Hw4 Q2

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Introduction

In this paper, we use the data from UK that number of cases of COVID-19 is related to what factors so that we will investigate that hypothesis

- Air pollution would positively influence in increase in COVID-19 cases
- The area with high unemployment results in more cases of COVID-19
- Ethnically minorities are more likely to get infected by COVID-19.

Method

$Y_i \sim Poisson(\mathrm{E_i}\lambda_\mathrm{i})$

$log[\lambda_i] = \mu + X_i\beta + U_i$

$U_i = BYM(\sigma^2, \tau^2)$

$\theta_1 = \sqrt{\sigma^2 + \tau^2}$

$\theta_2 = \sigma/\sqrt{\sigma^2 + \tau^2}$

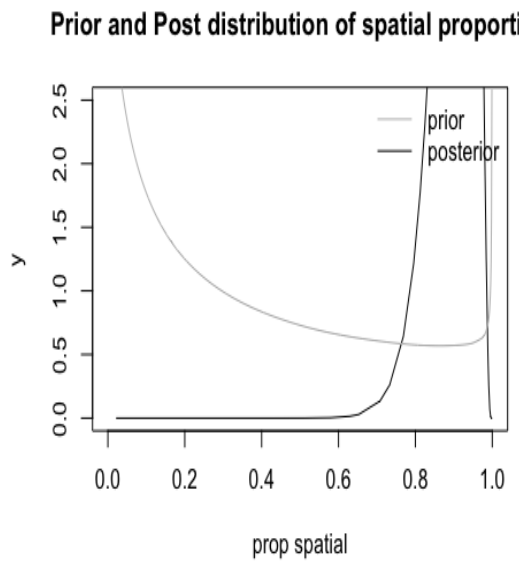
Prior distributions on θ_1 and θ_2

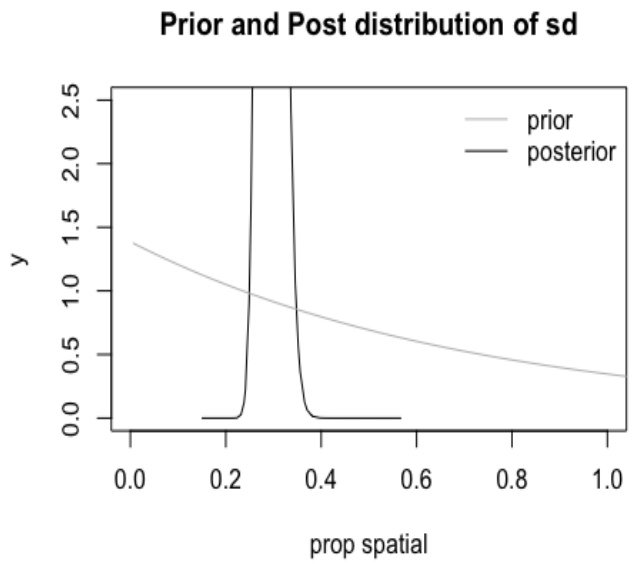
Y_i: Case count

E_i: expected count

X_i is the vector that includes

- Pmmodelled25 refers to the concentration of fine particular matter in the health authority.
- Ethnicity refers to the percentage of ethnicity minorities
- Unemployment refers to the percentage of unemployment






```
##                   mean 0.025quant  0.5quant 0.975quant
## (Intercept)  0.363934  0.2169813 0.3640466  0.6091025
## Ethnicity    1.012085  1.0080907 1.0120831  1.0160997
## modelledpm25 1.057811  0.9958948 1.0577659  1.1237733
## Unemployment 1.119875  1.0593063 1.1198742  1.1838485
## sd           1.342307  1.2951449 1.3408408  1.4002772
## propSpatial  2.455652  2.1572621 2.4778800  2.6526043
```

Appendix

```
(load("../Hw4/data/England_shp.RData"))
```

```
## [1] "UK_shp"
```

```
UK_shp$logExpected = log(UK_shp$E)
```

```
## Loading required package: sp
```

```
# remove an island
UK2 = UK_shp[grep("Wight", UK_shp$Name, invert = TRUE),
  ]
englandRes = diseasemapping::bym(cases ~ offset(logExpected) +
  Ethnicity + modelledpm25 + Unemployment, prior = list(sd = c(0.5,
  0.5), propSpatial = c(0.5, 0.5)), family = "poisson",
  data = UK2)
```

```
exp(englandRes$parameters$summary)[, c(1, 3:5)]
```

```
## Warning in inla.model.properties.generic(inla.trim.family(model), mm[names
(mm) == : Model 'bym2' in section 'latent' is marked as 'experimental'; chang
es may appear at any time.
##   Use this model with extra care!!! Further warnings are disabled.
```

```
save(englandRes, file = "../data/englandRes.RData")
```

```
casesCol = mapmisc::colourScale(UK2$cases, dec = -3, breaks = 12,
  col = "Spectral", style = "quantile", rev = TRUE)
Ecol = mapmisc::colourScale(UK2$E, breaks = casesCol$breaks,
  col = casesCol$col, style = "fixed")
pmCol = mapmisc::colourScale(UK2$modelledpm25, breaks = 9,
  dec = 0, style = "quantile")
ethCol = mapmisc::colourScale(UK2$Ethnicity, breaks = 9,
  digits = 1, style = "quantile")
uCol = mapmisc::colourScale(UK2$Unemployment, breaks = 12,
  dec = 0, style = "quantile")
rCol = mapmisc::colourScale(englandRes$data$random.mean,
  breaks = 12, dec = -log10(0.25), style = "quantile")
fCol = mapmisc::colourScale(englandRes$data$fitted.exp,
  breaks = 9, dec = 1, style = "quantile")
insetEngland1 = mapmisc::openmap(UK2, zoom = 3, fact = 4,
  path = "waze", crs = CRS("+init=epsg:3035"))
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_p
roj = prefer_proj): Discarded datum Unknown based on GRS80 ellipsoid in CRS d
efinition,
##  but +towgs84= values preserved
```

```
## Warning in spTransform(x, crsOut): NULL source CRS comment, falling back t
o PROJ
## string
```

```
## Warning in wkt(obj): CRS object has no comment
```

```
library("raster")
insetEngland = raster::crop(insetEngland1, extend(extent(insetEngland1),
  -c(25, 7, 4, 9.5) * 100 * 1000))
library("sp")
mapmisc::map.new(UK2)
```

```
## Warning in wkt(obj): CRS object has no comment
```

```
## Warning in wkt(obj): CRS object has no comment
```

```
mapmisc::insetMap(UK_shp, "topright", insetEngland, width = 0.4)
```

```
## Warning in wkt(pfrom): CRS object has no comment
```

```
## Warning in rgdal::rawTransform(projfrom, projto, nrow(xy), xy[, 1], xy[, :
 Using
## PROJ not WKT2 strings
```

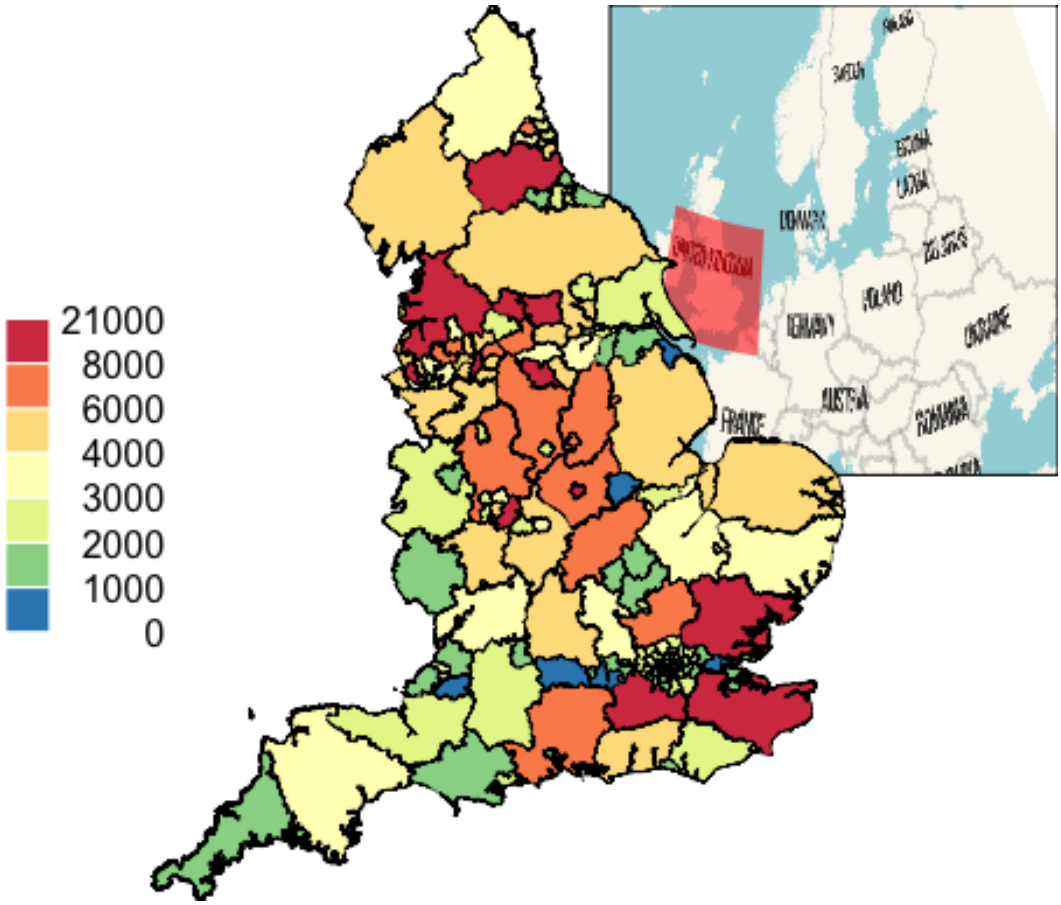
```
## Warning in spTransform(xsp, CRSobj = crs(mapOrig)): NULL source CRS commen
t,
## falling back to PROJ string
```

```
## Warning in wkt(obj): CRS object has no comment
```

```
plot(englandRes$parameters$sd$posterior, type = 'l', xlim = c(0,1), ylim = c(
0,2.5), xlab = "prop spatial", main = "Prior and Post distribution of sd")
lines(englandRes$parameters$sd$prior, col = 'grey')
legend("topright", lty=1, col= c("grey", "black"), legend = c("prior","poster
ior"), bty ="n")
```

```
plot(englandRes$parameters$propSpatial$posterior, type = 'l', xlim = c(0,1),
ylim = c(0,2.5), xlab = "prop spatial", main = "Prior and Post distribution o
f spatial proportion")
lines(englandRes$parameters$propSpatial$prior, col = 'grey')
legend("topright", lty=1, col= c("grey", "black"), legend = c("prior","poster
ior"), bty ="n")
```

```
plot(UK2, col = casesCol$plot, add = TRUE, lwd = 0.2)
mapmisc::legendBreaks("left", casesCol, bty = "n")
```

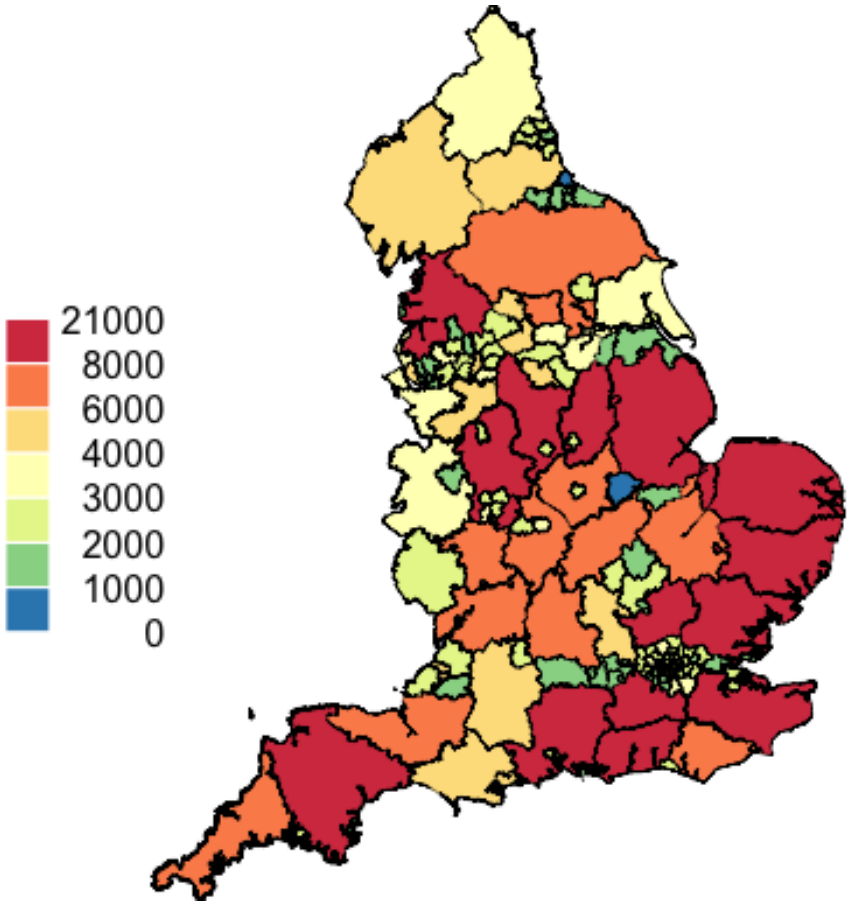



```
mapmisc::map.new(UK2)

## Warning in wkt(obj): CRS object has no comment

## Warning in wkt(obj): CRS object has no comment

plot(UK2, col = Ecol$plot, add = TRUE, lwd = 0.2)
mapmisc::legendBreaks("left", casesCol, bty = "n")
```

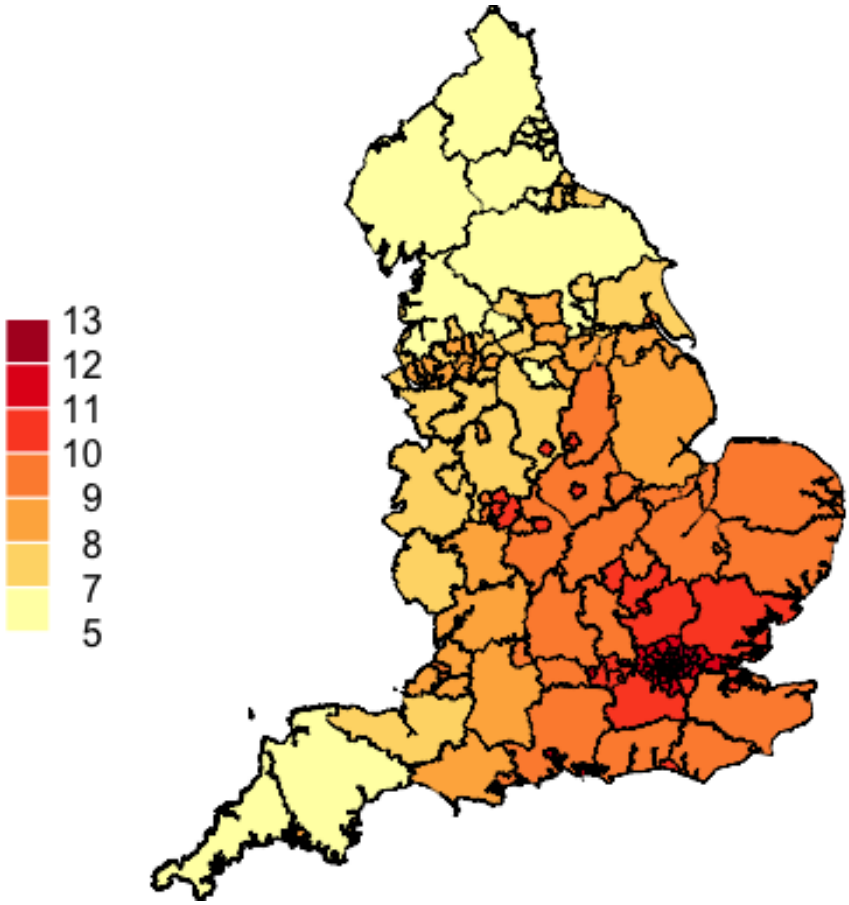



```
mapmisc::map.new(UK2)

## Warning in wkt(obj): CRS object has no comment

## Warning in wkt(obj): CRS object has no comment

plot(UK2, col = pmCol$plot, add = TRUE, lwd = 0.2)
mapmisc::legendBreaks("left", pmCol, bty = "n")
```

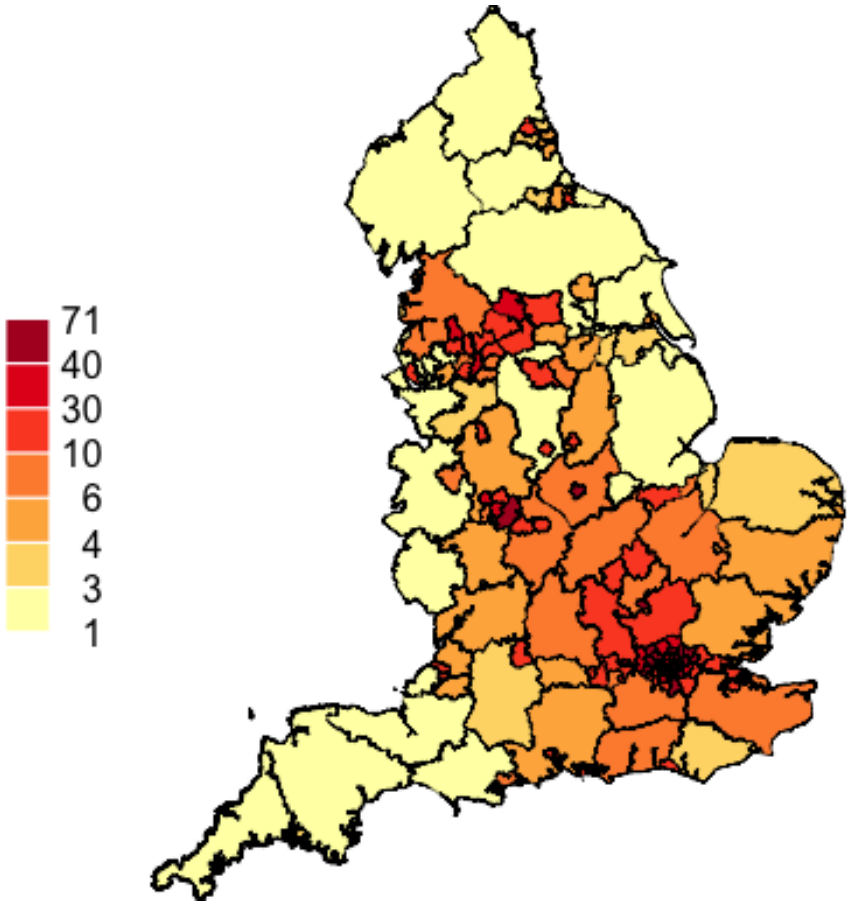



```
mapmisc::map.new(UK2)

## Warning in wkt(obj): CRS object has no comment

## Warning in wkt(obj): CRS object has no comment

plot(UK2, col = ethCol$plot, add = TRUE, lwd = 0.2)
mapmisc::legendBreaks("left", ethCol, bty = "n")
```

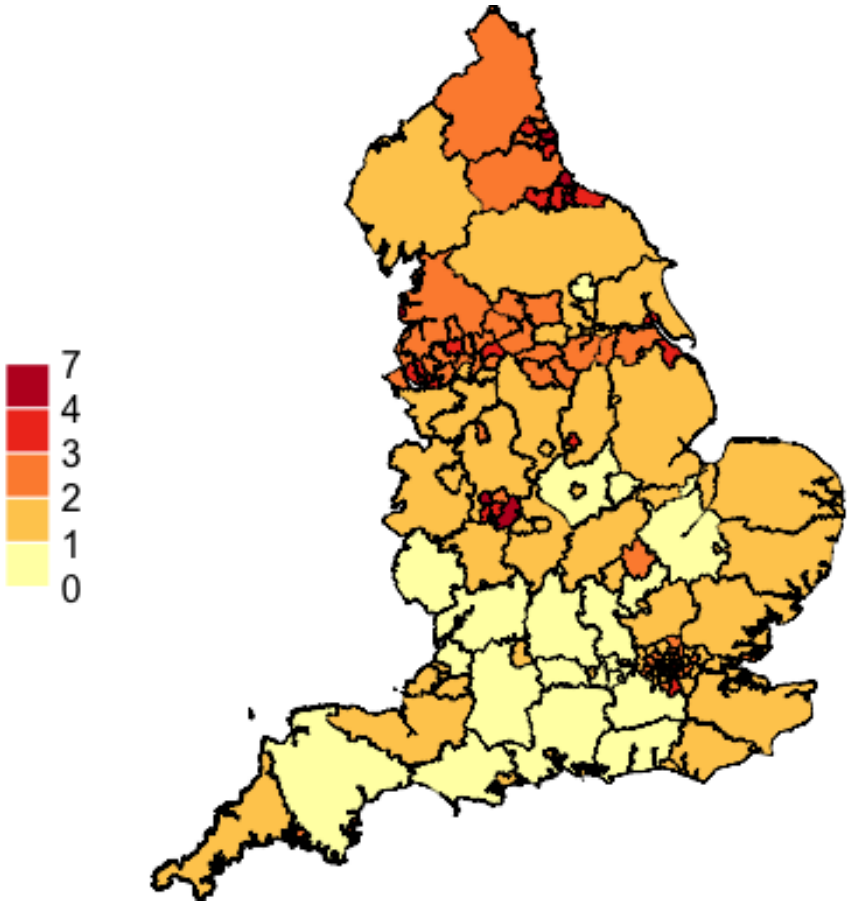



```
mapmisc::map.new(UK2)

## Warning in wkt(obj): CRS object has no comment

## Warning in wkt(obj): CRS object has no comment

plot(UK2, col = uCol$plot, add = TRUE, lwd = 0.2)
mapmisc::legendBreaks("left", uCol, bty = "n")
```

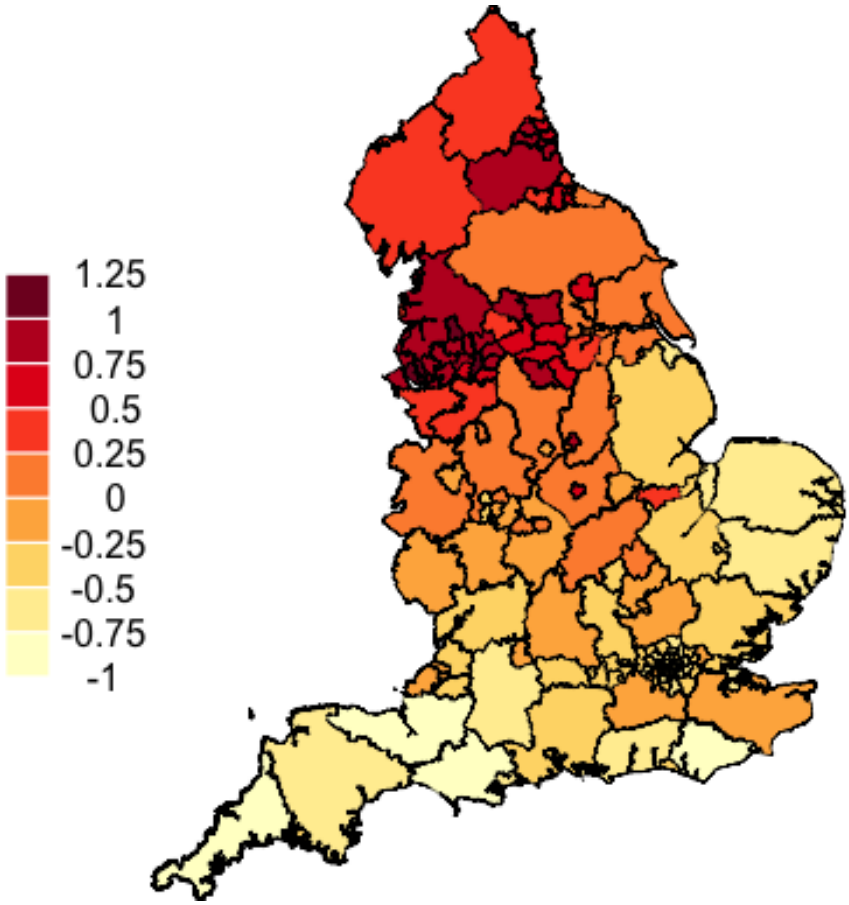



```
mapmisc::map.new(UK2)

## Warning in wkt(obj): CRS object has no comment

## Warning in wkt(obj): CRS object has no comment

plot(UK2, col = rCol$plot, add = TRUE, lwd = 0.2)
mapmisc::legendBreaks("left", rCol, bty = "n")
```

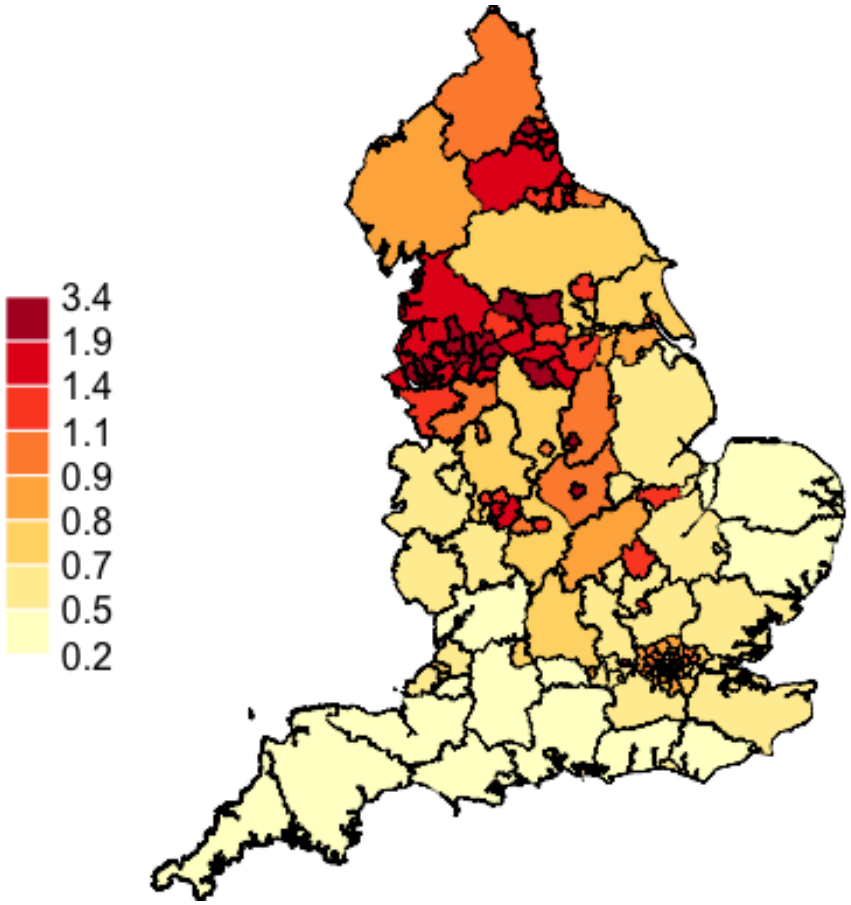



```
mapmisc::map.new(UK2)

## Warning in wkt(obj): CRS object has no comment

## Warning in wkt(obj): CRS object has no comment

plot(UK2, col = fCol$plot, add = TRUE, lwd = 0.2)
mapmisc::legendBreaks("left", fCol, bty = "n")
```


3.4
1.9
1.4
1.1
0.9
0.8
0.7
0.5
0.2