Example 4.1

Disease mapping: from foundations to multidimensional modeling

Martinez-Beneito M.A. and Botella-Rocamora P.

This document reproduces the analysis made at Example 4.1 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.

This document has been executed with real data that are not provided in order to preserve their confidentiality. Slightly modified data are provided instead, as described in Chapter 1 of the book. Thus, when reproducing this document you will not obtain exactly the same results, although they should be very close to those shown here.

Libraries and data loading

```r
# Data loading
#------------
# For reproducing the document, the following line should be changed to
# load('../Data/ObsOral-mod.Rdata') since that file contains the
# modified data making it possible to reproduce this document.
load("../Data/ObsOral.Rdata")
load("../Data/ObsOral-age.Rdata")
load("../Data/Population.Rdata")
```

SMRs

```r
# Municipalities X age-groups X years
dim(PopM)
```

```
## [1] 540  18  25
```

```r
# Population per municipality for the whole period of analysis (we have
# rounded these populations since for some years they have been
# estimated)
Pop = round(apply(PopM, c(1, 2), sum))
# age-specific rates
Rates.VR = Obs.age/apply(Pop, 2, sum)
# Expected cases
Exp.muni = as.vector(Pop %*% matrix(Rates.VR, ncol = 1))
# SMRs
SMR.muni = 100 * Obs.muni/Exp.muni
```

```r
# Number of SMRs equal to 0
sum(SMR.muni == 0)
```

```
## [1] 194
```

```r
summary(SMR.muni)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##    0.00    0.00   68.57   90.83  119.50 3977.45
```

Confidence intervals for the SMRs

```r
# 95% IC assuming Normality
IC.norm = cbind(SMR.muni * exp(qnorm(0.025)/sqrt(Obs.muni)), SMR.muni *
    exp(qnorm(0.975)/sqrt(Obs.muni)))
head(IC.norm, 5)
```

```
##            [,1]     [,2]
## 03001  0.000000      NaN
## 03002  3.346725 168.6643
## 03003 60.978706 974.8975
## 03004 61.311280 980.2146
## 03005 99.032440 293.7238
```

```r
# 95% Poisson-based IC
IC.pois = 100 * cbind(qchisq(0.025, 2 * Obs.muni)/(2 * Exp.muni), qchisq(0.975,
    2 * (Obs.muni + 1))/(2 * Exp.muni))
head(IC.pois, 5)
```

```
##             [,1]     [,2]
## 03001  0.0000000 411.0394
## 03002  0.6015167 132.3747
## 03003 29.5276827 880.7602
## 03004 29.6887250 885.5638
## 03005 90.8120692 291.6501
```

```r
# 95% Bayesian credible interval
IC.Bayes = 100 * cbind(qgamma(0.025, Obs.muni + 1, Exp.muni), qgamma(0.975,
    Obs.muni + 1, Exp.muni))
head(IC.Bayes, 5)
```

```
##             [,1]     [,2]
## 03001   2.821078 411.0394
## 03002   5.754563 132.3747
## 03003  75.422190 880.7602
## 03004  75.833538 885.5638
## 03005 100.415200 291.6501
```