Series 7

1. In this excercise we will deal with a particularly simple model: A model with fixed and random intercept but without any slope. The data is on travel times of sound waves through pieces of railroad tracks (for quality control). There were six tracks randomly selected and each track was measured three times. Thus, we have repeated measurements (three measurements on each track).

a) Load the package `nlme`. Read the help file on the data set `?Rail` and look at the data.

b) Compare the travel times by making a boxplot for each track.

c) Fit a random intercept model in order to explain the variation coming from the different tracks and from the measurement inaccuracy (use method REML).

d) Write down the model you have found as a mathematical equation.

e) What proportion of variance comes from the fact, that the rails were randomly sampled from the population of all rails? Is the total variance mainly due to measurement inaccuracy or due to variation between rails?

f) Compute 95%-confidence intervals for β, s_b and s.

g) What random effects were fitted for the individual tracks?
R-hint: `random.effects()`

h) Check the model assumptions by looking at the standardized residuals and a QQ-Plot of the random effects.

2. In this excercise we will analyse growth curves. Dentists measured the distances from the pituitary to the pterygomaxillary fissure (mm) in children. These distances were measured on x-ray images of the skull every two years.

a) Load the dataset `OrthoFem.csv` and have a look at it. The data is taken from the data set `Orthodont` in the package `nlme`. Have a look at the help file of the data (`?Orthodont`). In our data, we only kept the female patients and centered the age by substracting 11 years.
R-hint: `read.csv(file = ".../OrthoFem.csv", header = TRUE, row.names = 1)`

b) Make a xyplot (in package `lattice`) of distance vs. age for each subject (as in the book AMR page 236).

c) Fit a standard linear model explaining distance by age.

d) Fit a random intercept model.

e) Is the random intercept model a significant improvement over the standard linear model?

f) Can the fit be further improved significantly by considering a random intercept & random slope model?

g) Compare the confidence intervals of standard lm (=incorrect model) and the random slope model (=improved model). Are there relevant differences?
R-hint: `intervals` and `confint`

h) Check the random slope model by looking at the residual plots.

Preliminary discussion: 27.05.13.

Deadline: No hand-in.

Question hour: Tuesday, July 16: 14:00 - 15:00, ML F 40 and Tuesday, July 30: 14:00 - 15:00, HG F26.1 .

Exam consultation: Thursday, September 26: 12:00 - 12:30, HG G 26.1 .