basic notions related to statistics (position and dispersion indicators)
Computer science basics (software installation, spreadsheet software)
Install and open QGIS
Install and open RStudio (optional, teacher shares an RStudio Server instance)

LEARNING GOALS

The course aims at providing students with advanced notions related to soil and its key properties, the analysis of the spatial variability of environmental information with particular emphasis to soil properties and characteristics, also by means of data manipulation to build models of spatial interpolation. Further, it is provided students with the basic notions related to data retrieval, geospatial visualization and analysis, land evaluation.

Moreover, this course aims to provide students with the advanced concepts for managing precision irrigation at the farm scale. The roles of the three main components covered in this module—soil, plant, and atmosphere—will be illustrated with practical examples.
The course will clarify the function of the soil, including its primary physical and hydraulic characteristics and the main processes of water movement. It will also examine the impact of key agro-meteorological variables on the water consumption of major forage crops grown nationally and worldwide.
Specific focus will be placed on the quantitative assessment of crop water requirements and the use of sensors for the precision management of irrigation operations.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The course provides the student with, and the student is expected to demonstrate knowledge and understating of the issues related to: key soil physical and chemical characteristics; pedology, soil classification and spatial variability; pedometrics and quantitative approaches to soil spatial variability; spatial (and temporal) variability in the production process; decision support.

Applying knowledge and understanding

The course delivers ability and tools needed to apply knowledge in retrieving and fusing data coming from different collection of observations; producing high resolution data by means of low-cost, auxiliary and environmental covariates; analysing and modelling the geospatial variability of key crop/livestock features; digital mapping of variables belonging above all to weather, soil, crop and livestock conditions; aggregation of the available information to support management decisions.
In addition, the student must be able to evaluate (soil) spatial variability and their impact on farm management, farm state conditions and variability and their impact in the management process, data elaboration and mapping in open source software (QGIS, RStudio).

COURSE CONTENT/SYLLABUS

FRONTAL LESSONS	HOURS
- *Lecture 1. What is soil?* *Soil properties (main physical and chemical properties)* *Pedology and concepts about soil classification* *Soil profile and soil horizons.*	**6**
- *Lecture 2. What does spatial variability means?*	**4**

	Concepts about variability and spatial variability. *Environmental data (soil, climate, etc.) at farm and landscape scales.* *Concepts on cartography and digital mapping.*	
-	*Lecture 3. Data visualization and FAIR principles* *Sources of data and sensors (satellite, drone, proximal sensing, IoT, etc.)* *The WWW as a resource.* *Types of geospatial data (vector and raster)* *Findability, Accessibility, Interoperability and Reusability principles*	**4**
-	*Lecture 4. Quantitative approaches* *Concepts on quantitative approaches to soil and pedometrics.*	**5**
-	*Lecture 5. Spatial variability and mapping* *Analyse spatial variability* *Concepts on geostatistics* *Concepts on machine learning*	**6**
-	*Lecture 6. Geospatial analysis of environmental data* *Data retrieval and data fusion* *Geospatial modeling* *Decision support*	**5**
TOTAL		**30**

PRACTICAL TEACHING	ORE
Hands-on session: start with RStudio and QGIS	**1**
Visualize geospatial data: hands-on sessions using R and QGIS.	**1**
Hands-on sessions on soil and agrometeorological data.	**2**
Hands-on sessions on geospatial analysis using RStudio.	**7**
Hands-on sessions using data collected by teacher and/or students.	**2**
Hand-on sessions on spatial variability and mapping.	**7**
TOTAL	**20**

READINGS/BIBLIOGRAPHY

- "Principles and Practice of Soil Science: The Soil as a Natural Resource" by White, 4th Edition, LINK, ISBN: 978-0-632-06455-7. Chapters: 2, 3, 4, 14
- "Soils: Basic Concepts and Future Challenges" by Certini & Scalenghe, LINK, ISBN: 9780511535802. Chapter 8.
- "Geocomputation with R" by Lovelace, Nowosad and Muenchow (https://bookdown.org)
- "R Programming for Data Science" by Roger D. Peng [WEB] – Chapters: 1, 2, 3, 4, 5, 6, 9, 10, 11
- Lecture notes prepared by the teacher and available here: https://lectures.weatherprogapp.it

TEACHING METHODS

Teacher will use a) lectures per approx. 60% of the total hours, b) practical exercises with a computer (mainly with RStudio and QGIS) to further elaborate on applied knowledge for approx. 40% of the total hours.
Teacher will organize with students a field excursion in to refine the study of soils with a more geographical and territorial emphasis. On teacher discretion, the data collected during field excursion might be used in the written exam.
Teacher will also make use of additional teaching tools, such as recorded lectures, multimedia, software (QGIS, RStudio, Markdown), and online materials (https://lectures.weatherprogapp.it).
The teacher will use a student-centered method; tutorials; Practical lessons, learning by doing method. The lessons will be supported by multimedia teaching material available to students on the teacher's website, after registering for the course

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to: (*)	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	X

(*) multiple options are possible

b) Evaluation pattern:

The evaluation of the student is based on a written and oral examination. The written exam will take place at the end of the course and its performance is binding to have access to the oral exam. The mark will be computed giving the following relative weights: 60% for written exam and 40% for oral exam.

The final grade of the integrated course will therefore be composed as follows: 50% from the "Digital Mapping, Geospatial Statistics and Decision Support" module (5 CFU) and 50% from the "Precision Irrigation Systems and Sensing Technologies" module (5 CFU).

For the evaluation, the "Regulation for Guidelines_for_exams_management" approved by the Didactic Coordination Committee of the Master Degree in Precision Livestock Farming will be considered.