Multilevel models (continued)

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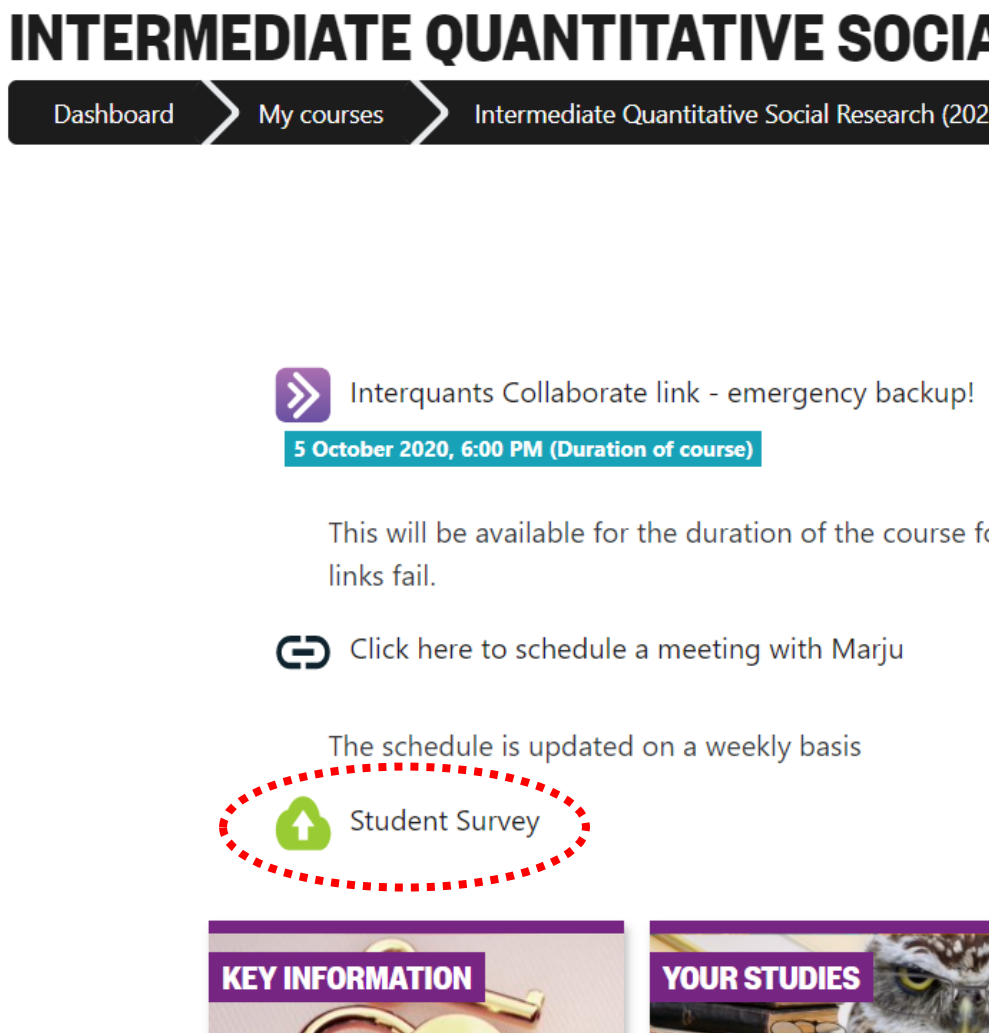
Administrative announcement

The module evaluation survey for this module is now open for students to complete.

- The survey will remain open until 12 April.

This is the first time Intermediate Quants was taught remotely, so your feedback goes a long way in improving future iterations of the course.

Thank you!



Today

- Diagnostics for LMMs, testing model assumptions in R
- Practice with LMMs – past exam problems

- Next week: Exam tips, more practice

Assumptions for LMMs

LMMs share model assumptions with OLS (“simple”) linear models:

- Additivity and Linearity
- Homogeneity of residual variance (homoscedasticity)
- No or little multicollinearity
- Normal distribution of errors

  Now also have higher level “errors”: random slopes & intercepts

Testing LMM assumptions in R

As before:

VIFs – use `vif` in the `car` package

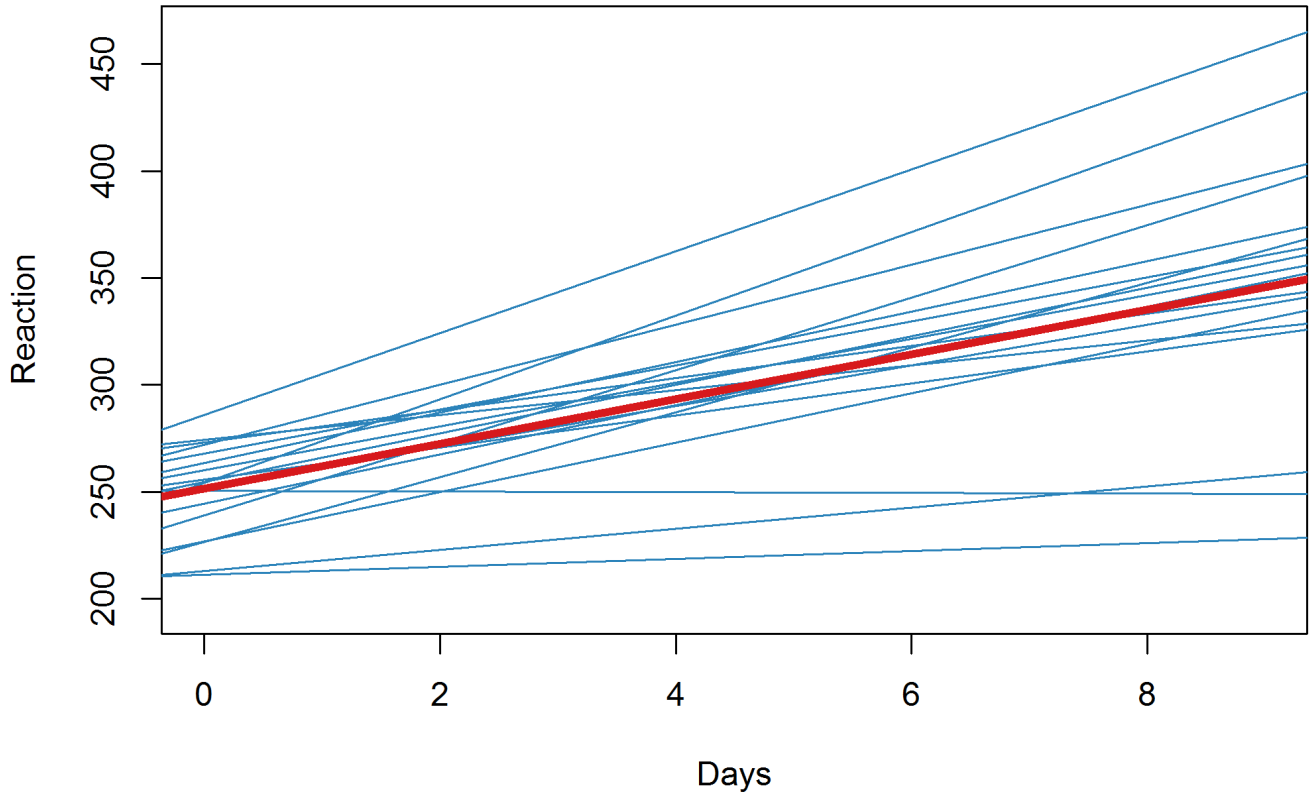
Getting the residuals and predicted values:

```
resid (mod)
predict(mod)
```

These commands give numbers, which can be scatter **plot**ted (to check for homogeneity of variance) and **hist**ogrammed (to check for normality)

Inspecting random effects

```
Reaction ~ 1 + Days + (1+Days|Subject)
```



Inspecting random effects

```
> ranef(myMod)

$Subject
    (Intercept)        Days
308   2.2585654   9.1989719
309 -40.3985769  -8.6197032
310 -38.9602458  -5.4488799
330  23.6904985  -4.8143313
331  22.2602027  -3.0698946
332   9.0395259  -0.2721707
…
```

(here just for Subject; you could have more, e.g., for schools or teachers)

Inspecting random effects

```
> ranef(myMod)$Subject

    (Intercept)        Days
308   2.2585654   9.1989719
309 -40.3985769  -8.6197032
310 -38.9602458  -5.4488799
330  23.6904985  -4.8143313
331  22.2602027  -3.0698946
332   9.0395259  -0.2721707
…
```

Inspecting random effects

Looking at the random intercepts: The parentheses in “(Intercept)” confuse R, so you need to use backquotes:

```
> ranef(myMod)$Subject$`(Intercept)`
```

2.2585654 -40.3985769 -38.9602458 23.6904985 22.2602027 9.0395259
16.8404311 -7.2325792 -0.3336958 34.8903508 -25.2101104
…

Inspecting random effects

Or you can ask for the first column to get the intercept:

```
> ranef(myMod)$Subject[,1]
```

2.2585654 -40.3985769 -38.9602458 23.6904985 22.2602027 9.0395259
16.8404311 -7.2325792 -0.3336958 34.8903508 -25.2101104

...

Let’s have a quick look through the tutorial to see the diagnostics in action

2.9 MULTILEVEL DIAGNOSTICS

LEARNING OUTCOMES

By the end of this week you will:

1. Understand what diagnostics are appropriate for LMMs.
2. Be able to test the assumptions of LMMs using R.

PRE-SESSIONAL ACTIVITIES

</> Tutorial: Multilevel Models (including diagnostics)

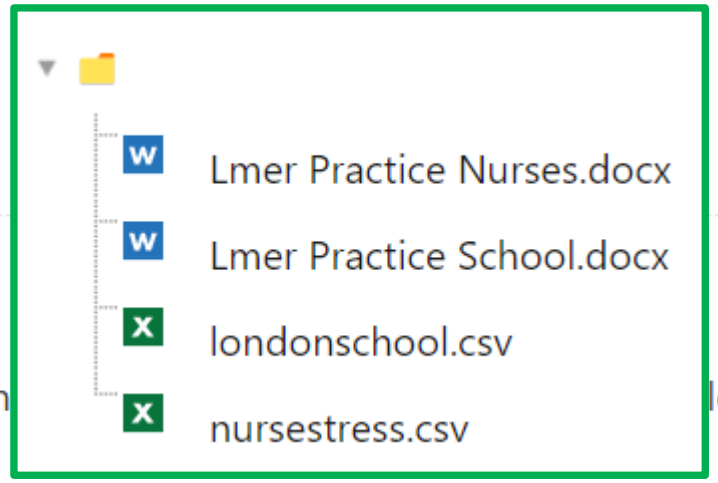
Practice

PRE-SESSIONAL ACTIVITIES

Multilevel Model Practice

Here are two past exam assignments on m long with the corresponding datasets.

Optional: Submit your practice excercises



Let's work with the Nurse Stress dataset first.

To participate, you can type commands in the Chat

For the upcoming week

- Submit your project on Moodle(or put in a request for an extension if needed)
- More exercises:

PRE-SESSIONAL ACTIVITIES

Work through the **past exam problems** for **Multilevel Models** (posted under last week) and **Linear and Logistic Regression** posted here.

You may **optionally submit your answers** (by Sunday, 14 March) in the folder below. They will not be marked and if Marju discusses answers in class using your work as an example, it will be anonymous. Feel free to submit partial solutions if you get stuck or don't have time to cover all problem sets. This will give us more material to work with as we discuss exam preparation.

Take a note of things in the practice exercises you find confusing or are not sure about. (This could be conceptual or technical). Come prepared to discuss any questions you have at the live session.

Linear and Logistic Regression Practice

Here are two more exercises, pulled from past exams.

Optional: Submit your practice excercises

Questions for me?

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