Linked Micromap Plots for Point Locations

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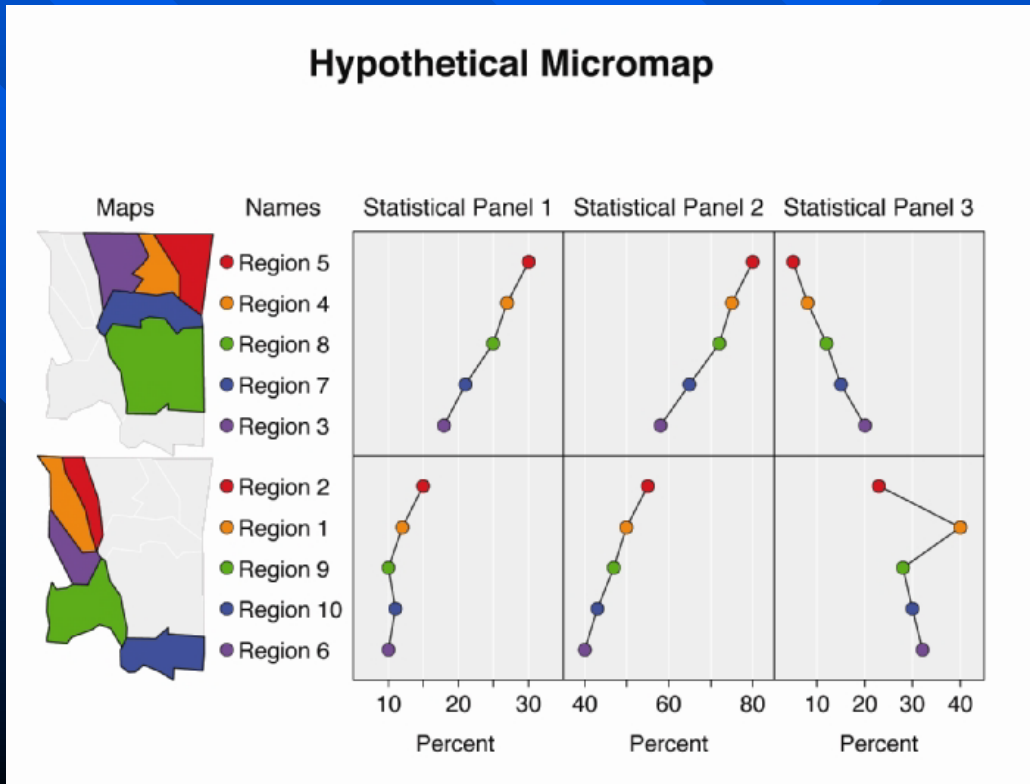
Concept of Micromaps

- Link of row-labeled univariate (or multivariate) statistical summaries to corresponding geographical region
- Focus on statistical display and not on maps
- Useful for
  - environmental data
  - agricultural data
  - medical data
  - public health data
  - economical data



History of Micromaps

- First presented at the 1996 American Statistical Association's annual meeting (Olsen, Carr, Courbois, Pierson, 1996)
- Main references:
  - Carr & Pierson (1996)
  - Carr et al. (1998)
  - Carr & Pickle (2010)
  - Symanzik et al. (2017)

Limitations of Choropleth Maps

1) Some map regions can be too small to effectively show color
2) Converting a continuous variable into a variable with a few ordered values results in an immediate loss of information
3) Difficult to show more than one variable in a choropleth map

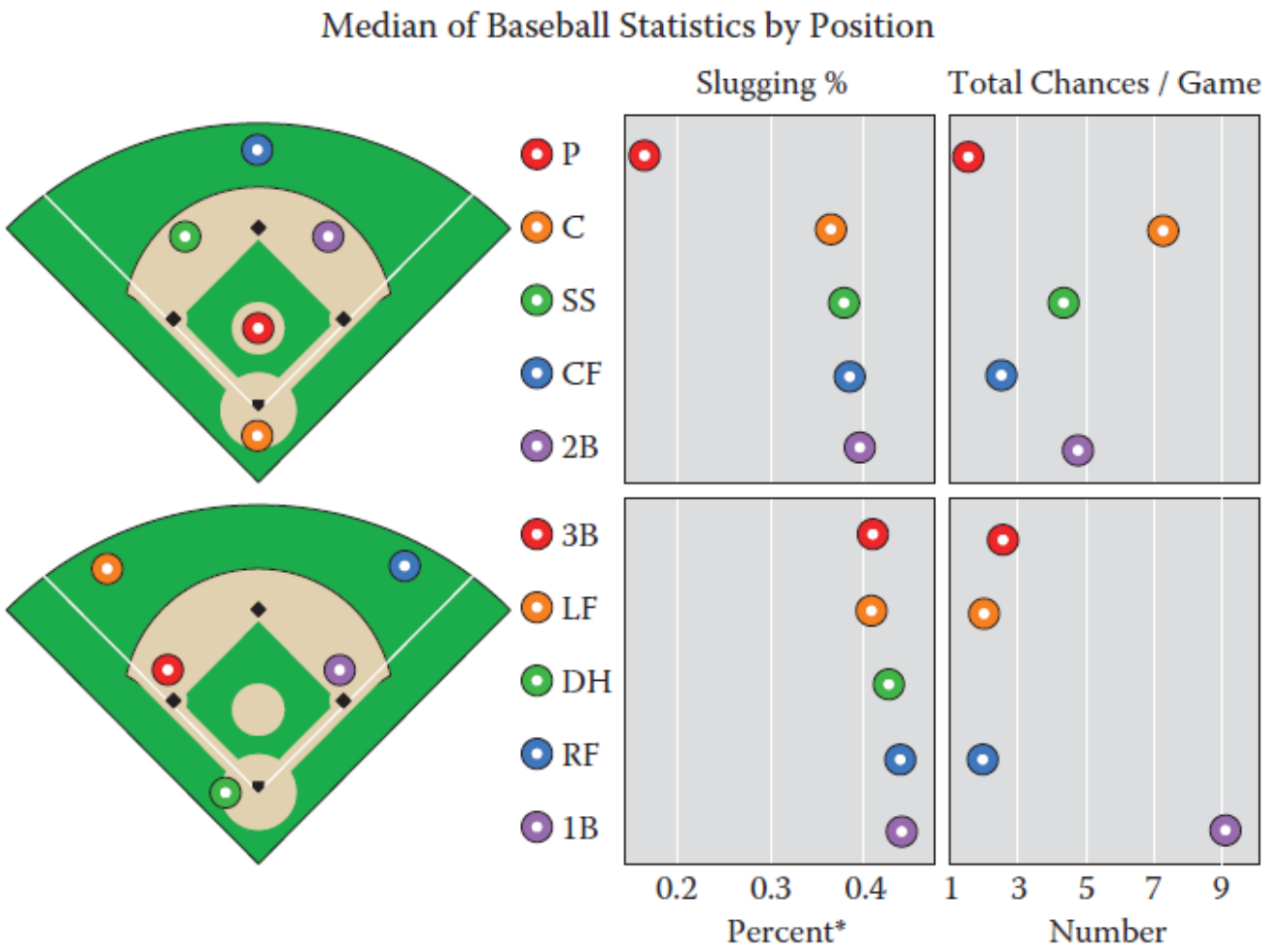
These limitaions have been addressed in regular linked micromap plots

Micromaps for Point Locations

Motivation for Linked Micromap Plots for Point Locations

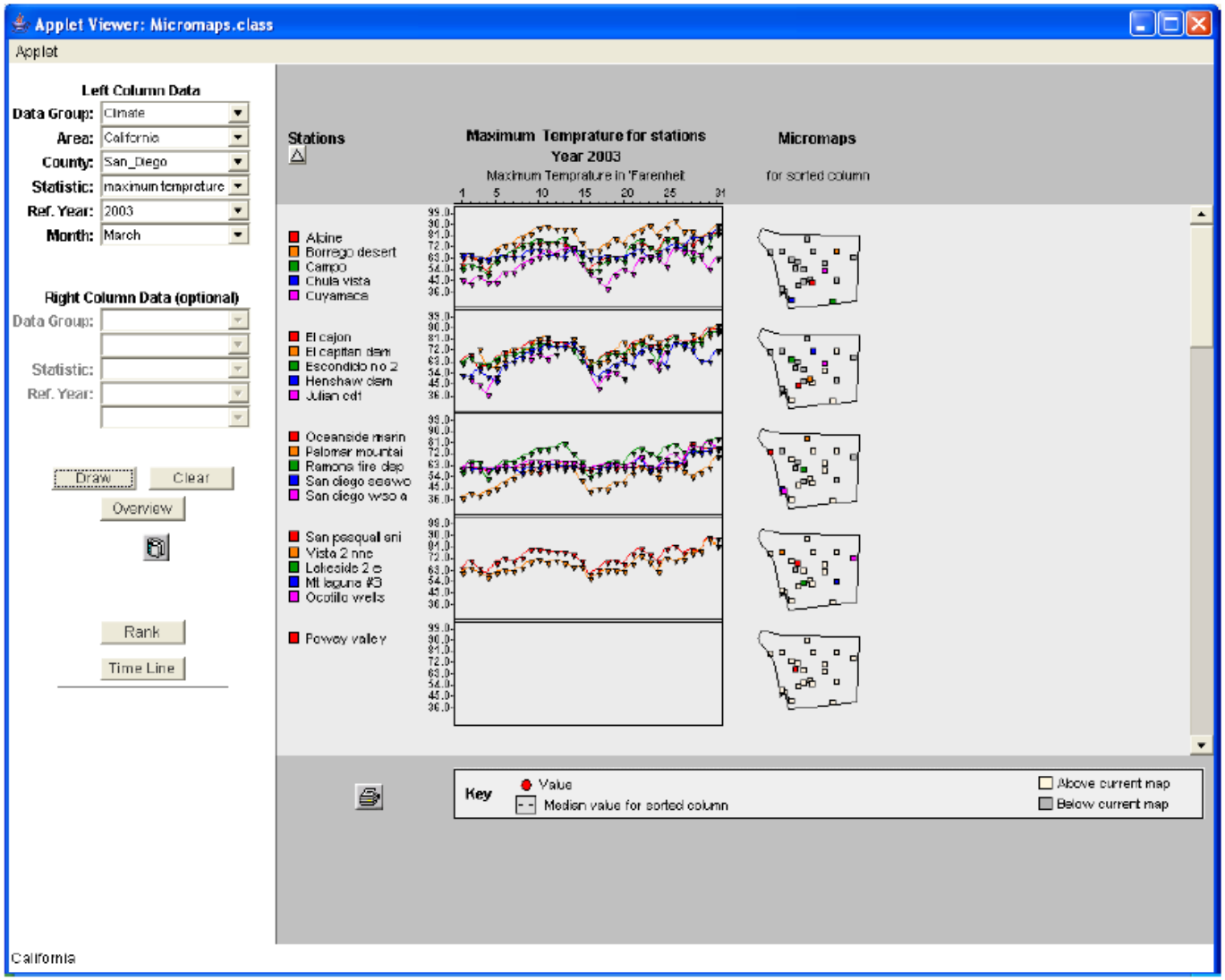
- Similar to regular linked micromap plots:
  - Can show multiple statistical variables on a map
  - Do not lose ordering and exact values of the variable(s)
  - Also, need enlargement of point locations to circles or squares, but ultimately may need less space on a map than ray-glyph maps

Past Examples of Micromaps for Point Locations (1)



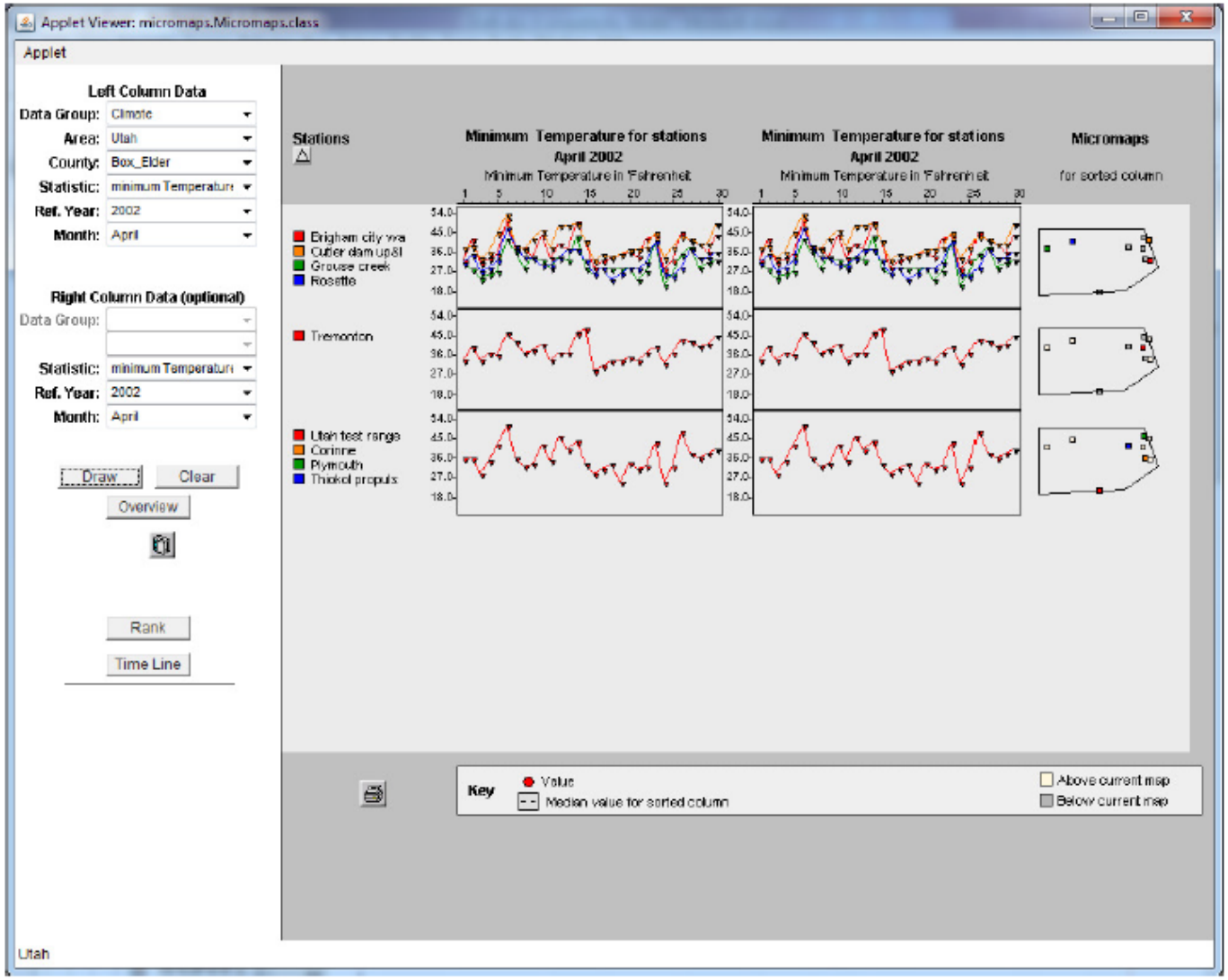
From: Carr & Pickle (2010), Fig 1.5

Past Examples of Micromaps for Point Locations (2)



From: Thapliyal (2009), Fig 4

Past Examples of Micromaps for Point Locations (3)



From: Yarra (2010), Fig 6

General Construction Steps for Micromaps for Point Locations in R

Steps to Create Linked Micromap Plots for Point Locations

1) Obtain coordinates of the point locations of interest along with the corresponding data to display.
2) Obtain geographic data for the underlying base map in the background.
3) Create a simple plot of the point locations and partially shift overplotting points.
4) Create polygons around the adjusted point locations.

Steps to Create Linked Micromap Plots for Point Locations

5) Combine the base map and the polygons representing point locations into a single spatial object.
6) Convert the object created in the previous step into a spatial data frame object.
7) Create a basic draft linked micromap plot.
8) Repeat Steps 3 to 7 as needed.
9) Add additional visualization elements to the draft linked micromap plot.

Case Study #1: Population of the 10 Biggest Cities in Asia

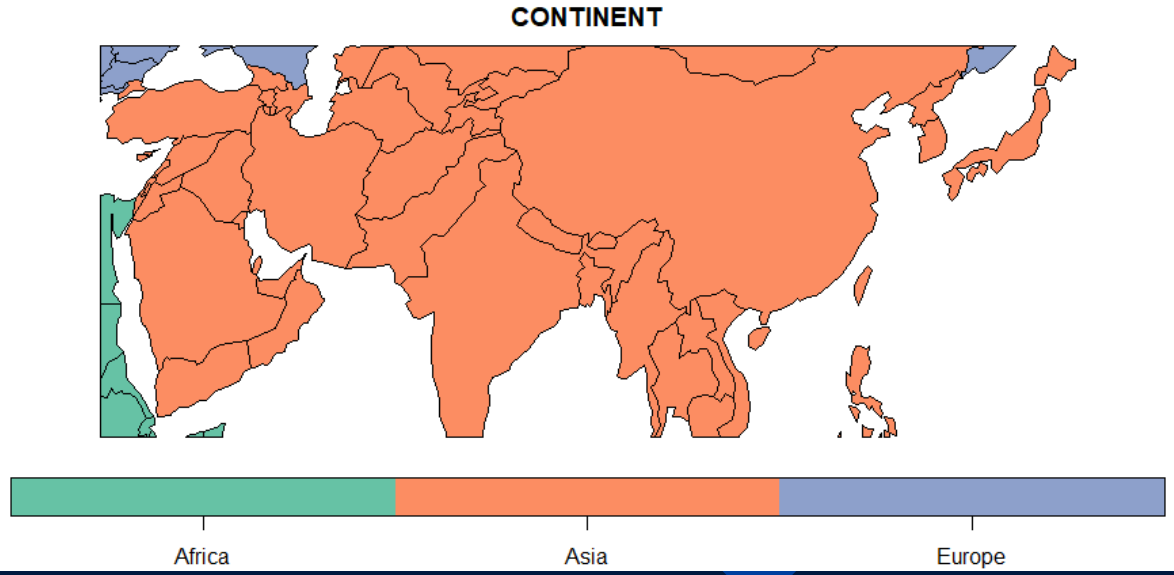
Step 1

Obtain coordinates of the point locations of interest along with the corresponding data to display.

```
> head(cities)
# A tibble: 6 × 5
  city     country  population   lat  long
  <chr>    <chr>         <dbl> <dbl> <dbl>
1 Shanghai China      24256800  31.2 121.
2 Beijing  China      21516000  39.9 116.
3 Mumbai   India      20667656  19.1  72.9
4 Delhi    India      16787941  28.7  77.2
5 Karachi  Pakistan   14910352  24.9  67.0
6 Istanbul Turkey     14657000  41.1  29
```

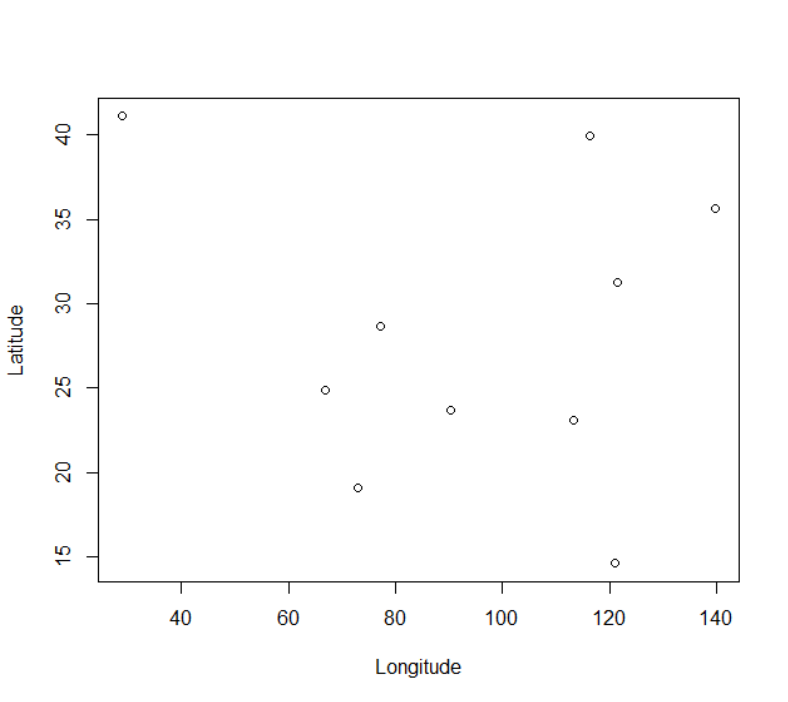
Step 2

Obtain geographic data for the underlying base map in the background.



Step 3

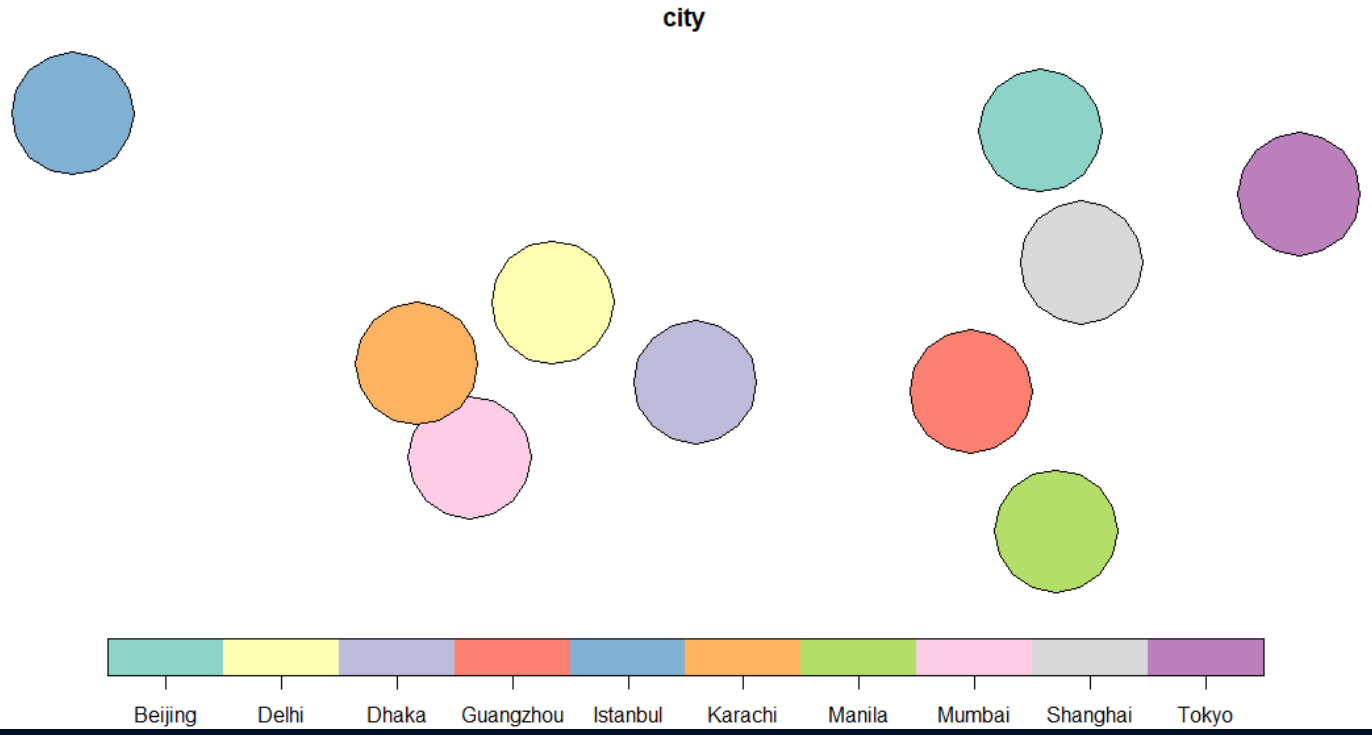
Create a simple map-based plot of the point locations and partially shift overplotting points.



- No apparent need to shift any of these points

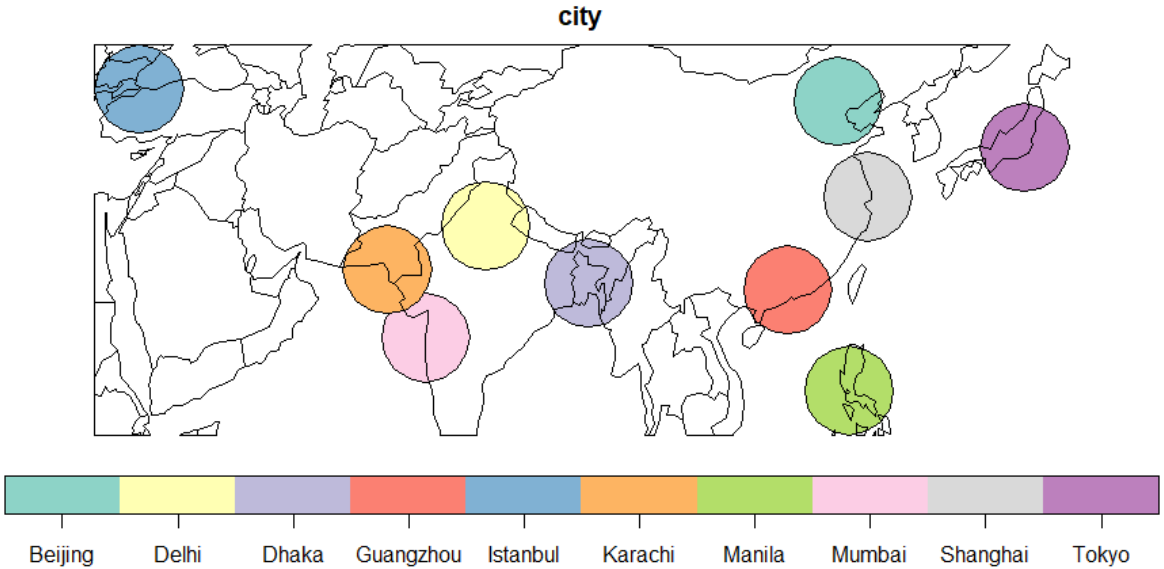
Step 4

Create polygons around the adjusted point locations.



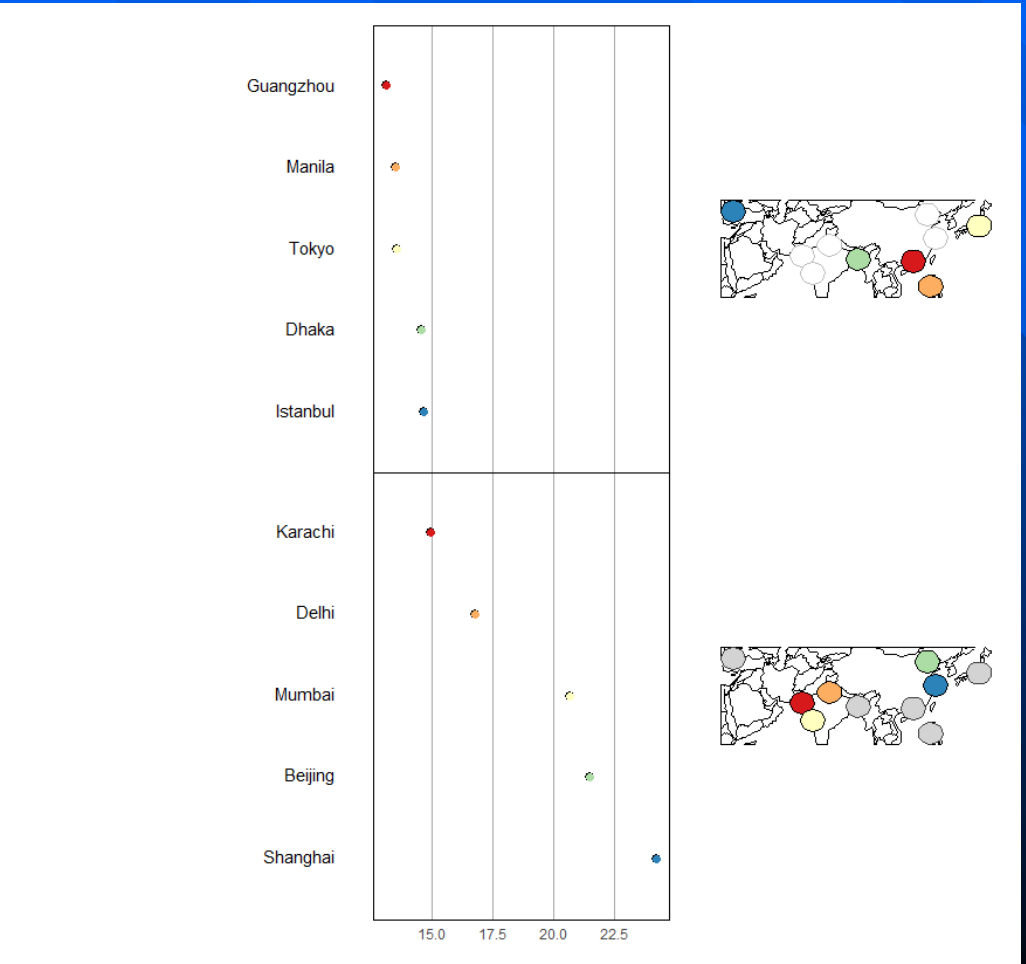
Steps 5 & 6

Combine the base map and the polygons representing point locations into a single spatial object. Convert the object created in the previous step into a spatial data frame object and plot it.



Step 7

Create a basic draft linked micromap plot.



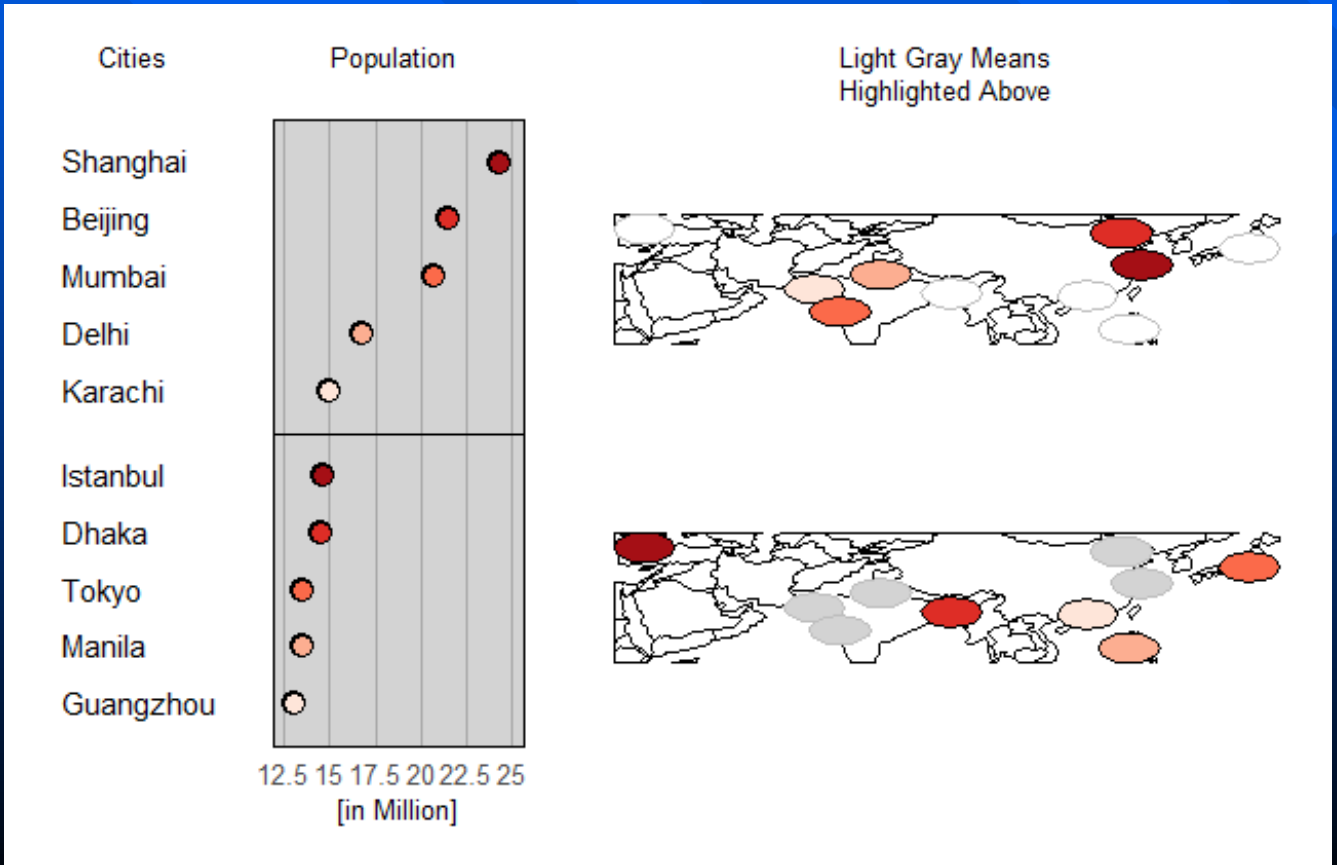
Step 8

Repeat Steps 3 to 7 as needed.

– Not needed here.

Step 9

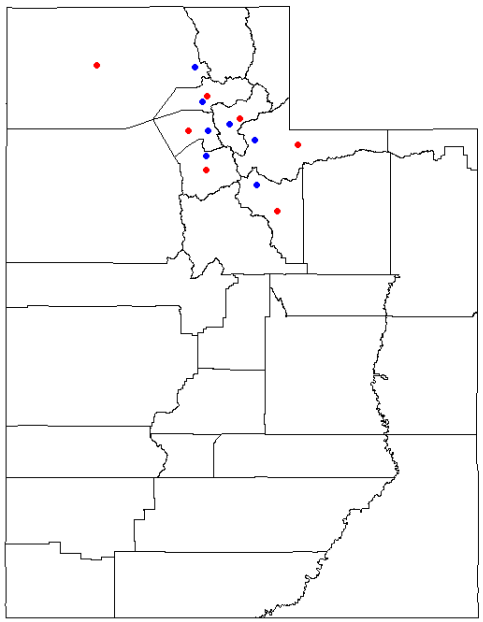
Add additional visualization elements to the draft linked micromap plot.



Case Study #2:
Elevation and Population of the 29 County Seats in Utah

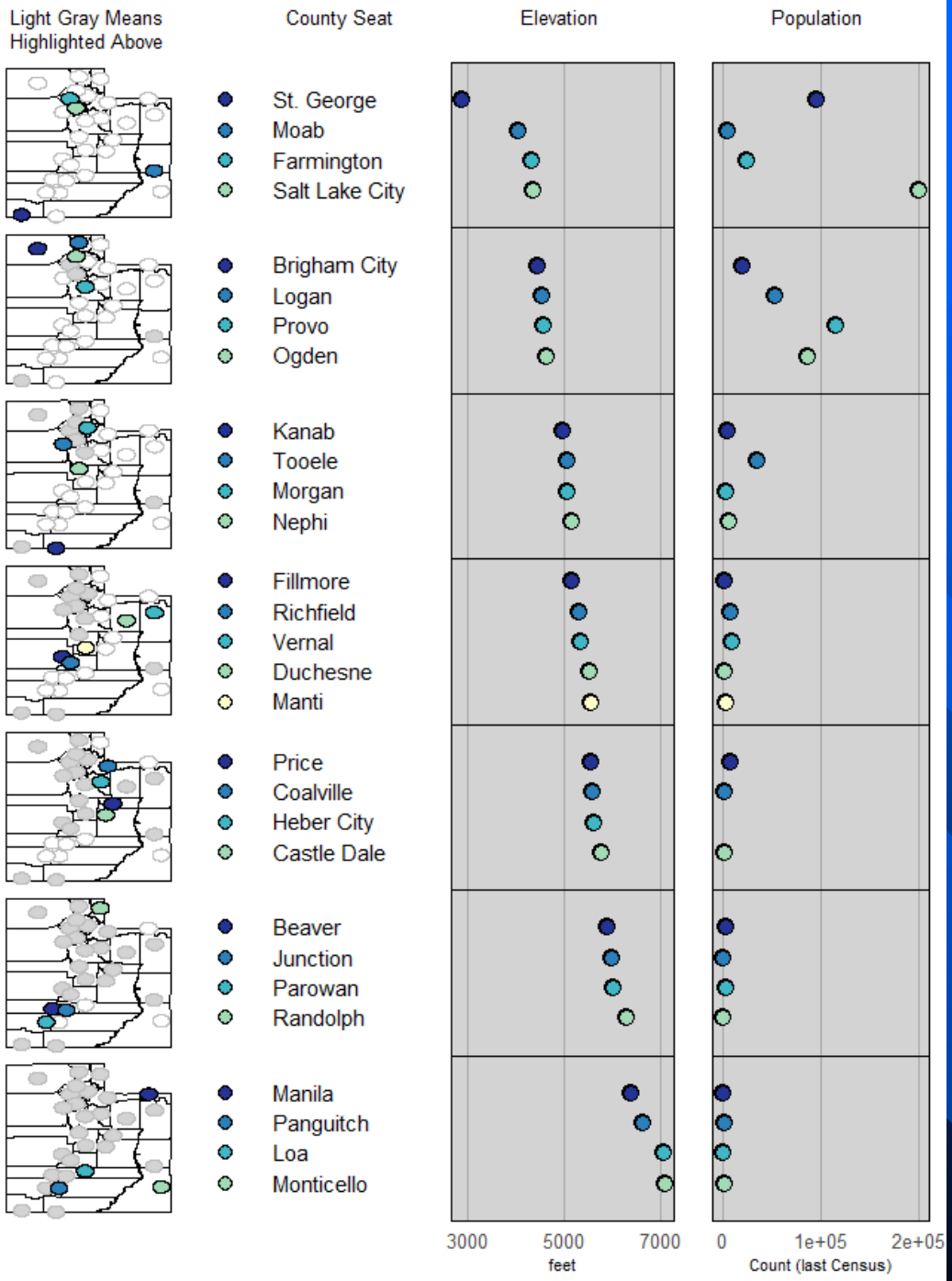
Step 3

Create a simple map-based plot of the point locations and partially shift overplotting points.



- A few of the county seats in Northern Utah have been shifted to their centroid location. Leave it to the reader to shift additional ones as needed.

- Blue dot: Original Location
- Red dot: Shifted Location



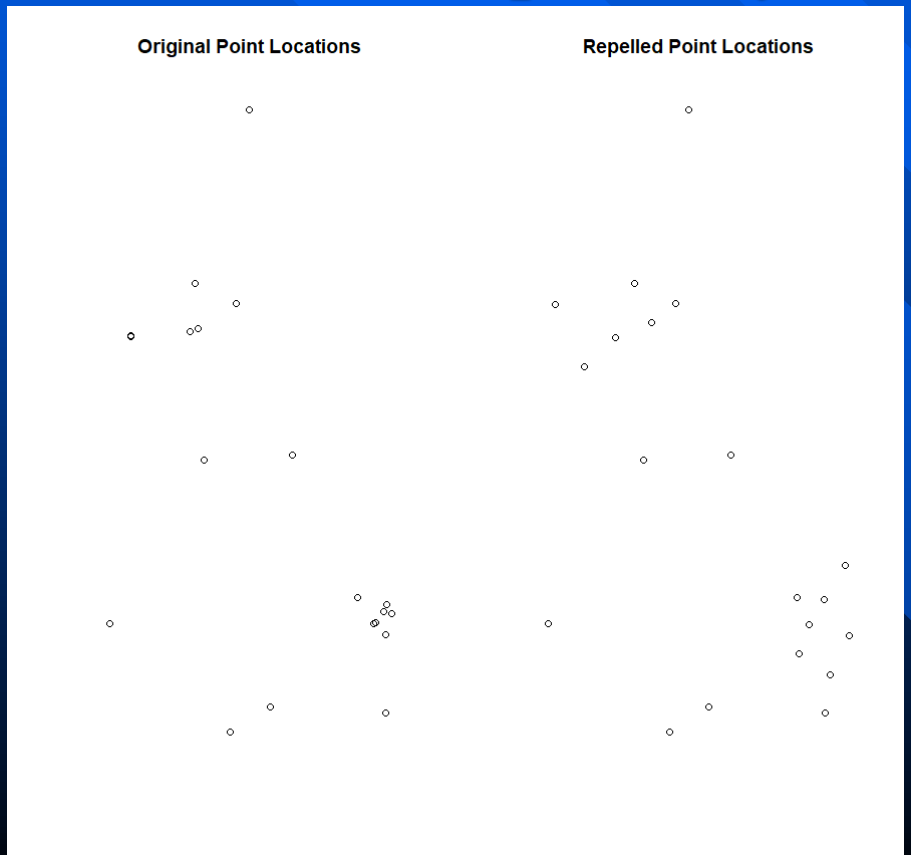
Step 9

Add additional visualization elements to the draft linked micromap plot.

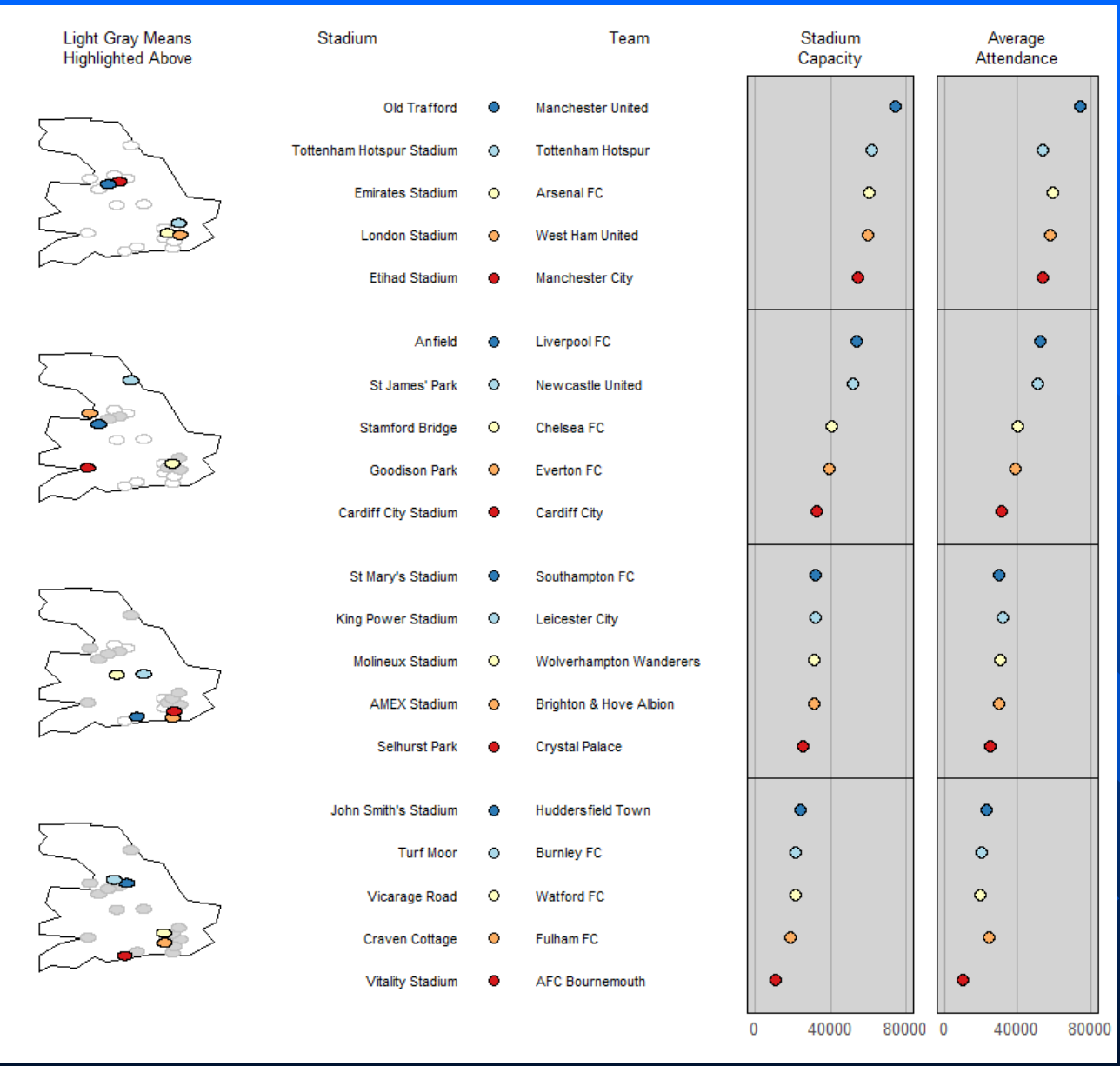
Case Study #3:
Premier League Football Stadiums in England and Wales in 2018

Step 3

Create a simple map-based plot of the point locations and partially shift overplotting points.



- Several stadium locations in London, Liverpool, and Manchester had to be repelled to avoid overplotting.



Step 9

Add additional visualization elements to the draft linked micromap plot.

Software, Data & R Code

- R 4.5.1 (or another recent version of R)
- *micromap* R package, Version 1.9.10, accessible at https://cran.r-project.org/web/packages/micromap/index.html
- Additional R packages such as *sf, dplyr & labeling* (recent versions)
- R code and data can be freely obtained from forthcoming micromap book and are accessible at https://github.com/symanzik/MicromapPlotsInR (specifically **06-pointLocations.Rmd**)

More Book Details

- Tentative Title: **"Micromap Plots in R - A Step-By-Step Approach to Visualize Spatial Data via Linked Micromaps, Conditioned Micromaps, and Comparative Micromaps in R"**
- Editor: **Jürgen Symanzik**
- Chapters on
  - *micromap* & *micromapST* R packages
  - Shapefile modifications for use in micromap applications
  - Additional glyph types and extensions
  - Micromaps for point locations (basis for this presentation)
  - Web applications
  - Conditioned choropleth maps (CCmaps)
  - Comparative micromaps
  - Non-traditional micromaps
  - Applications in the environmental & medical fields

Summary & Conclusion

- Linked micromap plots for point locations offer an alternative way to display multiple statistical variables in a map-based context
- Point locations may already be placed suitably far enough away from each other for plotting of circular areas around the points
- If not, point locations may have to be shifted, e.g., based on centroids for an enclosing spatial unit or via some repelling algorithm (possibly with some manual fine-tuning at the end)

Current & Future Work

- Extend to allow additional plot types, in particular time series for point locations
- Experiment with modified shapefiles for point locations in the micromapST R package, accessible at https://cran.r-project.org/web/packages/micromapST/index.html
- Standardize some of the functionality for use in web-based linked micromaps for point locations

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Questions ???

– or –

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