

## 8

# Checking the models I: independence

New commands are introduced in just one section of this chapter.

## 8.2 Repeated measures

The main text discusses how to correctly analyse a repeated measures dataset. The first option given is the single summary approach, as illustrated here.

### MINITAB COMMANDS FOR BOX 8.3 Analysing the pigs' final weight

Commands      `glm LOGWT60 = DIET;`  
                 `brief 3.`

Menu route     `Stat > ANOVA > General Linear Model`  
                 `LOGWT60 → Response`  
                 `DIET → Model`

Results...

⊙ In addition, coefficients for all terms.

### MINITAB OUTPUT FOR BOX 8.3 Analysing the pigs' final weight

#### General Linear Model: LOGWT60 versus DIET

| Factor | Type  | Levels | Values |
|--------|-------|--------|--------|
| DIET   | fixed | 2      | 1 2    |

Analysis of Variance for LOGWT60, using Adjusted SS for Tests

| Source | DF | Seq SS  | Adj SS  | Adj MS  | F    | P     |
|--------|----|---------|---------|---------|------|-------|
| DIET   | 1  | 0.06123 | 0.06123 | 0.06123 | 4.32 | 0.071 |
| Error  | 8  | 0.11339 | 0.11339 | 0.01417 |      |       |
| Total  | 9  | 0.17462 |         |         |      |       |

| Term     | Coef    | SE Coef | T      | P     |
|----------|---------|---------|--------|-------|
| Constant | 4.50799 | 0.03765 | 119.74 | 0.000 |
| DIET     |         |         |        |       |
| 1        | 0.07825 | 0.03765 | 2.08   | 0.071 |

The second option is a multivariate analysis. Minitab does provide a command to analyse these sorts of datasets, and a brief example is given here using the 'one-pig-one-datapoint' dataset (Table 8.2 in the main text). Using the MANOVA command, an analysis of variance with multiple Y variables will test the null hypothesis that there is no difference between the two diets.

| MINITAB COMMANDS FOR BOX 8.4 Analysis of variance with multiple Y variables |  |
|---|--|
| Commands  | anova LOGWT3 LOGWT8 LOGWT20 LOGWT60 = DIET;<br>manova;<br>nounivariate.                    |
| Menu route  | Stat > ANOVA > Balanced MANOVA<br>LOGWT3 LOGWT8 LOGWT20 LOGWT60 → Response<br>DIET → Model |

The subcommand NoUnivariate prevents Minitab also producing four one-way ANOVAs for each of the response variables.

| MINITAB OUTPUT FOR BOX 8.4 Analysis of variance with multiple Y variables |                |       |         |         |  |
|---|----------------|-------|---------|---------|--|
| <b>Anova: LOGWT3, LOGWT8, LOGWT20, LOGWT60 versus DIET</b>                |                |       |         |         |  |
| MANOVA for DIET   |                | s = 1 | m = 1.0 | n = 1.5 |  |
| Criterion   | Test Statistic | F     | DF      | P       |  |
| Wilk's  | 0.58243        | 0.896 | (4, 5)  | 0.529   |  |
| Lawley-Hotelling  | 0.71696        | 0.896 | (4, 5)  | 0.529   |  |
| Pillai's  | 0.41757        | 0.896 | (4, 5)  | 0.529   |  |
| Roy's   | 0.71696        |       |         |         |  |

## 8.6 Exercises

### How non-independence can inflate sample size enormously

This exercise uses the *sheep* dataset

| MINITAB COMMANDS FOR BOX 8.7 Look-up rate in feeding sheep |   |
|--|---|
| Commands   | glm LUPRATE = OBSPER + SEX;<br>brief 1. |

Menu route                    Stat > ANOVA > General Linear Model  
    LUPRATE → Response  
    OBSPER + SEX → Model

Results...

⊙ Analysis of variance table

#### MINITAB OUTPUT FOR BOX 8.7 Look-up rate in feeding sheep

General Linear Model: LUPRATE versus OBSPER, SEX

| Factor | Type  | Levels | Values   |
|--------|-------|--------|--|
| OBSPER | fixed | 20     | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 |
| SEX    | fixed | 2      | 1 2  |

Analysis of Variance for LUPRATE, using Adjusted SS for Tests

| Source | DF  | Seq SS   | Adj SS   | Adj MS   | F     | P     |
|--------|-----|----------|----------|----------|-------|-------|
| OBSPER | 19  | 0.191918 | 0.191918 | 0.010101 | 2.41  | 0.003 |
| SEX    | 1   | 0.132816 | 0.132816 | 0.132816 | 31.67 | 0.000 |
| Error  | 99  | 0.415244 | 0.415244 | 0.004194 |       |       |
| Total  | 119 | 0.739977 |          |          |       |       |

### Combining data from different experiments

See Minitab output for this exercise in the answers to exercises in Chapter 14.