## Module 4: Applications of Multi-level Models to Spatial Epidemiology

- 1. What is a Standardized Mortality Ratio (SMR)? (check all correct answers)
  - (a) The ratio between the observed number of deaths in a geographical area and the number of people living in the same area
  - (b) The ratio between the observed number of deaths in a geographical area and the number of deaths that we would expect to occur is a reference area with the same population mix
  - (c) The ratio between the number of deaths in a geographical area and the number of deaths in a neighboring area
  - (d) The ratio between the number of deaths in a geographical area and the average number of deaths across the whole study area
  - (e) None of the above
- 2. Under a disease-mapping model with local smoothing, the Bayesian estimate of the area-specific SMR is shrunk toward? (check all correct answers)
  - (a) The average of the SMRs in all areas
  - (b) The average of the SMRs in the neighboring areas only
  - (c) A weighted average of the SMRs in the neighboring areas only
  - (d) A weighted average of the SMRs in all areas
  - (e) None of the above
- 3. Which is more informative for identifying clusters of disease?
  - (a) Mapping SMRs
  - (b) Mapping SMR's posterior means obtained under a model with local smoothing
  - (c) Mapping SMR's posterior means obtained under a model with global smoothing
  - (d) Mapping SMR's posterior variances obtained under a model with local smoothing
  - (e) Mapping SMR's posterior variances obtained under a model with global smoothing

- 4. In the Scottish Lip Cancer Study, we found that the posterior mean of the relative risk of lip cancer in the area with the highest % of workers in agriculture is equal to 3.28 (under a model for local smoothing). This is
  - (a) A Bayesian estimate of a population average SMR
  - (b) A Bayesian estimate of an area-specific SMR characterized by having the largest percentage of workers in agriculture
  - (c) A Bayesian estimate of an area-specific SMR characterized by having the largest percentage of workers in agriculture and the largest value of the random effect
  - (d) A Bayesian estimate of an area-specific SMR characterized by having the largest percentage of workers in agriculture and marginalized with respect to the random effects distribution
- 5. In the NMMAPS study, why are city-specific estimates heavily shrunk toward the national average?
  - (a) The city-specific estimates have large standard errors
  - (b) The number of air pollution related deaths is very small in most of cities
  - (c) The pollution levels are very low
  - (d) Pollution levels vary little with time
  - (e) Number of deaths vary little with time