Directed Studies VHM 881 Course
Fall 2004, Atlantic Veterinary College, PEI
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Home Assignment 2

The home assignment consists of 6 parts (below), which should all be answered. The home assignment is due on Wednesday, November 24, 2004 (definitive date). It is worth 15% of the course mark. All aids except personal assistance are allowed.

The topic of the home assignment is estimation/prediction of random effects in linear and generalised linear mixed models. We consider two examples of such models, the Poisson-gamma model (Parts 2–3) and a linear mixed model based on the normal distribution (4–6).

Part 1
Describe in your own words and in formulas the three methods/approaches to predict random effects in a mixed model known by the acronyms BP, BLP and BLUP. Include in your description the necessary assumptions behind the three methods.

Part 2
Exercise E 8.5 in the textbook. Note: it is well-known that a mixture of Poisson distributions with gamma-distributed random effects produces a negative-binomial distribution.

Part 3
Exercise E 9.1 in the textbook.

Part 4
Analyze the Pixel dataset (from the `nlme` library) by an appropriate linear mixed model in both R and MLwiN, and check whether you obtain the same parameter estimates and predicted values of random effects in the two software packages. Note: in the MLwiN software you get the predicted values via the Residuals window.

Part 5
Describe in your own words the two main possible uses of predicted random effects in mixed models, following the textbook or Chapter 2 of Goldstein (1995, 2002), *Multilevel Statistical Models*, 2nd/3rd ed. (the second edition of the book is still available at the web-address: `http://www.mlwin.com/hgpersonal/`). Goldstein developed two sets of standard errors for predicted values of random effects, also available in MLwiN. Determine empirically if the standard errors used in R for standardising predicted values seem to be identical to any of these.

Part 6
Study the distribution of the standardised residuals provided in R by simulating a number of datasets from the estimates of your model for the Pixel data and assessing the empirical distribution of suitable distribution characteristics, e.g. the mean, standard deviation, skewness, 90% percentile, and P-value for a test of normality.