

PNG0088 Understanding & Coding the R Programming Language

Teachers: Matt Low & Malin Aronsson (Dept. of Ecology, SLU)

Credits: 3 ECTS

Date and location: November/December 2021, Distance course/Ultuna campus, Uppsala

Course overview:

The course is about R as a language, to allow you to understand the code you read and write (and where those weird error messages come from). It will start from a very basic level and teaches many of the principles that are necessary to be able to write your own programs in R but are usually skipped over in the rush to do some 'stats'. It is ideal for people who: (1) have never used R before, or (2) use it but don't really understand what they are doing or (3) use it at a basic level and want to develop their programming skills (e.g. how to do loops, write their own functions or do graphics). The course is NOT about statistics. Because people on the course will come from diverse backgrounds, the methods we teach will be general enough so they can be applied to any research question.

Day 1: The building blocks of R programming

1. Introduction to objects and functions in R
2. How R stores information - vectors & matrices
3. The 3 vector principles - recycling, vectorisation and indexing
4. How data are represented - Lists & data frames

Day 2: Programming for automating processes

1. If-else statements
2. Loops and programming repetition
3. Programming functions

Day 3: Plotting and graphics

1. The basics of plotting
2. Manipulating plot parameters
3. Adding shapes, lines, points and text
4. Combining multiple plots

Day 4: Additional concepts and exercises

1. Writing clear code
2. Debugging
3. Dates and time in R
4. Manipulating datasets
5. Exercises of increasing complexity

Day 5: Statistical objects

1. Linear models and GLMMs
2. Storing and manipulating statistical objects
3. Creating and visualizing model predictions
4. LOTS more exercises!

Course Structure:

The course runs for 5 days with each day beginning at 8:45 and finishing at ~17:00 with 1 hour for lunch and 2 fika breaks. Each day is a combination of lectures and exercises with an in-class computer exercise introduced after every new concept. During these exercises the teachers will work with the students to help them achieve the objective of each task, and to answer any questions regarding the concepts. This allows us to provide immediate help for students that have difficulty with any concept.

Aims & Intended learning outcome:

The aim of the course is to help each student overcome the initial steep learning curve that is associated with learning R, and how to think in a structured and logical way to make programming easier. By the end of the course students will:

1. Know the differences between data structure types and why these are used
2. Be able to create data structures and extract information from these
3. Understand how functions work in R and be able to create their own
4. Use specific programming methods to automate repetitive processes
5. Create publication-quality figures from data
6. Implement and extract information from statistical objects
7. Write code in a series of logical steps to create complex outputs using combinations of simple functions

Assessment:

There will be no formal examination to pass this course. Instead, during the course students will demonstrate during in-class exercises the following programming skills and concepts of R.

1. Creating vector and matrix structures
2. Importing and manipulating datasets using csv files created from excel
3. The 3 vector principles in R (recycling, vectorisation & indexing) and how these relate to data objects and functions
4. if-else statements, iterative loops and writing functions
5. Manipulating base graphics to produce publication-quality figures
6. Extracting, storing and plotting data from statistical objects
7. Combining the principles from 1-6 to solve complex problems

Literature:

Students will have to work through a primer before the course and will be given pdfs of all lectures and answers to in-class exercises at the end of each day.