MA50260 Statistical Modelling

Lecture 20: GLMMs Diagnostics and Summary

Ilaria Bussoli

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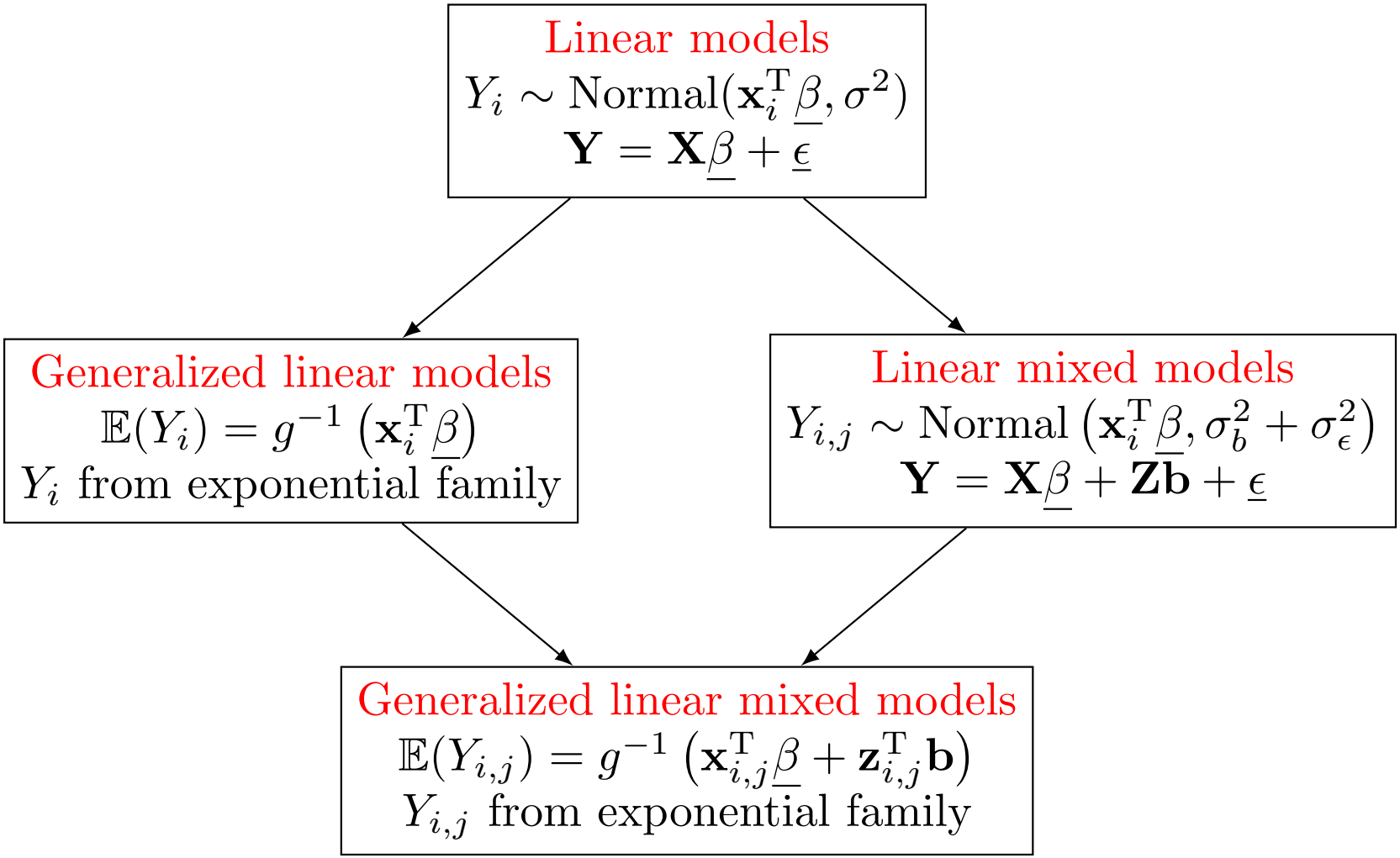
Generalised Linear Mixed Models



Diagnostics (I)

To check whether the probability distribution and link function are appropriate, we can consider

- Calculate the Pearson residuals

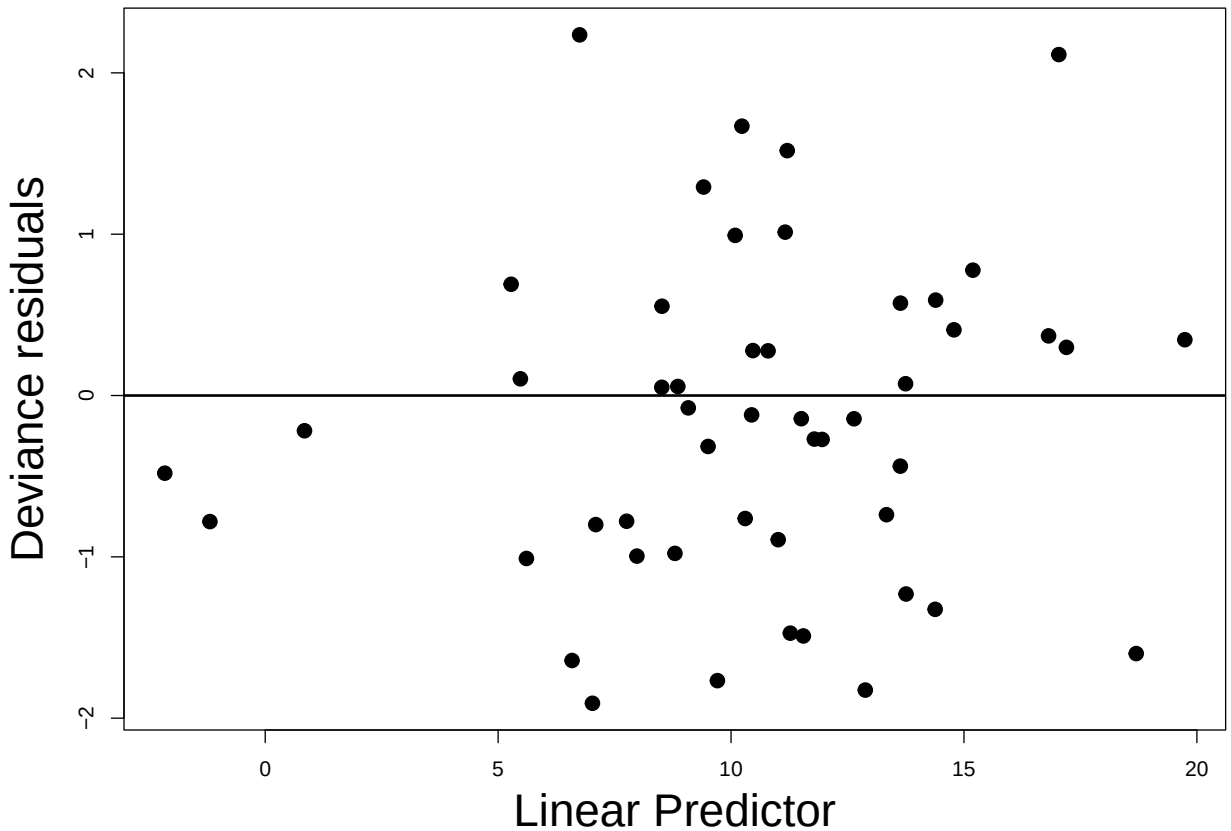
$$r_{i,j}^{P} = \frac{y_{i,j} - \hat{\mu}_{i,j}}{\sqrt{V(\hat{\mu}_{i,j})}}.$$

- Derive the deviance residuals

$$r_{i,j}^{D} = \sqrt{D_{i,j}}\,\text{sign}\left(y_{i,j} - \hat{\mu}_{i,j}\right).$$

- Examine residuals for patterns, outliers and normality.
- Plot the residuals vs the linear predictor $\hat{\eta}$.

Diagnostics (II)



Diagnostics (III)

To examine the random effects $\mathbf{b}$, we can, for example, consider

- Dot plots of random effects to see if any post-analysis would be of interest.
- Check normality of random effects (PP plots or QQ plots).
- Check whether autocorrelation exists in the residuals.

Diagnostics (IV)

Let's consider the estimated random effects for the seeds germination data.

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## $Plate
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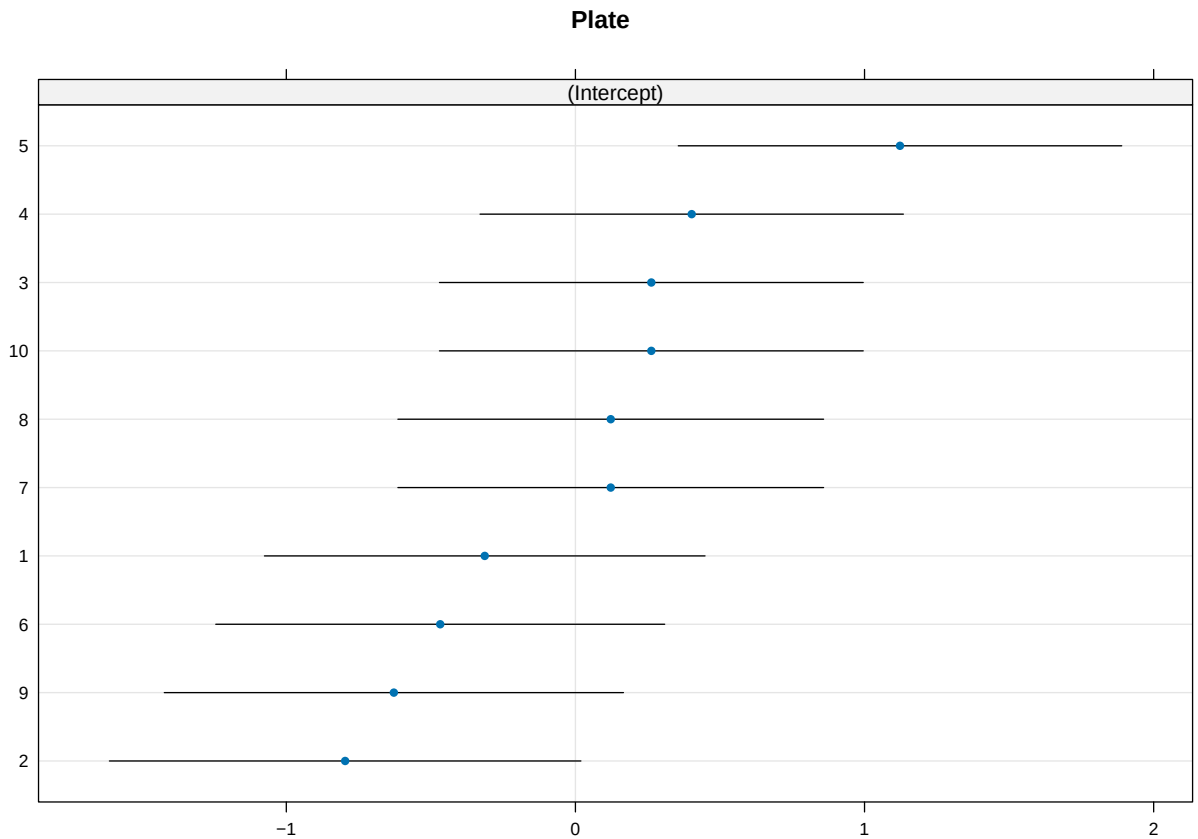
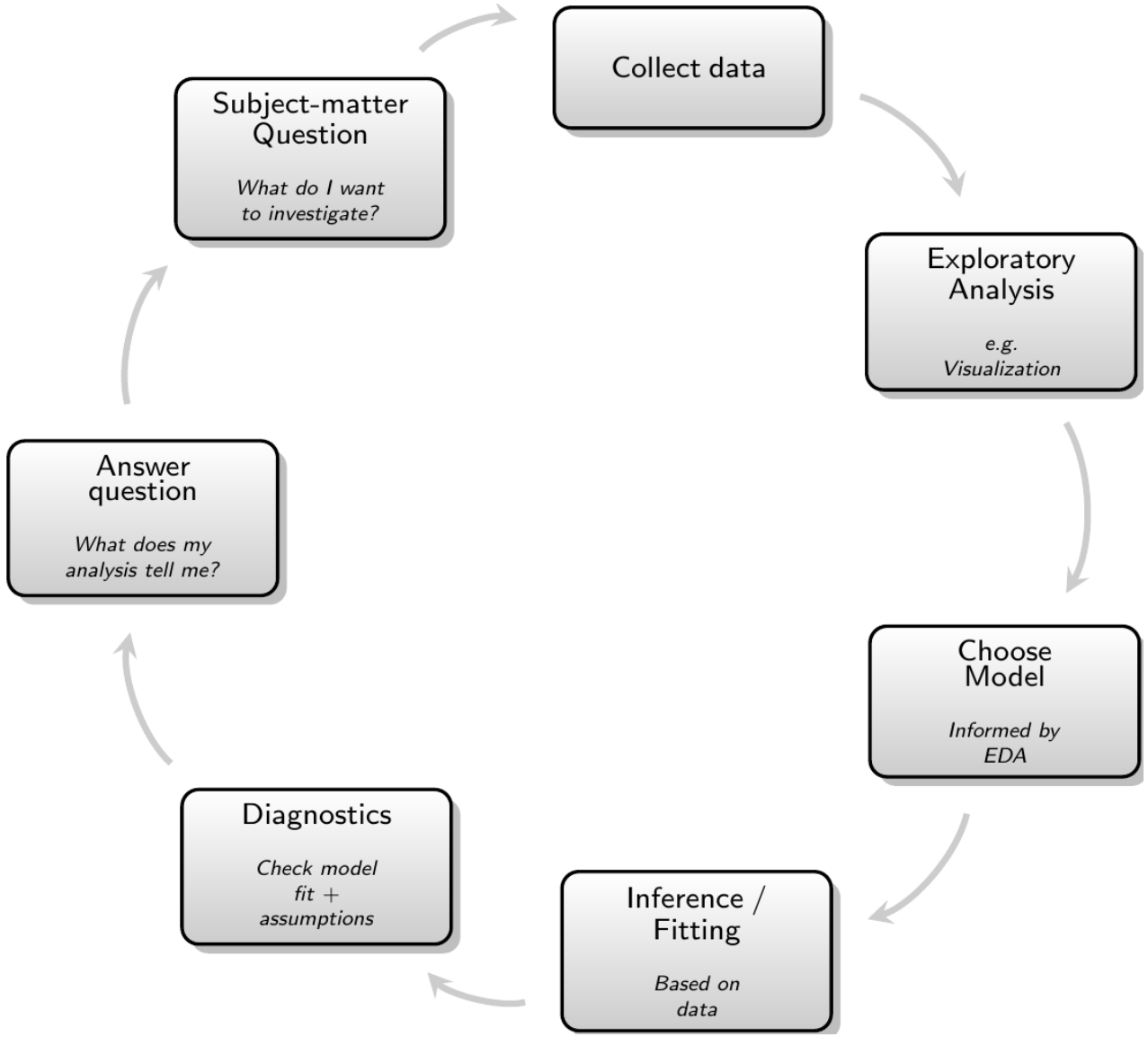


Summary (I)


Collect data
Exploratory Analysis
e.g. Visualization
Choose Model
Informed by EDA
Inference / Fitting
Based on data
Diagnostics
Check model fit + assumptions
Answer question
What does my analysis tell me?
Subject-matter Question
What do I want to investigate?

Summary (II) - Linear Regression Models

- Assumptions
- Estimation $\Rightarrow$ Least square estimate
- Hypothesis Tests and Confidence Intervals
- Model Comparison $\Rightarrow$ F-test
- Diagnostics

Summary (III) - Generalized Linear Models

- Assumptions
- Estimation $\Rightarrow$ Fisher Scoring and IRWLS
- Hypothesis Tests and Confidence Intervals
- Model Comparison $\Rightarrow$ AIC, BIC and Deviance
- Diagnostics

Summary (IV) - Linear Mixed Models

- Assumptions
- Estimation $\Rightarrow$ Restricted Maximum Likelihood
- (Hypothesis Tests and Confidence Intervals)
- Diagnostics
- Nested and Crossed Designs

Summary (V) - Generalized Linear Mixed Models

- Assumptions
- Estimation $\Rightarrow$ PQL and Gauss-Hermite quadrature
- Hypothesis Tests and Confidence Intervals
- Model Comparison $\Rightarrow$ AIC and BIC
- Diagnostics