Example 3.5

Disease mapping: from foundations to multidimensional modeling

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This document reproduces the analysis made at Example 3.5 of the book: "Disease mapping: from foundations to multidimensional modeling" by Martinez-Beneito M.A. and Botella-Rocamora P., published by CRC press in 2019. You can watch the analysis made with full detail at this pdf document, or even execute it if you want with the material available at https://github.com/MigueBeneito/DMBook. Anyway, this pdf file should be enough for following most of the details of the analysis made for this example.

The statistical analysis below has been run in `R`, by additionally using the library `Rmarkdown`, so be sure that you have this software installed if you want to reproduce by yourself the content of this document. In that case we advise you to download first the annex material at https://github.com/MigueBeneito/DMBook, open with `Rstudio` the corresponding `.Rproj` file that you will find at the folder corresponding to this example and compile the corresponding `.Rmd` document. This will allow you to reproduce the whole statistical analysis below.

Libraries and data loading

```
# Libraries loading
#------------------
if (!require(rgdal)) {
    install.packages("rgdal")
    library(rgdal)
}
if (!require(RColorBrewer)) {
    install.packages("RColorBrewer")
    library(RColorBrewer)
}

# Data loading
#------------
# load cartography files: Spain country borders
Country <- readOGR(dsn = "../Data/Carto", layer = "country")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: "C:\MiguePaloma\Libro\Accompanying material\Data\Carto", layer: "country"
## with 1 features
## It has 5 fields
```

```
# Valencian provinces borders
Provinces <- readOGR(dsn = "../Data/Carto", layer = "provinces")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: "C:\MiguePaloma\Libro\Accompanying material\Data\Carto", layer: "provinces"
## with 3 features
## It has 7 fields
```

```
# Valencian municipalities borders
Muni <- readOGR(dsn = "../Data/Carto", layer = "muni")
```

```
## OGR data source with driver: ESRI Shapefile
```

```
## Source: "C:\MiguePaloma\Libro\Accompanying material\Data\Carto", layer: "muni"
## with 540 features
## It has 13 fields
## Integer64 fields read as strings:  MUNI_ MUNI_ID
```

```
head(Muni@data)
```

```
##        AREA PERIMETER MUNI_ MUNI_ID CODMUNI CODPROV CODAUTO CODCOMAR
## 0  68923822  40608.41  4984    4984   12141      12      12       02
## 1 414217775 144448.63  5063    5063   12080      12      12       02
## 2 136400403  58001.89  5064    5064   12093      12      12       02
## 3  27023253  26767.95  5076    5076   12068      12      12       02
## 4  14215659  23116.96  5081    5081   12087      12      12       02
## 5  30777133  27462.59  5119    5119   12037      12      12       02
##                  NOMBRE POB91 POB95 POB95M POB95F
## 0 Zorita del Maestrazgo   150   147     74     73
## 1               Morella  2881  2842   1402   1440
## 2   Puebla de Benifasar   227   210    103    107
## 3                Herbes   135   127     64     63
## 4             Palanques    24    21     13      8
## 5     Castell de Cabres    24    21     11     10
```

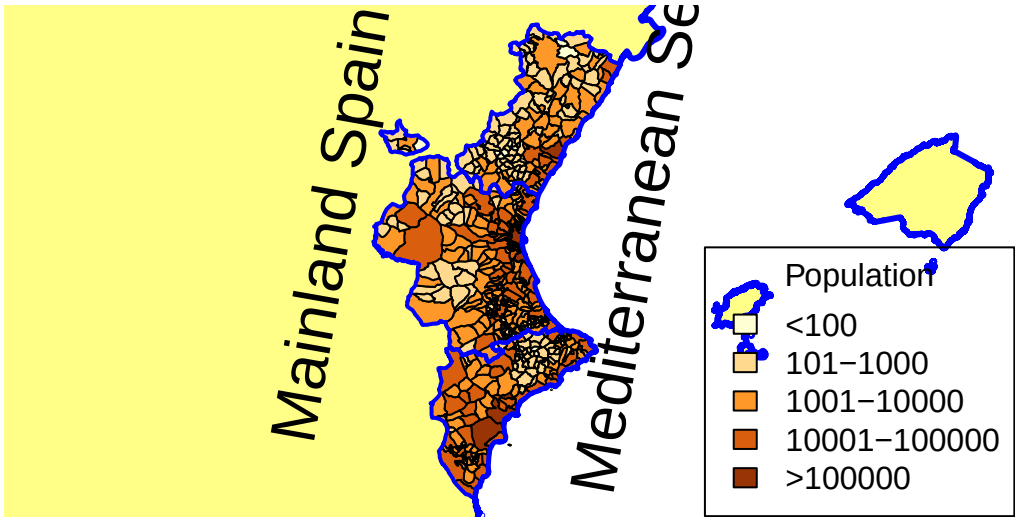
```
# Note that the municipalities cartography is not ordered by
# municipality codes (CODMUNI). We are going to order it in that manner
# in order to avoid future errors when plotting variables ordered in
# that way (the most typical way).
Muni <- Muni[order(Muni$CODMUNI), ]

# load populations
load("../Data/Population.Rdata")
```

Plotting of the municipalities, provinces and Spain borders

```
# Average annual population (for men and women) for the period of study
PopMuni <- apply(PopM + PopW, 1, sum)/25
palette <- brewer.pal(5, "YlOrBr")
cuts <- as.numeric(cut(PopMuni, c(0, 100, 1000, 10000, 1e+05, Inf)))
# colours defined as a function of the municipality populations
colours <- palette[cuts]

# Plotting of the (coloured) municipalities, provinces and Spain
# borders
plot(Muni)
plot(Country, border = "blue", lwd = 3, col = "#FFFF88", add = T)
plot(Muni, col = colours, add = T)
plot(Provinces, add = T, border = "blue", lwd = 2)
text(x = 810000, y = 4380000, label = "Mediterranean Sea", cex = 2, srt = 80)
text(x = 6e+05, y = 4380000, label = "Mainland Spain", cex = 2, srt = 80)
legend(x = "bottomright", legend = c("<100", "101-1000", "1001-10000",
    "10001-100000", ">100000"), fill = palette, title = "Population")
```


Mainland Spain
Mediterranean Se
Population
<100
101−1000
1001−10000
10001−100000
>100000