Random Effects Models for Ordinal Data

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Abstract

One of the most frequently encountered types of data is where the response variables are measured on an ordinal scale. Although there have been substantial developments in the statistical techniques for the analysis of ordinal data, methods appropriate for repeatedly assessed ordinal data collected from field experiments are limited.

A series of biennial field screening trials for evaluating cultivar resistance of potato to the disease, late blight, caused by the fungus *Phytophthora infestans* (Mont.) de Bary has been conducted by the New Zealand Institute of Crop and Food Research since 1983. In each trial, the progression of late blight was visually assessed several times during the planting season using a nine-point ordinal scale based on the percentage of necrotic tissues. As for many other agricultural field experiments, spatial differences between the experimental units is one of the major concerns in the analysis of data from the potato late blight trial.

The aim of this thesis is to construct a statistical model which can be used to analyse the data collected from the series of potato late blight trials. We review existing methodologies for analysing ordinal data with mixed effects particularly those methods in the Bayesian framework. Using data collected from the potato late blight trials we develop a Bayesian hierarchical model for the analyses of repeatedly assessed ordinal scores with spatial effects, in particular the time dependence of the scores assessed on the same experimental units was modelled by a sigmoid logistic curve.

Data collected from the potato late blight trials demonstrated the importance of spatial effects in agricultural field trials. These effects cannot be neglected when analysing such data. Although statistical methods can be refined to account for the complexity of the data, appropriate trial design still plays a central role in field experiments.

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