Week 2

GIS and spatial data in R

[icon] Overview

Welcome to Week 2 of Spatial Analysis.

You will start this week learning about the basic principles of GIS and then you will get your first experience with the representation of spatial data in R. We will be using the package sp this week and CRAN and Meuse data.

By the end of this week, you will learn:

Topic 1: Geographic information systems

- Geospatial data models
- Map projections
- Coordinate systems

Topic 2: Spatial objects in R

- Learn about the package sp and spatial objects in R
- Explore Meuse data

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: Geographic information systems

This topic discusses the main principles of geographic information systems (GIS). You will learn about geospatial data models that use Earth-referenced data. You will get a basic understanding of different map projections and coordinate systems used in GIS.

Introduction to geographic information systems

Watch Video: https://www.youtube.com/watch?v=LHDCRjAxpI0

In this section, you will learn the foundations of GIS. You will understand which problems can be addressed with GIS and basic principles of GIS data representation. You will study two main components of georeferenced data: spatial and attribute.

Read

In the reading Geographic information systems, you will learn more about the foundations of GIS.

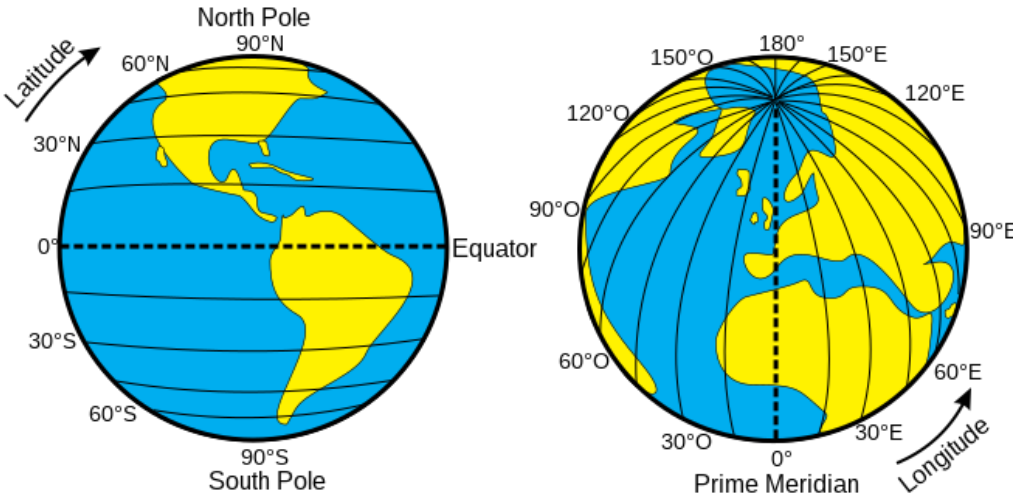
From the folder, open the document titled **Week_2_Topic_1** and read **slides 1–4**.

Map projections and coordinate systems

A large number of projections of the Earth surface into a plane have been designed to minimise the distortion and preserve certain properties of the Earth, as shown below in Figure 1.2. You will learn principles of conformal, equidistant and equivalent (equal-area) projections. When the type of projection is selected, to accurately identify a location on Earth a coordinate system is required. You will study the basic elements of each coordinate system.

Figure 1.2

Example of map projections and coordinate systems



Note. © 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. CC0 1.0 Universal (CC0 1.0)

Read

In the reading Map projections and coordinate systems, you will explore map projections and coordinate systems in relation to spatial analysis.

From the folder, open the document titled **Week_2_Topic_1** and read **slides 5–7**.

Topic 2: Spatial objects in R

In this topic, you will learn several ways to represent spatial data in R by using the R package sp. Next, we illustrate some spatial methods using the Meuse data. This data set will be a standard example for many topics.

Spatial objects in R

In this section, you will learn about the main principle of representing spatial data in R by using the R package sp. We will start with the foundation class Spatial and then extend it to SpatialPoints and Spatial*DataFrame. You will learn several specific spatial methods from sp that are useful for spatial data representation.

Read

In the reading Spatial objects in R, you will learn about the use of sp in R for spatial data representation. You can follow these R commands and practise the use of sp.

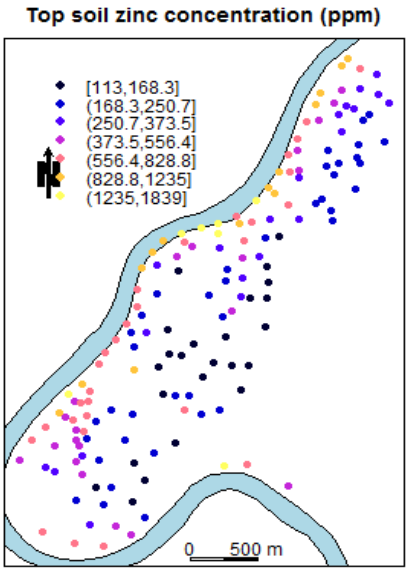
From the folder, open the document titled **Week_2_Topic_2** and read **slides 1–16**.

Meuse data

One of the classical data sets to illustrate different problems and results in spatial data analysis is the Meuse data, an example of which is represented in Figure 1.4. We will be using this data in several examples. In this section, we describe some main attributes of this data set and will use the spplot functions to visualise them.

Figure 1.4

Example of visualisation of Meuse data



Note. © Jackverr. (2011, 15 May). *Meuse river zinc concentration*. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:MeuseRiverZincConcentr01.png. CC BY-SA 3.0

Read

In the reading Spatial objects in R, you will learn about the use of spplot to visualise Meuse data.

From the folder, open the document titled **Week_2_Topic_2** and read **slides 17–20**.

Revise key R commands used in this week's materials.

Read

In the reading Key R commands, you will revise some of the key R commands that were used in this week's materials.

From the folder, open the document titled **Week_2_Topic_2** and read **slide 21**.

Workshop 2

Activity

Workshop 2

This activity will be completed in R. Repeat the R programming content covered in Week 2. Modify the code and understand the impact of different R parameters on changes in results.

Your task

- Repeat R commands learnt in Week 2.
- 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, you learnt about the main principles of GIS. You also explored the R package sp and used it for your first spatial data analysis.

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: R. (n.d.) *The comprehensive R archive network*. Retrieved October 31, 2022 from https://cran.rstudio.com

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

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

Jackverr. (2011, 15 May). *Meuse river zinc concentration*. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:MeuseRiverZincConcentr01.png

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