Fundamentals of Spatial Analysis in R

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Contents

Chapter 1

Prerequisites

This is a *sample* book written in **Markdown**. You can use anything that Pandoc's Markdown supports, e.g., a math equation $a^2 + b^2 = c^2$.

The **bookdown** package can be installed from CRAN or Github:

```
install.packages("bookdown")
# or the development version
# devtools::install_github("rstudio/bookdown")
```

Remember each Rmd file contains one and only one chapter, and a chapter is defined by the first-level heading `#`.

To compile this example to PDF, you need XeLaTeX. You are recommended to install TinyTeX (which includes XeLaTeX): https://yihui.name/tinytex/.

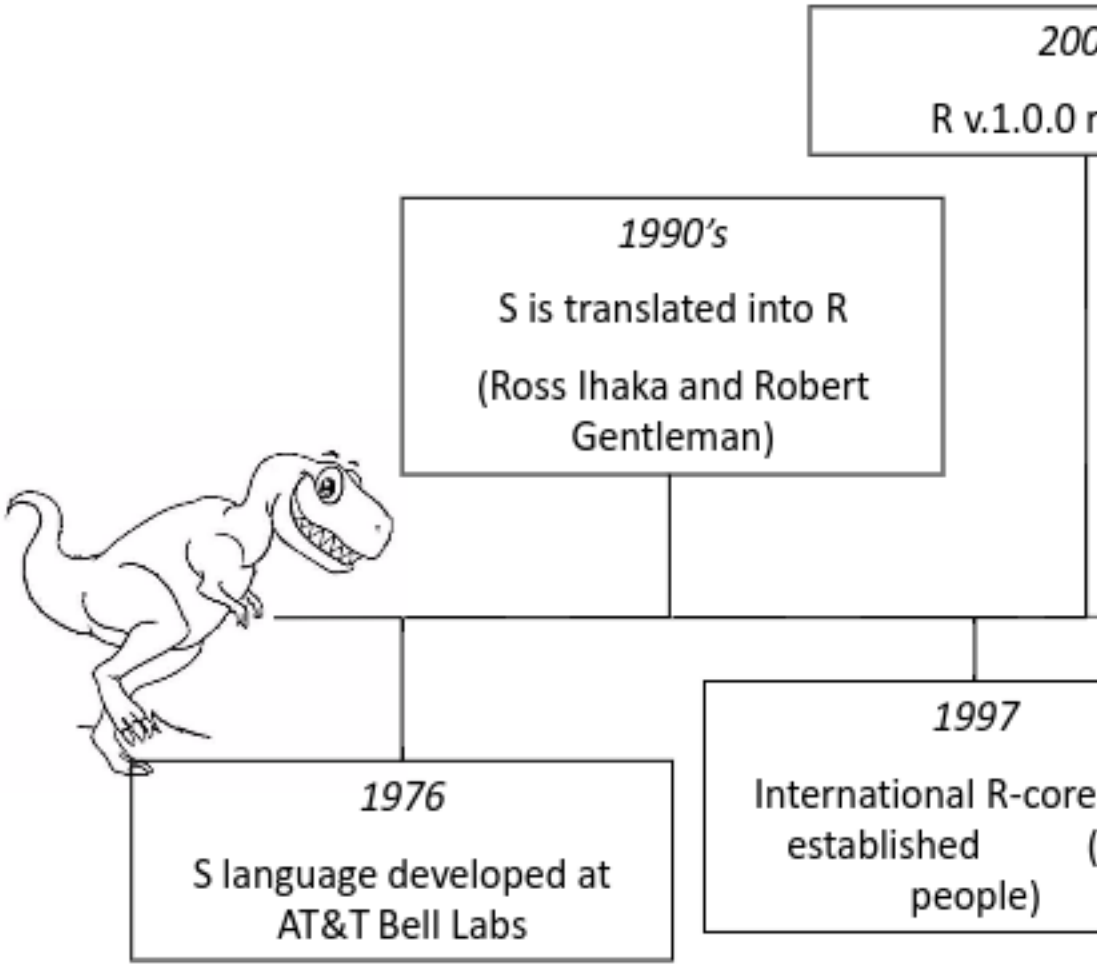
Chapter 2

Introduction

- A bit about me
- Intros
- What is everyone's experience level?
- What are you expected to know?
  - Basic R objects and methods
  - `tidyverse` packages and syntax
    - i.e. `ggplot2`, `dplyr`, `readr`, `tidyr`, the pipe operator %>%
  - If these are new, don't sweat it - google them, we'll talk through them as we go if needed
- This portion of workshop expectation no expectation of experience with spatial in R - we'll cover all the basics

What is R and why should we use R for spatial analysis? Let's break that into two questions - first, what is R and why should we use it?

- A language and environment for statistical computing and graphics
- R is lightweight, free, open-source and cross-platform
- Works with contributed packages - currently 12,938 -extensibility
- Automation and recording of workflow (reproducibility)
- Optimized work flow - data manipulation, analysis and visualization all in one place
- R does not alter underlying data - manipulation and visualization in memory
- R is great for repetetive graphics



of R.bb

Figure 2.1: History of R

2.1 Workshop agenda

2.2 Spatial Data in R

2.3 Code along

Just a sampling of what we'll cover. Run code, examine output, ask any questions - we'll explore it all in more detail through the morning.

2.3.1 geocoding example with tmaptools using open street map

```
# uses OSM
library(tmap)
library(tmaptools)
library(dplyr)
tex_cap <-tmaptools::geocode_OSM("Texas Capital",
        as.sf = TRUE) %>%
  glimpse()
```

```
## Observations: 1
## Variables: 8
## $ query    <chr> "Texas Capital"
## $ lat      <dbl> -31.46748
## $ lon      <dbl> -64.22844
## $ lat_min  <dbl> -31.46748
## $ lat_max  <dbl> -31.46748
## $ lon_min  <dbl> -64.22995
## $ lon_max  <dbl> -64.22723
## $ geometry <POINT [°]> POINT (-64.22844 -31.46748)
```

2.3.2 interactive mapping

```
library(mapview)
mapview(tex_cap)
```

```
## PhantomJS not found. You can install it with webshot::install_phantomjs(). If it is installed,
```

2.3.3 Choropleth map

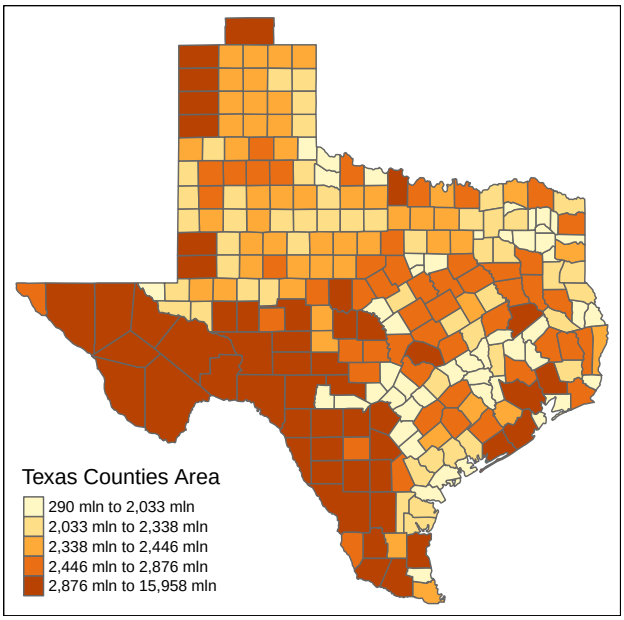
The package maps (automatically installed and loaded with ggplot2) provides maps of the USA, with state and county borders, that can be retrieved and converted as sf objects:

```
library(sf)
library(maps)
counties <- st_as_sf(map("county", plot = FALSE, fill = TRUE))
counties <- subset(counties, grepl("texas", counties$ID) & !grepl('missouri,texas',cou
counties$area <- as.numeric(st_area(counties))
head(counties)
```

```
## Simple feature collection with 6 features and 2 fields
## geometry type:  MULTIPOLYGON
## dimension:      XY
## bbox:           xmin: -103.0751 ymin: 28.14942 xmax: -94.13123 ymax: 37.00161
## epsg (SRID):    4326
## proj4string:    +proj=longlat +datum=WGS84 +no_defs
##                   ID                            geom       area
## 2165 oklahoma,texas MULTIPOLYGON (((-101.6255 3... 5434507068
## 2488 texas,anderson MULTIPOLYGON (((-95.75271 3... 2817584981
## 2489  texas,andrews MULTIPOLYGON (((-102.2042 3... 3962852909
## 2490 texas,angelina MULTIPOLYGON (((-94.13123 3... 2200352194
## 2491  texas,aransas MULTIPOLYGON (((-96.80122 2...  290370313
## 2492   texas,archer MULTIPOLYGON (((-98.42269 3... 2422607253
```

```
tm_shape(counties) +
  tm_polygons("area",
              style="quantile",
              title="Texas Counties Area")
```

```
## Warning: The shape counties is invalid. See sf::st_is_valid
```



example-1.bb

2.4 Challenge: Does this work?

Did my .css styling adjustment work?

2.4.1 Answer

1. Yes
2. No

Chapter 3

Vector data with sf

Load `tidycensus` - you'll need to set your Census API key. A key can be obtained from here.

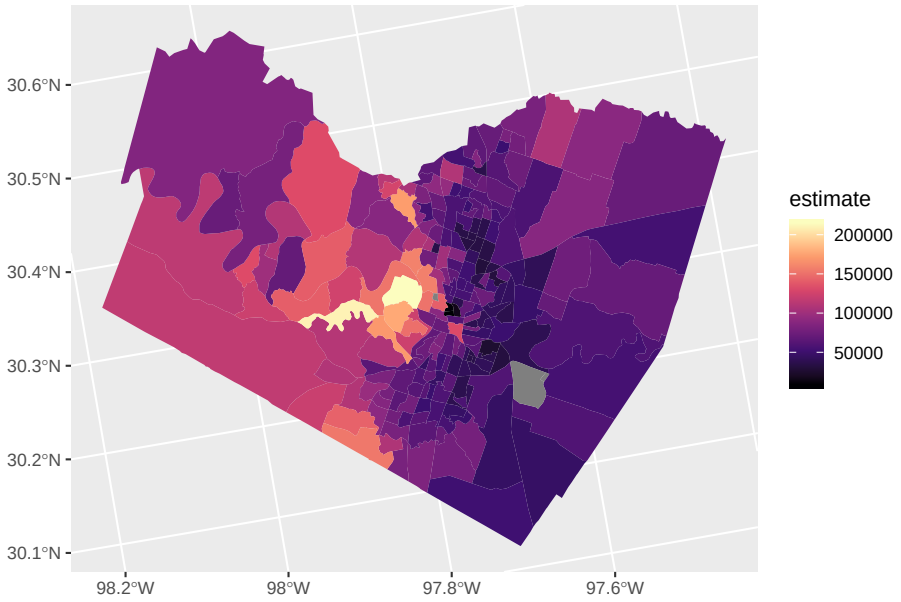
```
library(tidycensus)
library(tidyverse)

census_api_key("YOUR API KEY GOES HERE")
```

```
library(tidycensus)
library(ggplot2)
options(tigris_use_cache = TRUE)
austin_tracts <- get_acs(state = 'TX', county = 'Travis', geography = "tract",
                         variables = "B19013_001", geometry = TRUE)
```

```
## Getting data from the 2013-2017 5-year ACS
```

```
austin_tracts %>%
  ggplot(aes(fill = estimate)) +
  geom_sf(color = NA) +
  coord_sf(crs = 26911) +
  scale_fill_viridis_c(option = "magma")
```


30.6°N
30.5°N
30.4°N
30.3°N
30.2°N
30.1°N
98.2°W
98°W
97.8°W
97.6°W
estimate
200000
150000
100000
50000

Chapter 4

Raster data

Chapter 5

Applications

Some *significant* applications are demonstrated in this chapter.

5.1 Example one

5.2 Example two

Chapter 6

Final Words

We have finished a nice book.

References

6.0.1 R Spatial Resources

- R Spatial - **Spatial Data Science with R**
- **Geocomputation with R**
- **R Spatial Task View**
- **Modern Geospatial Data Analysis with R by Zev Ross**
- **Spatial Data Science - Pebesma and Bivand**
- **Spatial Data Science Course- Prof. Adam Wilson**
- **Introduction to Mapping and Spatial Analysis with R**
- **Google R Style Guide**
- **Advanced R by Hadley Wickham**
- **Intro to GIS and Spatial Analysis by Manuel Gimond**
- **FOSS4G2019 R for Geospatial Processing**
- **An Introduction to Spatial Analysis and Mapping in R**

6.0.2 R Vector Processing / Simple Features Resources

- **Simple Features for R**
- **Spatial Data in R: New Directions**
- **sp-sf Migration**
- **An Exploration of Simple Features for R**
- **Simple Features: Building Spatial Data Pipelines in R**
- **Tidy spatial data in R: using dplyr, tidyr, and ggplot2 with sf**

6.0.3 R Raster Resources

- Wageningen University **Intro to Raster**
- Wageningen University **Advanced Raster Analysis**
- **The Visual Raster Cheat Sheet GitHub Repo**
- **Rastervis**
- **stars - spatiotemporal arrays**

6.0.4 R Mapping Resources

- **mapview**
- **Leaflet for R**
- **tmap**
- Zev Ross **Creating beautiful demographic maps in R with the `tidycensus` and `tmap` packages**
- Geocomputation with R: **Making maps with R**
- Ryan Peek: **Mapping in R**