

# 2017 Statistical Methods for Spatial Data:

## Homework 1

To be handed in on Monday January 23rd, 2017. Hand in your R code as an appendix.

1. Consider the data discussed in class in which counts of male lip cancer  $Y_i$  over  $i = 1, \dots, 56$  counties in Scotland are available along with expected counts  $E_i$  and the proportion in agriculture, fishing and farming (AFF),  $x_i$ .

Consider a quasi-likelihood Poisson log-linear regression model

$$E[Y_i] = E_i \exp(\alpha + \beta x_i) \quad (1)$$

with  $\text{var}(Y_i) = \kappa E[Y_i]$ ,  $i = 1, \dots, 56$ , where  $\kappa > 0$  is a parameter that allows overdispersion to be modeled.

- (a) Provide maps of the SMRs,  $Y_i/E_i$ , and of the proportion in AFF,  $x_i$ .  
[Hint: look at the `help` function for the `mapvariable` in the `SpatialEpi` R package.]
  - (b) Give an interpretation of the parameters  $\exp(\alpha)$  and  $\exp(\beta)$ .
  - (c) Fit model (1) and report the estimates and standard errors for each of  $\alpha$  and  $\beta$ . Give a 95% confidence interval for  $\exp(\beta)$ . Also report the estimate of  $\kappa$ .
  - (d) Now fit an alternative model that includes latitude and longitude in the log-linear model, in order to investigate “confounding by location”.  
[Hint: the eastings and northings are contained in `scotland$geo`.]
  - (e) Discuss your findings.
2. On a separate sheet, and in less than a page, describe your course project.