



Universitat de Lleida

DEGREE CURRICULUM  
**ST IN DATA MANAGEMENT  
AND VISUALIZATION WITH R**

Coordination: AMEZTEGUI GONZALEZ, AITOR

Academic year 2023-24

## Subject's general information

<b>Subject name</b>	ST IN DATA MANAGEMENT AND VISUALIZATION WITH R			
<b>Code</b>	111022			
<b>Semester</b>	ANUAL CONTINUED EVALUATION			
<b>Typology</b>	<b>Degree</b>	<b>Course</b>	<b>Character</b>	<b>Modality</b>
	Master's Degree Erasmus Mundus in Spatial and Ecological Modelling in European Forestry	2	OPTIONAL	Attendance-based
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<b>Course number of credits (ECTS)</b>	5			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRAULA		TEORIA
	<b>Number of credits</b>	4		1
	<b>Number of groups</b>	1		1
<b>Coordination</b>	AMEZTEGUI GONZALEZ, AITOR			
<b>Department</b>	AGRICULTURAL AND FOREST SCIENCES AND ENGINEERING			
<b>Teaching load distribution between lectures and independent student work</b>	Lectures: 20% Independent work: 80%			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	English			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
AMEZTEGUI GONZALEZ, AITOR	aitor.ameztegui@udl.cat	5	

## Subject's extra information

Introductory course on data science, focused on the collection, management, visualization and analysis of data. We cover the entire data science pipeline from data acquisition to publication. The course will focus on the R statistical computing language and is addressed to second-year students of the Master's Degree Erasmus Mundus in Spatial and Ecological Modelling in European Forestry at the University of Lleida. The aim is to teach the students how to use R to effectively manage, clean, analyze and visualize data. The course is based on a "hands-on" approach, so that the students can easily transfer the acquired knowledge to real case studies, and even use it to process and analyze their own set of data, helping them in the preparation of their Master Thesis.

## Learning objectives

The aim is to teach the students how to use R to effectively manage, clean, analyze and visualize data. The course is based on a "hands-on" approach, so that the students can easily transfer the acquired knowledge to real case studies, and even use it to process and analyze their own set of data, helping them in the preparation of their Master Thesis

## Subject contents

### **Part 0. Course Organization and Basic Contents**

- Welcome. Course organization and warm-up
- Getting familiar with R and RStudio
- R basics
- Introduction to R Markdown

### **Part 1: Data Management**

- Unit 1: Introduction: The data pipeline, the tidyverse and the concept of tidy data. Good coding practices.
- Unit 2: Explore your data. Data transformation: create variables, filter, select & organize data
- Unit 3: Wrangle your data. Data import and export: reading and writing different file types. Modify your data frame and work with several tables.
- Unit 4: Program in R within the tidyverse. Functions and functional sequences. Iteration.

### **Part 2: Data visualization**

- Unit 5: Fundamentals of data visualization. Principles of figure design. From data to visualization. How ggplot works
- Unit 6: Directory of visualizations. Visualizing amounts, proportions and distributions. Revealing trends and seeing relationships. Visualization of time-series data. Spatial data in the tidyverse
- Unit 7: Graphics for communication. Controlling axes and manipulating colours in ggplot. Adding text and annotations. Saving plots.

## Methodology

"Data management and visualization with R" is designed as an asynchronous online course. That means that

learning happens on your schedule. And it is based on a “hands-on” approach. This means that instructors will provide materials to introduce the main concepts, but you will learn by doing, that is, most of the learning will occur while you try to solve the exercises, assignments or reports. We know that coding can be hard at the beginning, and that you will make lots of mistakes. That's good! A key part of your success in using R lies in your ability to be self-reliant and be able to get help and apply it to your own problem. This is why it is important to become familiar from the beginning with the various alternatives for getting help (including, of course, asking the instructors!)

The course is organized around the following components:

- **Lectures:** we will try to keep them short, but some "theory" will be needed here and there. This will be provided as short videos introducing the main ideas.
- **Labs:** this is where most of the concepts will be presented. They're self paced tutorials with examples, and a final self-assessment questionnaire (does not count for grades) where students can evaluate the degree of learning and understanding of the knowledge imparted. Each lab will contain some questions/exercises you will need to answer by creating a "lab report" (we'll see how).
- **Readings:** In some units we will recommend some external readings to expand or consolidate concepts covered in labs and lecture
- **Homework:** You will be assigned some larger data analysis tasks throughout the semester. These assignments will be completed individually (but can ask doubts of course!), and we will set the deadlines as the course progresses.
- **Exams:** Individual, two midterms. We will ask you to complete a number of small programming and or analysis tasks related to the material presented in the class. You will have access to all the materials provided in the course, and well... to the internet, so you will be able to check any source you wish. However, you **MUST** solve the exams individually, and all communication with classmates is explicitly forbidden.

### A note on sharing/reusing code

- A huge volume of code is available on the web to solve any number of problems.
- Unless we explicitly tell you not to use something, the course's policy is that *you may make use of any online resources* (e.g. StackOverflow) but if you copy pieces of code from somewhere **you must cite** where you obtained it.
- Except for the exams, you are welcome to discuss the problems together and ask for advice, but you may not directly send or make **use of code from another student** in this class
- On the exams all communication with classmates is explicitly forbidden.

## Development plan

**All the info, links and materials of the course will be posted at [datamanagement.netlify.app](https://datamanagement.netlify.app)**

We will use R as the software to solve all the data management and visualization problems. R is one of the most popular languages for data management, and is very versatile, multiplatform, and 100% free (in both senses). Moreover, analyses conducted in R are transparent, easily shareable, and reproducible.

To avoid the need to install any software in your computer, we will use [RStudio Cloud](https://rstudio.cloud), which is a cloud managed instance of the RStudio IDE. We have had very good experiences using RStudio Cloud in previous years, since it reduces friction at first exposure to R, and avoids the need for software local installation, or to install packages, circulate files with data or download files.

You will learn all what you need to know about R and Rstudio Cloud at the beginning of the course, but you can also check this introductory document: [https://datamanagement.netlify.app/labs/lab01\\_intro-r.html](https://datamanagement.netlify.app/labs/lab01_intro-r.html)

## Evaluation

Component	Weight
Lab exercises	30%
Homeworks	30%
Midterm Exam 1	20%
Midterm Exam 2	20%

## Bibliography

These are the main texts used to prepare this course. All of them are either freely available, or available for loan in the library of the University of Lleida.

<a href="#">R for Data Science</a>	Grolemund, Wickham	O'Reilly, 2016
<a href="#">Data visualization: a practical introduction</a>	Healy	O'Reilly, 2019
<a href="#">Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures</a>	Wilke	O'Reilly, 2019
<a href="#">The Functional Art: An introduction to information graphics and visualization</a>	Cairo	New Riders Publishing, 2012
<a href="#">The truthful Art: Data, Charts, and Maps for Communication</a>	Cairo	New Riders Publishing, 2016
<a href="#">Making data visual: a practical guide to using visualization for insight</a>	Fisher , Meyer	O'Reilly, 2019
<a href="#">Good Enough Practices in Scientific Computing</a>	Wilson et al.	PLoS Computational Biology 2016