Module 13: Multiple Membership Multilevel Models

Stata Practical

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Pre-requisites

- Modules 1-5,11,12

Contents

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Introduction to the Patient Satisfaction Dataset

We will analyse simulated data based on a fictitious patient survey carried out in a local hospital. In this fictitious survey, hip replacement patients were asked to score how satisfied they were with the level of care provided to them by hospital nurses during their recent hospital stay. We expect nurses to play an important role in the scores patients give with patients reporting more favourably when cared for by certain nurses. Ultimately, the hospital wants to learn what it is about these nurses which results in patients reporting better hospital experiences. Armed with such knowledge, the hospital would then like to implement additional training for all nurses with the ultimate goal of improving all patients' hospital experiences.

During the course of their hospital stays, most patients were cared for by multiple nurses and so the data are more complex than a simple two-level hierarchy of patients nested within nurses. Rather the data are characterised by a non-hierarchical multiple membership structure whereby patients (level 1) are multiple members of nurses (level 2).

The simulated data consist of 1,000 patients who, between them, were cared for by 25 nurses. Four hundred patients were cared for by only one nurse during their stay, 300 patients were cared for by two nurses, 200 patients by three nurses, and 100 patients by four nurses. The data record which nurses cared for which patients.

The response variable is a continuous measure of patients' overall satisfaction with the care they received during their hospital stay. The data also record a continuous measure of patients' likelihood of having a successful operation calculated at a preoperative assessment clinic. The score is based on patients' current medical fitness, their medical history and any other factors that might lead to complications with their operation. Both scores are standardised to have zero means and variances of one.

The multilevel modelling routines in different software packages require data describing the multiple membership structure (i.e. the nurse identifiers and the proportion of time each patient is cared for by each nurse) to be stored in one of two different forms: *compact* form or *wide* form.[1] Both forms have one row per patient, but store the multiple membership information using different sets of variables. In this dataset, we store these data twice, once in each form so that we can contrast the two approaches.

Compact form consists of two sets of variables: the multiple membership ID variables **n1st** to **n4th** which record the first, second, third and fourth nurse that cared for each patient and the associated multiple membership weight variables **p1st** to **p4th**

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[1] For example, the multilevel modelling classical estimation routines in MLwiN require these data to be in wide form, while the Bayesian routines in MLwiN only accept these data in compact form. The multilevel modelling routines in Stata and R only accept the multiple membership information in wide form.

which record the proportion of time cared for by each of these nurses.[2] Wide form carries the same information in one set of variables, **p1** to **p25**, which records the proportion of time each patient is cared for by each of the 25 nurses.[3] For example, **p1** reports the proportion of time cared for by nurse 1, **p2** the proportion of time cared for by nurse 2, and so on, up until **p25,** the proportion of time cared for by nurse 25, the final nurse.

The data contain a single nurse level variable, a measure of how happy nurses feel about their jobs. This nurse level variable is also stored in the dataset in both compact (**h1st**, **h2nd**, **h3rd** and **h4th**) and wide (**h1** to **h25**) forms.

The dataset contains the following variables

Variable name	Description and codes
patient	Patient ID
satis	Patient postoperative satisfaction score. Scores are (approximately) standardised to have a mean of zero and a variance of one, with a higher score indicating a more satisfied patient.
assess	Patient preoperative assessment score. Scores are standardised to have a mean of zero and a variance of one, with a higher score indicating a patient that was assessed to be more likely to have a successful operation.
nurses	Number of nurses seen by patient
n1st	Nurse ID for patient's 1st nurse
n2nd	Nurse ID for patient's 2nd nurse
n3rd	Nurse ID for patient's 3rd nurse
n4th	Nurse ID for patient's 4th nurse
p1st	Prop. time cared for by 1st nurse
p2nd	Prop. time cared for by 2nd nurse
p3rd	Prop. time cared for by 3rd nurse
p4th	Prop. time cared for by 4th nurse
h1st	Happiness score for 1st nurse
h2nd	Happiness score for 2nd nurse
h3rd	Happiness score for 3rd nurse
h4th	Happiness score for 4th nurse
p1	Prop. time cared for by nurse 1
p2	Prop. time cared for by nurse 2

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[2] Had the maximum number of nurses seen by any patient been five rather than four, then there would have been five multiple membership ID variables and five associated multiple membership weight variables rather than four.

[3] In this example wide form is a less efficient means of storage than compact form as it takes 25 variables to store the multiple membership information compared to eight variables for compact form.

⋮	⋮
p25	Prop. time cared for by nurse 25
h1	Happiness score for nurse 1
h2	Happiness score for nurse 2
⋮	⋮
h25	Happiness score for nurse 25

P13.1   Examining and Describing the Data

Load '13.1.dta' into memory and open the do-file for this lesson

From within the LEMMA learning environment
- Go to **Module 13: Multiple Membership Multilevel Models**, and scroll down to **Stata files**
- Click '**13.1.dta**' to open the dataset

and use the `describe` command to produce a summary of the dataset

```
. describe

Contains data from 13.1.dta
  obs:         1,000
 vars:            66                          25 Jul 2012 14:43
 size:       247,000
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
patient         int    %9.0g                   Patient ID
satis           float  %3.2f                   Satisfaction Score
assess          float  %9.0g                   Assessment Score
nurses          byte   %9.0g                   Number of nurses seen by patient
n1st            byte   %9.0g                   Nurse ID for patient's 1st nurse
n2nd            byte   %9.0g                   Nurse ID for patient's 2nd nurse
n3rd            byte   %9.0g                   Nurse ID for patient's 3rd nurse
n4th            byte   %9.0g                   Nurse ID for patient's 4th nurse
p1st            float  %9.0g                   Prop. time cared for by 1st nurse
p2nd            float  %9.0g                   Prop. time cared for by 2nd nurse
p3rd            float  %9.0g                   Prop. time cared for by 3rd nurse
p4th            float  %9.0g                   Prop. time cared for by 4th nurse
h1st            float  %3.2f                   Happiness score for 1st nurse
h2nd            float  %3.2f                   Happiness score for 2nd nurse
h3rd            float  %3.2f                   Happiness score for 3rd nurse
h4th            float  %3.2f                   Happiness score for 4th nurse
p1              float  %9.0g                   Prop. time cared for by nurse 1
p2              float  %9.0g                   Prop. time cared for by nurse 2
p3              float  %9.0g                   Prop. time cared for by nurse 3
p4              float  %9.0g                   Prop. time cared for by nurse 4
p5              float  %9.0g                   Prop. time cared for by nurse 5
p6              float  %9.0g                   Prop. time cared for by nurse 6
p7              float  %9.0g                   Prop. time cared for by nurse 7
p8              float  %9.0g                   Prop. time cared for by nurse 8
p9              float  %9.0g                   Prop. time cared for by nurse 9
p10             float  %9.0g                   Prop. time cared for by nurse 10
p11             float  %9.0g                   Prop. time cared for by nurse 11
p12             float  %9.0g                   Prop. time cared for by nurse 12
p13             float  %9.0g                   Prop. time cared for by nurse 13
p14             float  %9.0g                   Prop. time cared for by nurse 14
p15             float  %9.0g                   Prop. time cared for by nurse 15
p16             float  %9.0g                   Prop. time cared for by nurse 16
p17             float  %9.0g                   Prop. time cared for by nurse 17
p18             float  %9.0g                   Prop. time cared for by nurse 18
p19             float  %9.0g                   Prop. time cared for by nurse 19
p20             float  %9.0g                   Prop. time cared for by nurse 20
p21             float  %9.0g                   Prop. time cared for by nurse 21
p22             float  %9.0g                   Prop. time cared for by nurse 22
p23             float  %9.0g                   Prop. time cared for by nurse 23
p24             float  %9.0g                   Prop. time cared for by nurse 24
p25             float  %9.0g                   Prop. time cared for by nurse 25
h1              float  %3.2f                   Happiness score for nurse 1
```

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