

Week 1

Spatial data and their representation in R

[icon] Overview

Welcome to Week 1 of Spatial Analysis.

This subject surveys the theory of random fields, spatial processes, spatial statistics models, and their applications to a wide range of spatial data, including image analysis and geographic information systems (GIS). Examples of spatial data analysis include analysis of spatial distributions of points, lines and areas, investigating dependencies between spatial locations, and using the existing data from given locations to predict data at new locations. The subject will cover the methodology and modern developments for spatial-temporal modelling, estimation and prediction, and spectral analysis of spatial processes. All the methods presented will be introduced in the context of specific datasets with R software.

You will start this week learning about spatial data and revising basic structures in R.

By the end of this week, you will learn:

Topic 1: Spatial data

- Main types and properties of spatial data
- Four important data prototypes in spatial data analysis: geostatistical data, lattice data, spatial point patterns and spatial set patterns
- Main objectives of spatial analysis

Topic 2: R software

- Revise the main structures of R software

By completing this module, you will be working towards the following subject intended learning outcomes:

1. Formulate purposeful questions to explore new statistical ideas and subsequently design valid statistical experiments.

Topic 1: Spatial data

We will begin this week by discussing the main types and properties of spatial data. You will learn about four important data prototypes in spatial data analysis:

- geostatistical data
- lattice data
- spatial point patterns
- spatial set patterns.

You will also study the main objectives of spatial analysis.

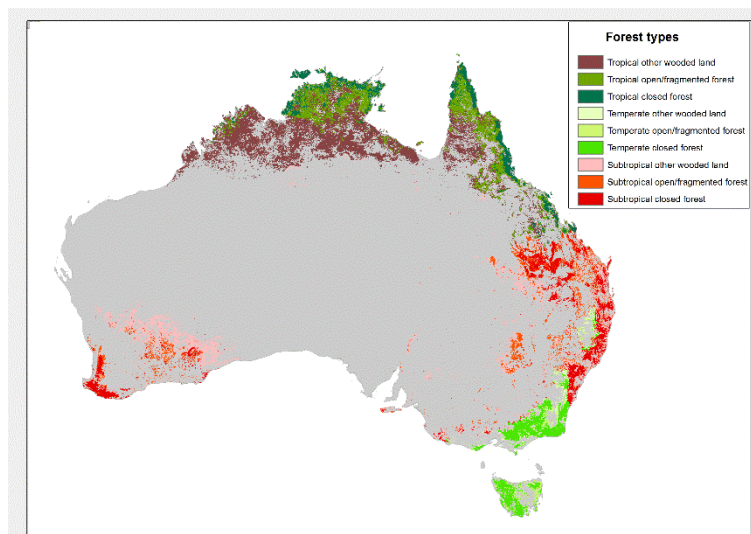
Examples of spatial data

So, what is spatial data? Let us start with a broad description and some examples in the first of our readings. After these introductory examples, you will learn about three applications that use such data. These applications were traditionally developed by different data science or statistical communities but have big intersections in terms of spatial methods and data used.

Figure 1.1 is an example of how spatial data is presented in spatial analysis.

Figure 1.1

Example of visualisation of spatial data



Note. © Marathon, M. (2017, July 19). *Australian forest cover by Global Ecological Zones*. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Australia_forest_cover_by_Global_Ecological_Zones.tif. CC BY-SA 4.0

Read

In the reading Introduction to spatial analysis, you will explore the examples of spatial data and how they are presented and the various applications that use spatial methods.

Open the document titled **Week_1_Topic_1** and read **slides 1–9**.

Types of spatial data

There are many different types of spatial data, and there is no unique classification for them. In this section, we will discuss the classification based on four types:

- geostatistical data
- lattice data
- spatial point patterns
- spatial set patterns.

These types are rather different in terms of their representation, data science models and methods used to analyse them. Usually, different areas of spatial statistics deal with them. However, there are no clear-cut borders between them, especially when one considers different spatial resolutions. It might not be very clear to which type a specific data set can be assigned. In some cases, a combination of different methods can be appropriate.

In this subject, we mainly discuss methods to investigate geostatistical data and spatial point patterns.

Read

In the reading Types of spatial data, you will learn about the different types of spatial data along with examples.

From the folder, open the document titled **Week_1_Topic_1** and read **slides 10–15**.

Objectives of spatial analysis

In this section, you will learn the main objectives of spatial data analysis. You will also discover the key differences between temporal and spatial analysis. Finally, you will be provided with information about analysis of data collected in both space and time.

Read

In the reading Objectives of spatial data, you will learn about the objectives of spatial data with examples.

From the folder, open the document titled **Week_1_Topic_1** and read **slides 16–19**.

Topic 2: Basics of R

In this topic, you will start with a short revision of the R software and its basic structures.

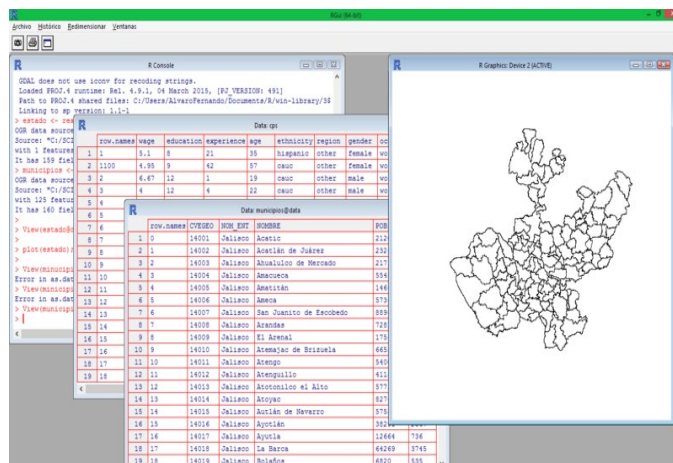
R software

R software is a very popular tool for data handling and analysis. Figure 1.3 is an example of how R is used in spatial analysis.

In this section, we briefly recall how to install R and its packages and give examples of spatial R packages. Then, you will revise the basic key structures and methods used in R to represent and model data.

Figure 1.3

Example of use of R to visualise spatial data



Note. © Alvaro, Sr. (2015, September 27). *R en Windows*. Wikimedia Commons.

https://commons.wikimedia.org/wiki/File:R_en_windows.PNG. CC BY-SA 4.0

Read

In the reading Key concepts of R, you will explore the use of R in conducting spatial analysis, the various packages available within R and the installation process.

From the folder, open the document titled **Week 1 Topic 2** and read **slides 1–11**.

Workshop 1

Activity

Workshop 1

This activity will be completed in R. Repeat the R programming content covered in Week 1. Modify the code and understand the impact of different R parameters on changes in results.

Your task

- Repeat R commands learnt in Week 1.
- Try to modify the code and understand the impact and meaning of different R function parameters. Interpret the observed changes in plots and analysis results.
- Feel free to discuss questions with other students as you go, and please also take the time to help others. It is amazing how much we all can learn from each other's questions, and how in helping others we strengthen our own understanding.
- Revisit these problems in later weeks and challenge yourself to get a deeper understanding to build on what you learn later.

Guidelines

- This activity is not graded but is an essential part of your learning.
- You don't need to submit your R code; however, to be successful in this subject it is necessary to work through all R coding materials from this week and understand how to apply the corresponding R commands.
- You should try R commands in this week's materials before the workshop. This will give you an opportunity to efficiently work with the facilitator during the workshop and get your questions answered.
- You should spend around two hours on this activity.
- In case you are unable to attend this workshop, full R code will be provided after the workshop.

Summary

This week, we looked at general principles of classification and representation of spatial data. You also revised basic R structures and methods.

Next week, we will continue learning about how to use R for spatial data representation.

Here's a list of tasks that you should be working on or have completed:

- **Required readings**
- **Workshop**

The following resources provide you with this week's references and additional suggested readings.

[icon] Additional suggested readings and resources

While these readings and resources are not essential, they provide greater insight into the concepts covered in the week and give you the choice to enhance your learning or pursue an area of interest in greater detail.

Software downloads:

- [R software](https://cran.rstudio.com): R. (n.d.) *The comprehensive R archive network*. Retrieved October 31, 2022 from <https://cran.rstudio.com>
- [RStudio](https://www.rstudio.com/products/rstudio/download/): RStudio. (2022). *Download the RStudio IDE*. <https://www.rstudio.com/products/rstudio/download/>

Book:

- Bivand, R. S., Pebesma, E., & Gomez-Rubio, V. (2013). *Applied spatial data analysis with R* (2nd ed.). Springer. <https://doi.org/10.1007/s12061-014-9118-y>

[icon] References

Alvaro, Sr. (2015, September 27). *R in Windows*. Wikimedia Commons.
https://commons.wikimedia.org/wiki/File:R_en_windows.PNG

Djexplo. (2019, July 10). *Latitude and longitude of the Earth*. Wikimedia Commons.
https://commons.wikimedia.org/wiki/File:Latitude_and_Longitude_of_the_Earth_fr.svg