EM algorithm for Linear Mixed model proposal

Phi Le

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1 Introduction

Ordinary linear regression has been used effectively for data analysis of independent observations for a long time. People have applied it in learning the price of stokes, medical studies, clinical trials, etc. However, those types of models have some limitation where the repeated measure happened. It could not be able to capture the correlation structure of within repeated individual observations. We may need some new types of models to take the correlations into studies. Linear mixed effect models were introduced to tackle those correlation problems.

Linear mixed model is one of the good models to measure the effects of repeated measure. Mixed model has more complex structure than the classical linear regression. They can be used to account the correlation of data within individuals. Mixed model is also well suited for the analysis of longitudinal data, where each time series constitutes an individual curve, a cluster. Mixed model is also suited for biological and medical data, which display notorious heterogeneity of responses to stimuli and treatment [1].

2 Aim

In this project, we are going to write a program for this model. We will include the random and fixed effects models. More precisely, we consider the following linear mixed effects model

$$Y_{ij} = \beta_0 + u_i + X_{ij}\beta + \epsilon_{ij}$$

where ϵ_{ij} and u_i are independent and $\epsilon_{ij} \sim N(0, \sigma_e^2)$ and $u_i \sim N(0, \sigma_u^2)$ and σ_e, σ_u are unknown.

The missing data will be u_i as a latent data and the observed data is Y_{ij}. We will write a program to find the coefficients of the β_0, β by using Maximum Likelihood Estimate method through EM algorithm [2].

References

[1] Eugene Demidenko, *Mixed models theory and applications with R - Second Edition,* John Wiley & Sons, 2013.

[2] Dempster, A.P.; Laird, N.M.; Rubin, D.B., *Maximum Likelihood from Incomplete Data via the EM Algorithm.* Journal of the Royal Statistical Society, Series B. 39 (1): 1–38, 1977.