AARHUS UNIVERSITY
Department of Biostatistics

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PhD-course in ANOVA and Repeated Measurements, Fall 2016

Exercises day 2

Morning

Exercise 4

Two groups of pigs (Sham and CPB: Cardio Pulmonary Bypass) had EVF (Erytrocyte Volume Fraction), Platelet count, and Leukocyte count measured at six time points. The data can be found in `leukocyte.dta` and `leukocyte.xls`.

1. Plot the individual leukocyte curves, the grouped individual curves and the mean group curves.
2. Calculate the standard deviations and correlations corresponding to each group.
3. Analyze the leukocyte count data using the multivariate repeated measurements ANOVA.
4. Make a QQ-plot for the residuals.

The variables m1,..., m6 are generated from the leukocyte variables by multiplying by 5, adding 2, and changing the order of the time points (for example: $\text{m1} = 5 \cdot \text{leuk3} + 2$).

5. Plot the individual m-curves, the grouped individual curves and the mean group curves. What result from the multivariate repeated measurements ANOVA based on m1,..., m6 would you expect?
6. Perform the analysis and compare with the results of the analysis in question 3 (more specifically compare the p-values).

Exercise 5

In a similar study, as the one in the previous exercise, C-reactive protein (crp) was measured at

t=1	Baseline, immediately after anaesthesia
t=2	5 minutes after weaning off CPB
t=3	2 hours post CPB
t=4	4 hours post CPB

Here group 1 is the CPB-group and group 2 is the sham group. The data can be found in `crp.dta` and `crp.xls`.

1. Plot the individual curves, the grouped individual curves and the mean group curves.
2. Calculate the standard deviations and correlations corresponding to each group.

3. Analyze the crp data using the multivariate repeated measurements ANOVA.
4. Repeat questions 1-3 on the log-transformed crp data and compare with the results of the analysis of the data on the original scale.
5. What are the assumptions behind the analysis in question 3? Check the validity of the assumptions.

Afternoon

Exercise 6

Consider the crp data from exercise 5.

1. Analyze the log-transformed data using a univariate repeated measurements ANOVA.
2. Estimate the within animal variation, the between animal variation, and the correlation between measurements on the same pig.
3. What are the assumptions behind the analysis in question 1? Check the validity of the assumptions.
4. Compare with the findings in Exercise 5 question 4.

Exercise 7

In an experiment including 12 CHF patients and 12 healthy volunteers, all individuals had the cardiac output (l/min) measured. The measurements were obtained using the inert gas re-breathing technique under increasing workload (0, 30, 60, 90, and 120 watt).

The data are in `cardiac.dta` and `cardiac.xls`.

	Healthy						CHF				
Id	0	30	60	90	120	Id	0	30	60	90	120
1	10.0	13.5	13.1	15.5	16.0	1	3.5	5.7	6.4	7.0	7.6
2	3.4	8.1	8.8	10.2	12.4	2	5.0	8.1	9.4	10.7	11.6
3	6.7	9.4	10.3	11.4	13.5	3	3.4	5.3		7.7	8.8
4	4.4	8.0	9.2	10.6	11.9	4	4.6	8.7	8.9	9.6	11.2
5	9.8	15.4	15.0		16.1	5	4.7		9.6	11.0	11.3
6	6.4	9.8	9.9	10.8	12.5	6	4.3	5.8	4.6	6.7	
7	2.4	5.5	6.9	8.2	11.3	7	4.2	7.0	7.9	9.8	10.9
8	6.5		12.6	14.5	15.5	8	3.1	4.9	5.8	6.1	
9	5.1	6.8	8.6	10.6	12.1	9	3.3	5.6	6.3	6.8	8.4
10	6.8	11.6	11.9	12.4	14.6	10	3.8	5.1	5.5	6.2	7.4
11	11.1	14.6	15.3	16.6	18.0	11	5.3	9.3	10.1	11.3	11.7
12	6.3	10.6	11.2	12.8	14.0	12	5.3	7.0	7.7	8.5	9.1

1. Plot the individual curves, the grouped individual curves and the mean group curves.
2. Calculate the standard deviations and correlations corresponding to each group.
3. Analyze the data using the univariate repeated measurements ANOVA.
4. Analyze the data using the multivariate repeated measurements ANOVA. Is it possible to simplify to the univariate repeated measurement model?