

Methods for Dummies

Second-level Analysis

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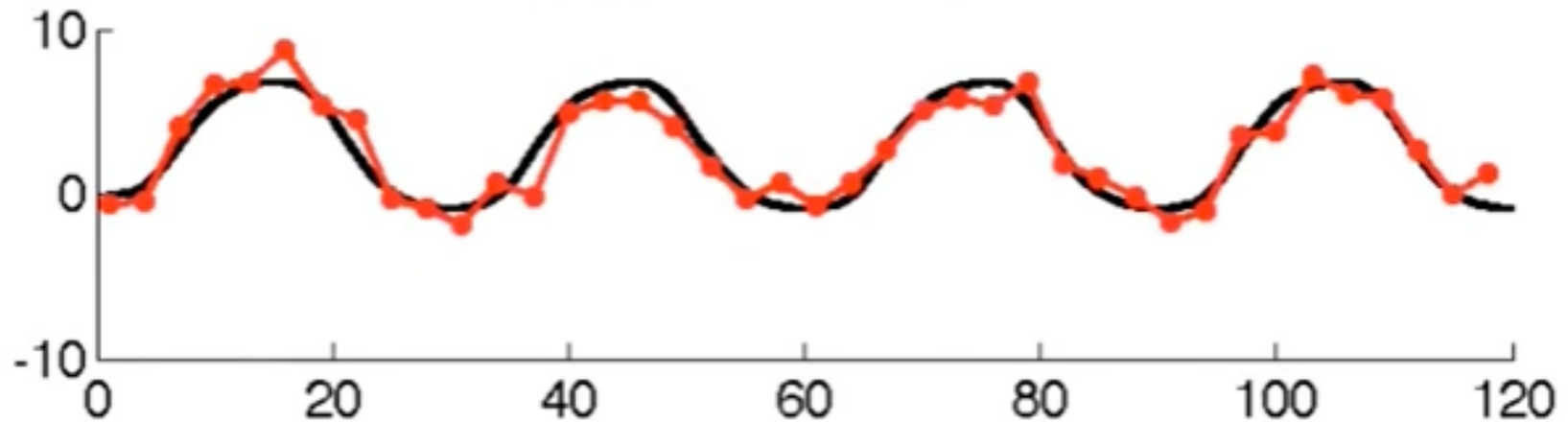
Fixed and Random Effects

Fixed versus random effects

Different assumptions about the source of random variation in voxel activity

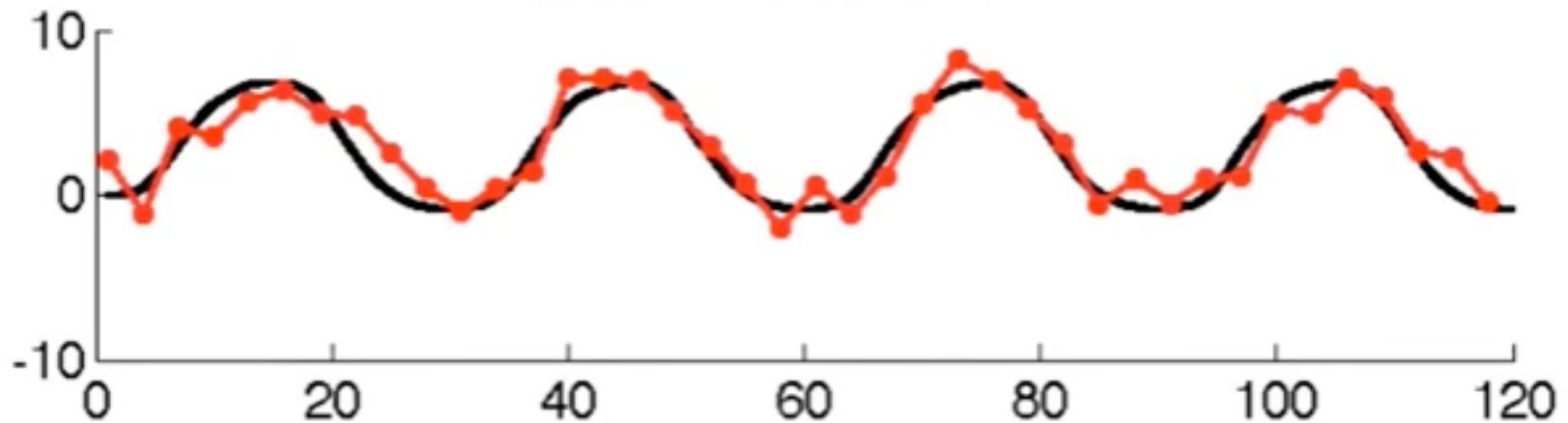
Fixed effect

One source of variation: **measurement error**



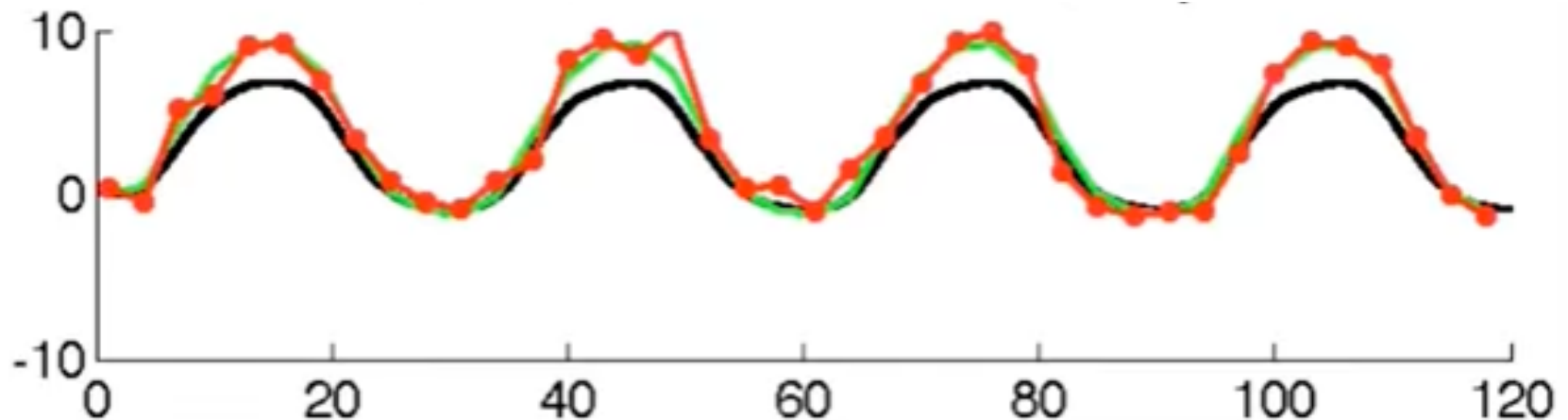
Fixed effect

One source of variation: **measurement error**



Random effect

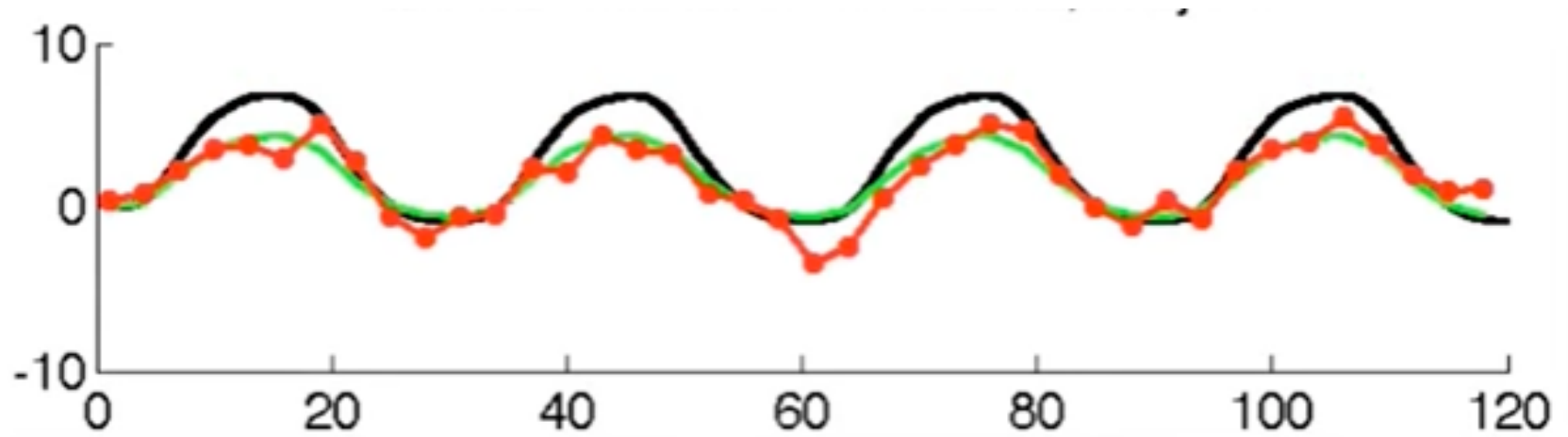
Two sources of variation
measurement error
Response magnitude



Black line – population mean

Random effect

Two sources of variation
measurement error
Response magnitude

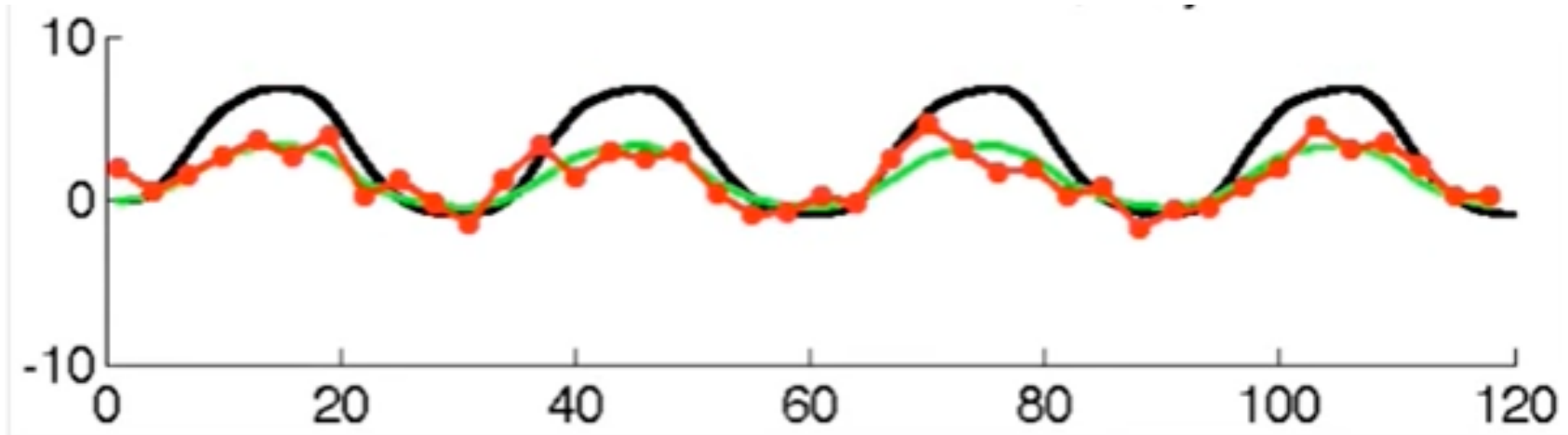


Subject as a random factor

Random effects

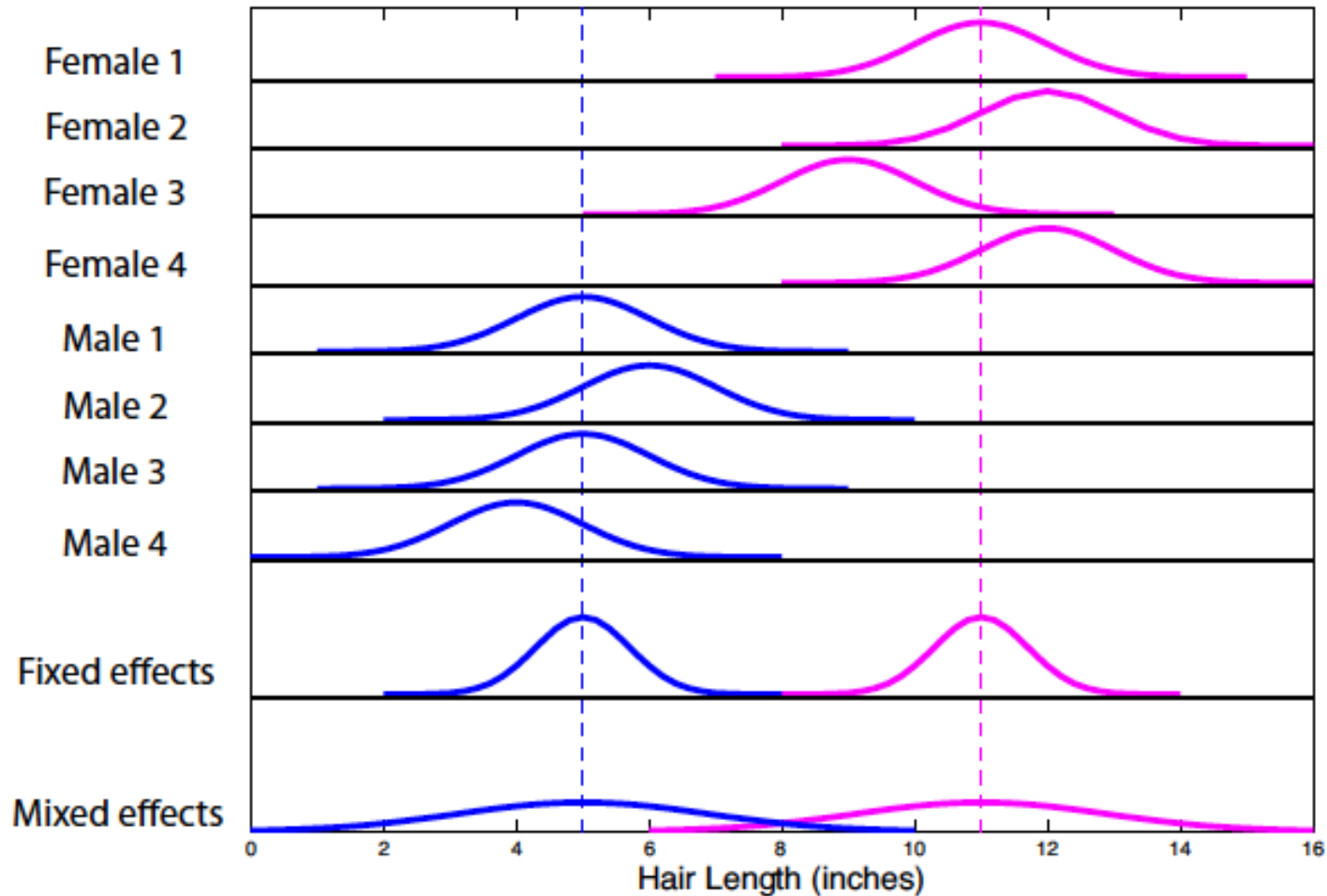
$$y = X^{(1)}\beta^{(1)} + \varepsilon^{(1)}$$

$$\beta^{(1)} = X^{(2)}\beta^{(2)} + \varepsilon^{(2)}$$



- Two sources of variation:
 - Measurement error (within subject)
 - Response magnitude (between-subject)
- Response magnitude is random
 - each subject/session has random magnitude
 - population mean is *fixed*. → Mixed-effect analysis

Summary: Fixed vs. mixed effects



(from Poldrack, Mumford and Nichol's 'Handbook of fMRI analyses')

Fixed-effects:

We can only say something about our particular group of subjects

- No generalisation
- case studies

Random-effects:

We make inferences about the population from which the subjects were drawn

- generalisation possible

“Mixed effects models should be used whenever data are grouped within certain levels of a population and inferences are to be applied to the entire population.”

- Mumford and Poldrack (2007)

Methods for Random Effects

Hierarchical

- Most accurate method – gold standard
- Set up a GLM containing parameters for the effects and variances at both the subject AND group levels, to all be estimated at the same time.
- Estimates subject and group statistics via “iterative looping”
- Computationally demanding

Resources

- Previous MfD slides
- Glascher, J. & Gitelman, D. (2008) Contrast weights in flexible factorial design with multiple groups of subjects.
- Slides from Guillaume Flandin's talk in Zurich, Feb 2014
- Mumford, J. A., & Poldrack, R. A. (2007). Modeling group fMRI data. *Social cognitive and affective neuroscience*, 2(3), 251-257.
- Friston, K. J., Stephan, K. E., Lund, T. E., Morcom, A., & Kiebel, S. (2005). Mixed-effects and fMRI studies. *Neuroimage*, 24(1), 244-252.