R Code And Tasks Chapter 5 (MAS 6003)

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6.1 Types of 2 way tables - response / control variables

6.1.1 Case(a): Skin cancer (melanoma) data - 2 response variables

Cross sectional study of malignant melanoma. Both tumour type and site are **response variables** because none of the row or column totals were fixed in advance of the data collection.

```
library(reshape2)
```

```
## Warning: package 'reshape2' was built under R version 3.3.2
```

```
rm(list=ls())
load("data/MAS367-GLMs.RData", envir = e <- new.env())

Mela <- e$Mela
head(Mela)
```

```
##   number tumour.type          site
## 1     22           A Head.and.Neck
## 2     16           B Head.and.Neck
## 3     19           C Head.and.Neck
## 4     11           D Head.and.Neck
## 5      2           A         Trunk
## 6     54           B         Trunk
```

```
dcast(Mela,tumour.type~ site, value.var="number")
```

```
##   tumour.type Head.and.Neck Trunk Extremities
## 1           A            22     2          10
## 2           B            16    54         115
## 3           C            19    33          73
## 4           D            11    17          28
```

6.1.2 Case(b) : Flu vaccine data - 1 response and 1 control variable

Patients were randomly assigned to the two groups (Placebo, Vaccine), and the response (levels of an antibody found in the blood six weeks after vaccination) was determined. Antibody level is the **response** and vaccine group is a **controlled variable** (with totals fixed by experimental design).

```
vaccine <- e$vaccine
head(vaccine)
```

```
##   count response treatment
## 1    25    small   placebo
## 2     6    small   vaccine
## 3     8 moderate   placebo
## 4    18 moderate   vaccine
## 5     5    large   placebo
## 6    11    large   vaccine
```

```
dcast(vaccine, treatment ~ response, value.var="count")
```

```
##   treatment small moderate large
## 1   placebo    25        8     5
## 2   vaccine     6       18    11
```

6.2.1 Association, Independence and Homogeneity

Indepence :

Case(a)

Probabilities of interest $\pi_{ij} = P(A = i, B = j)$

$$P(A = i, B = j) = P(A = i) \times P(B = j)$$

Case(b)

Probabilities of interest are conditional probablities $\pi ij = P(B = j|A = i)$.

The interest is in whether the probability distribution of the response (antibody level) is the same in each level of the controlled variable (drug group). If it doesn't depend on i then we can write

$$(\pi_{ij} = \pi_{.j})$$

.

This is known as **homogeneity**.

6.3 Distribution for two-way tables

6.3.1 Case(a): two response variables

6.3.2 Case(b): one response variable

6.3.3 Case(c): independent poisson (no fixed margins).

6.3.4 Expected values

6.4 GLMs and two-way contingency tables

6.4.1 Natural hypothesis are log-linear models

6.4.2 Poisson log-linear modelling for two-way tables

6.4.3 Maximum likelihood estimation for π_{ij} in case (a) and Task 19 and Task 20.

Task 19 Verify the maximum likelihood estimate for π_{ij} for the A + B model for case(a). Task 20 Verify the maximum likelihood estimate for π_{ij} for the A + B model for case(b).

6.5 Interaction plots and examination of residues.

`interaction.plot` honorable mentioned.

6.6 Analysis of the skin cancer data (case(a)) using log-linear models (Task 21)

6.6.1 Fitted values for the skin cancer data

- $A \times B$ saturated model.

```
glm.sat <- glm(number ~ factor(tumour.type) * factor(site), family = poisson(log), data=Mela)
matrix(glm.sat$fitted.values,ncol=3)
```

```
##      [,1] [,2] [,3]
## [1,]   22    2   10
## [2,]   16   54  115
## [3,]   19   33   73
## [4,]   11   17   28
```

- $A + B$:independence

```
glm.sat <- glm(number ~ factor(tumour.type) + factor(site), family = poisson(log), data=Mela)
matrix(glm.sat$fitted.values,ncol=3)
```

```
##       [,1]   [,2]    [,3]
## [1,]  5.78  9.010  19.210
## [2,] 31.45 49.025 104.525
## [3,] 21.25 33.125  70.625
## [4,]  9.52 14.840  31.640
```

- A : independence and the same probability for each column category

```
glm.sat <- glm(number ~ factor(tumour.type), family = poisson(log), data=Mela)
matrix(glm.sat$fitted.values,ncol=3)
```

```
##          [,1]     [,2]     [,3]
## [1,] 11.33333 11.33333 11.33333
## [2,] 61.66667 61.66667 61.66667
## [3,] 41.66667 41.66667 41.66667
## [4,] 18.66667 18.66667 18.66667
```

- B : independence and the same probability for each row category

Calculate the table of fitted values for the linear predictor containing B for case(a)

```
glm.sat <- glm(number ~ factor(site), family = poisson(log), data=Mela)
res<-matrix(glm.sat$fitted.values,ncol=3)
res
```

```
##      [,1] [,2] [,3]
## [1,]   17 26.5 56.5
## [2,]   17 26.5 56.5
## [3,]   17 26.5 56.5
## [4,]   17 26.5 56.5
```

```
rowSums(res)
```

```
## [1] 100 100 100 100
```

```
colSums(res)
```

```
## [1]  68 106 226
```

6.6.2

- $A \times B$: saturated model

```
void <- glm(number ~ factor(tumour.type) * factor(site), family = poisson(log), data=Mela)
```

6.6.3 Skin cancer data case(a) revisited