

## MATH 523 - ASSIGNMENT 2

*To be handed in not later than 5pm, 19th March 2013.*

*Please hand in during lectures, to Burnside 1225, or to the Mathematics Office Burnside 1005*

1. The data set contained in the comma separated file `MNLung.csv` contains data on the counts of lung cancer deaths in 87 counties in Minnesota in males and females. The objective of the study for which the data were collected was to examine whether exposure to the gas Radon was related to changes in standardized morbidity measures. The data set contains seven columns:

- County: Name of the county;
- ID: ID number of the county in the data set;
- YM: count of number of lung cancer cases in **males** over a five year period;
- EM: the expected count of number of **male** cases, based on demographic factors;
- YF: count of number of lung cancer cases in **females** over a five year period;
- EF: the expected count of number of **female** cases, based on demographic factors;
- Radon: an average measure of radon exposure in each county across the five year period.

The *standardized morbidity ratio* (SMR) for county  $i$  is defined by  $SMR_i = Y_i/E_i$ .

Using an appropriate Poisson GLM, address the following questions:

- (a) Is there any evidence in these data that radon is associated with changes in SMR ?

5 MARKS

- (b) Is there any difference the SMRs for males and females, either including or excluding radon in the model ?

5 MARKS

- (c) Report the predicted SMR, with associated measure of uncertainty, for males in an hypothetical county where the average exposure to radon measured 6 units.

3 MARKS

- (d) Comment on the validity of the Poisson assumption for these data.

2 MARKS

2. The following data represent the counts of the numbers of failures of three medical devices (M1, M2 and M3) during stress tests in a balanced designed experiment where 1000 of each device were tested at each of four mechanical stress levels (I, II, III, IV) in a laboratory stress test (yielding a total of 12000 tests).

|        |    | Stress Level |    |     |    |
|--------|----|--------------|----|-----|----|
|        |    | I            | II | III | IV |
| Device | M1 | 6            | 8  | 18  | 10 |
|        | M2 | 13           | 18 | 29  | 20 |
|        | M3 | 9            | 8  | 21  | 19 |

The data are contained in the file `Stresstest.csv`.

Using Poisson modelling, assess whether there is any significant difference between the failure rates of the devices.