

Heterogeneity

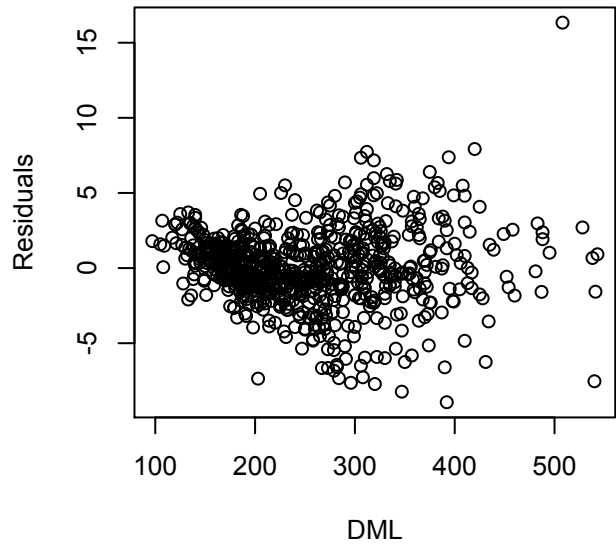
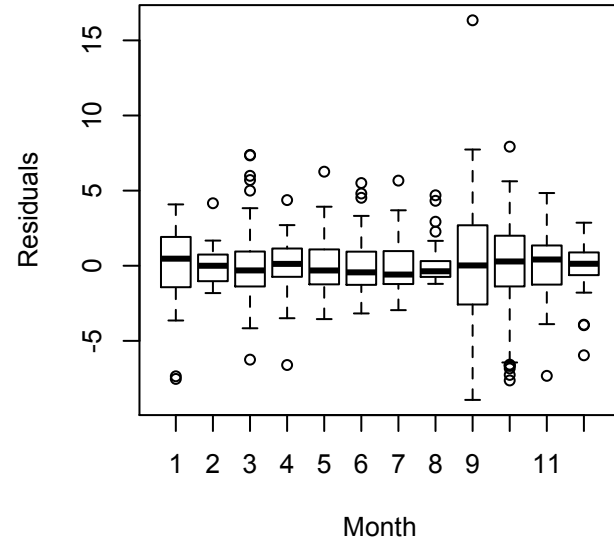
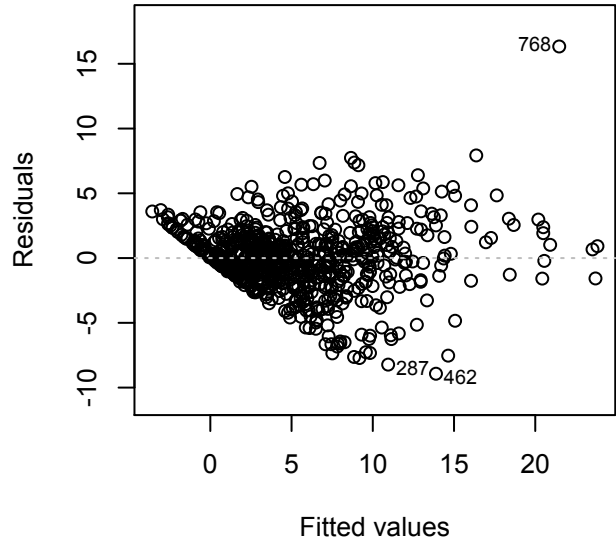
$$Y = \underbrace{\text{fixed part}}_{\alpha + \beta_1 X_1 + \dots + \beta_q X_q} + \underbrace{\text{random part}}_{\text{Heterogeneity}}$$

$\alpha + f_1(X_1) + \dots + f_q(X_q)$

Nested data (random effects)
Temporal correlation
Spatial correlation
Random noise

The aim is to model the testis weight as a function of the dorsal mantle length (DML) and the month recorded

```
library(AED)
data(Squid)
Squid$fMONTH <- factor(Squid$MONTH)
M1 <- lm(Testisweight~DML * fMONTH, data = Squid)
op <- par(mfrow = c(2, 2), mar = c(4, 4, 2, 2))
plot(M1, which = c(1), col = 1, add.smooth = FALSE,caption = "")
plot(Squid$fMONTH, resid(M1), xlab = "Month",ylab = "Residuals")
plot(Squid$DML, resid(M1), xlab = "DML",ylab = "Residuals")
par(op)
```



“Fixed Variance”

$$\varepsilon_i \sim N(0, \sigma^2 \times DML_i) \quad i = 1, \dots, 768$$

```
library(nlme)
```

```
M.lm <- lm(Testisweight~DML * fMONTH, data=Squid)
```

```
vf1Fixed <- varFixed(~DML)
```

```
M.gls1 <- gls(Testisweight~DML * fMONTH,weights = vf1Fixed, data = Squid)
```

```
AIC(M.lm,M.gls1)
```

```
plot(M.gls1)
```

“varIdent”

```
vf2 <- varIdent(form=~1 | fMONTH)
M.gls2 <- gls(Testisweight~DML*fMONTH, data =Squid, weights = vf2)
summary(M.gls2)
AIC(M.lm, M.gls1, M.gls2)
```

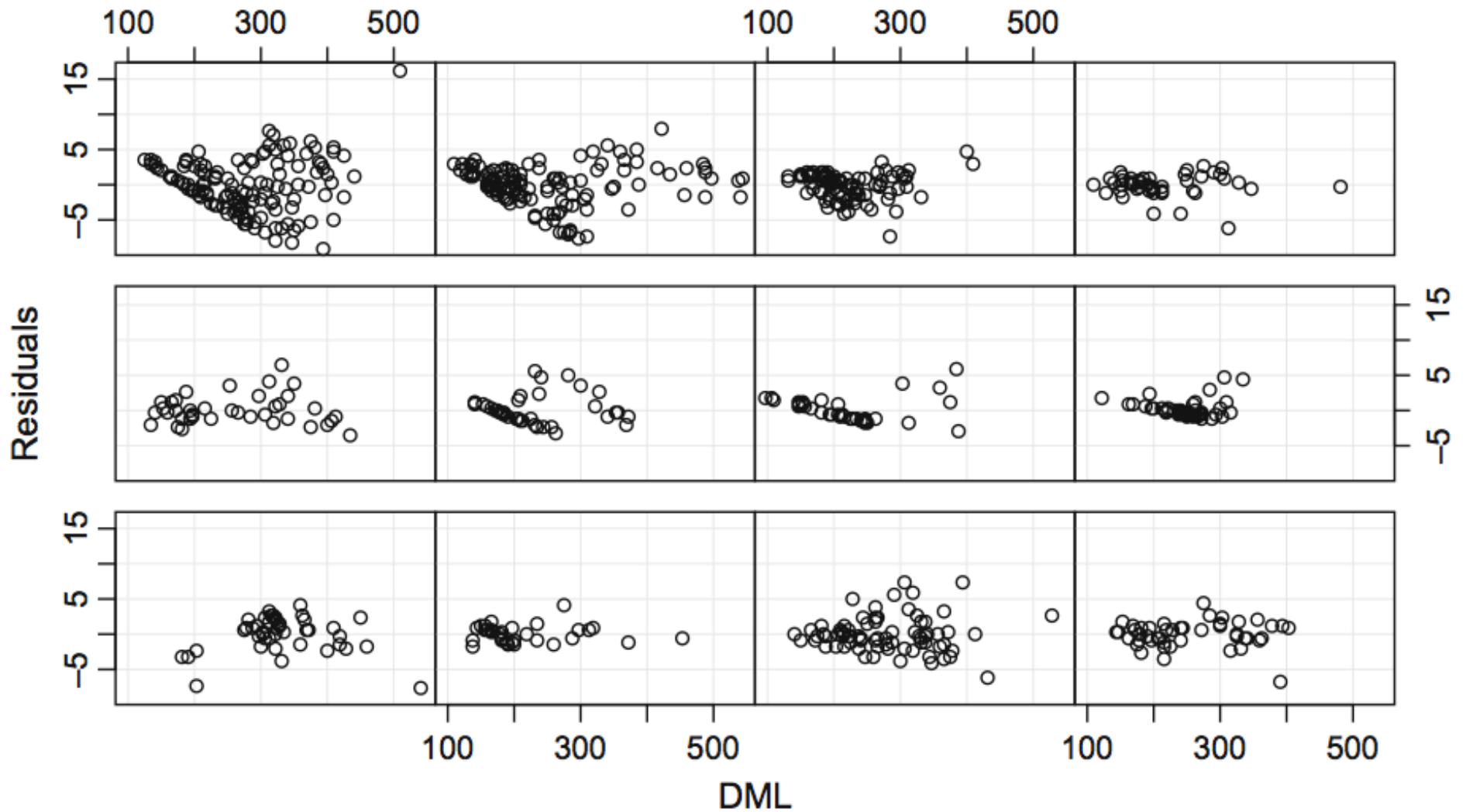


Fig. 4.3 Coplot of residuals obtained by the linear regression model in Equation (4.1) versus DML conditional on month. The lower left panel corresponds to month 1, the lower right to month 4, and the upper right to month 12. Note that some months show clear heterogeneity, and others do not.

“varConstPower”

$$\text{var}(\varepsilon_{ij}) = \sigma^2 \times (\delta_1 + |DML_{ij}|^{\delta_2})^2$$

```
vf7 <- varConstPower(form = ~ DML | fMONTH)
M.gls7 <- gls(Testisweight~DML * fMONTH, weights = vf7, data = Squid)
AIC(M.lm, M.gls1, M.gls2, M.gls7)
```

Name of the
function in R

What does it do?

VarFixed

Fixed variance

VarIdent

Different variances per stratum

VarPower

Power of the variance covariate

VarExp

Exponential of the variance covariate

VarConstPower

Constant plus power of the variance
covariate

VarComb

A combination of variance functions
