Mixed effects models

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1 Hypothesis testing:

We would now like to perform tests of significance of the different effects present in a model.
Consider the following fixed effect model :

$$y_{ijk} = \mu + \alpha_i + \beta_j + \epsilon_{ijk}$$

Let us recall how to test the significance of the input corresponding to the j index (β parameter, in this case).

$$H_0 : \beta_j\text{'s are all same.}$$

Since under the null hypothesis , all β_j's are same , we assume them to take a constant value (say k) which is then absorbed into μ by the model.
We then fit both the models (the one with β_j's and the one without) and compare them using the Log-likelihood test !

Now consider the following Random effect model :-

$$y_{ijk} = \mu + \alpha_i + b_j + \epsilon_{ijk}$$
$$b_j \sim N(o, \sigma_b^2)$$

In this case however , testing whether input corresponding to j index (b's in this case) is not so simple.The prime reason : b_j's are not parameters.(A null hypothesis must always be couched using only parameters.)
We have to test something involving σ_b^2.Thus,

$$H_0 : \sigma_b^2 = 0$$

Note :
This is only in case of b's. In case of α's (in case we want to test); we still have:
H_0 : α's are all same

Note :
Thus, tests are no longer as basic as in case of fixed effect model.
(even for α's which is a fixed effect in the mixed effect model)

Reason :
The null distribution gets far more complicate due to the presence of random effect.

We shall now see how to deal with the tests in these cases.