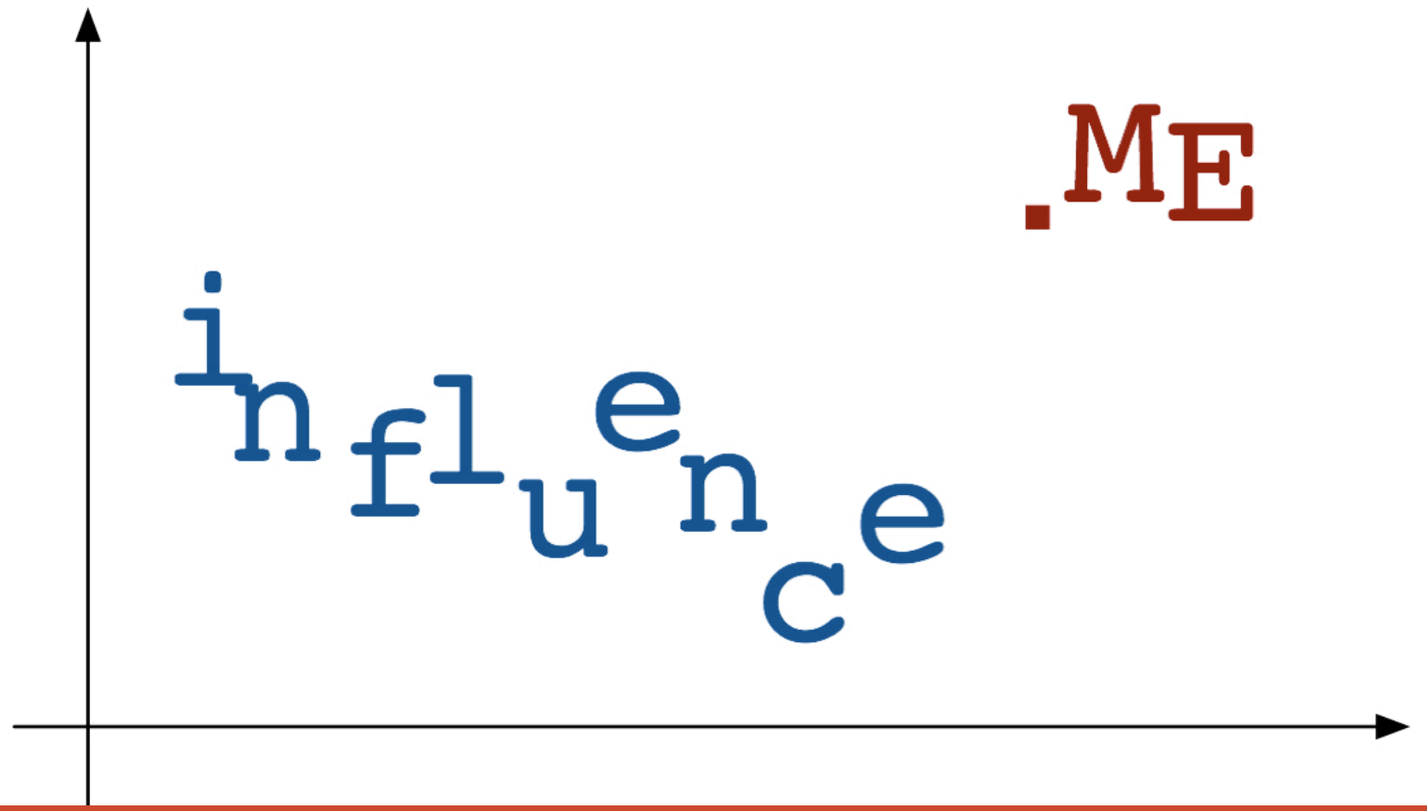
Influence.ME:
Tools for detecting influential data in mixed models

Rense Nieuwenhuis // Ben Pelzer // Manfred te Grotenhuis



Radboud University Nijmegen

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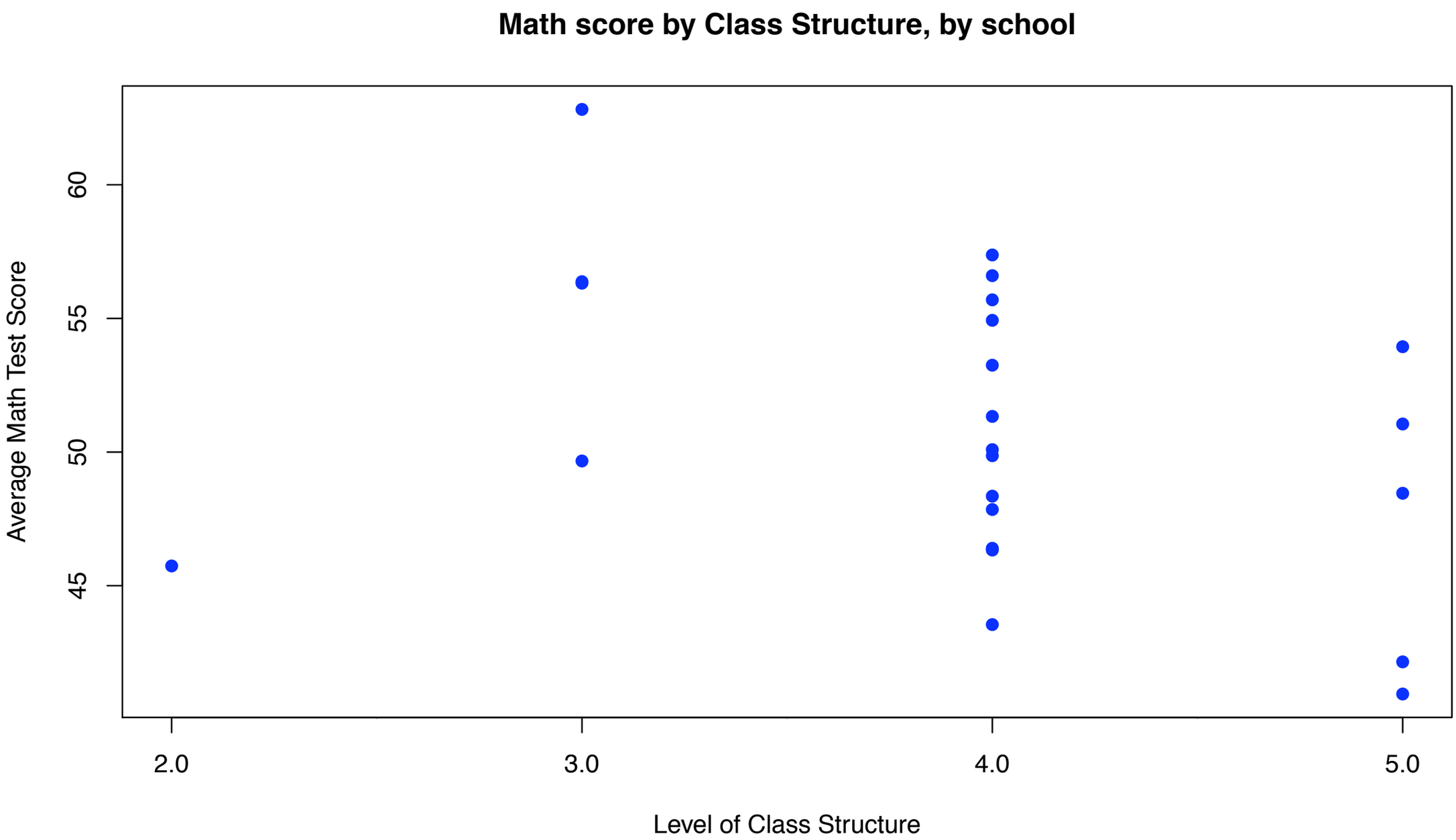

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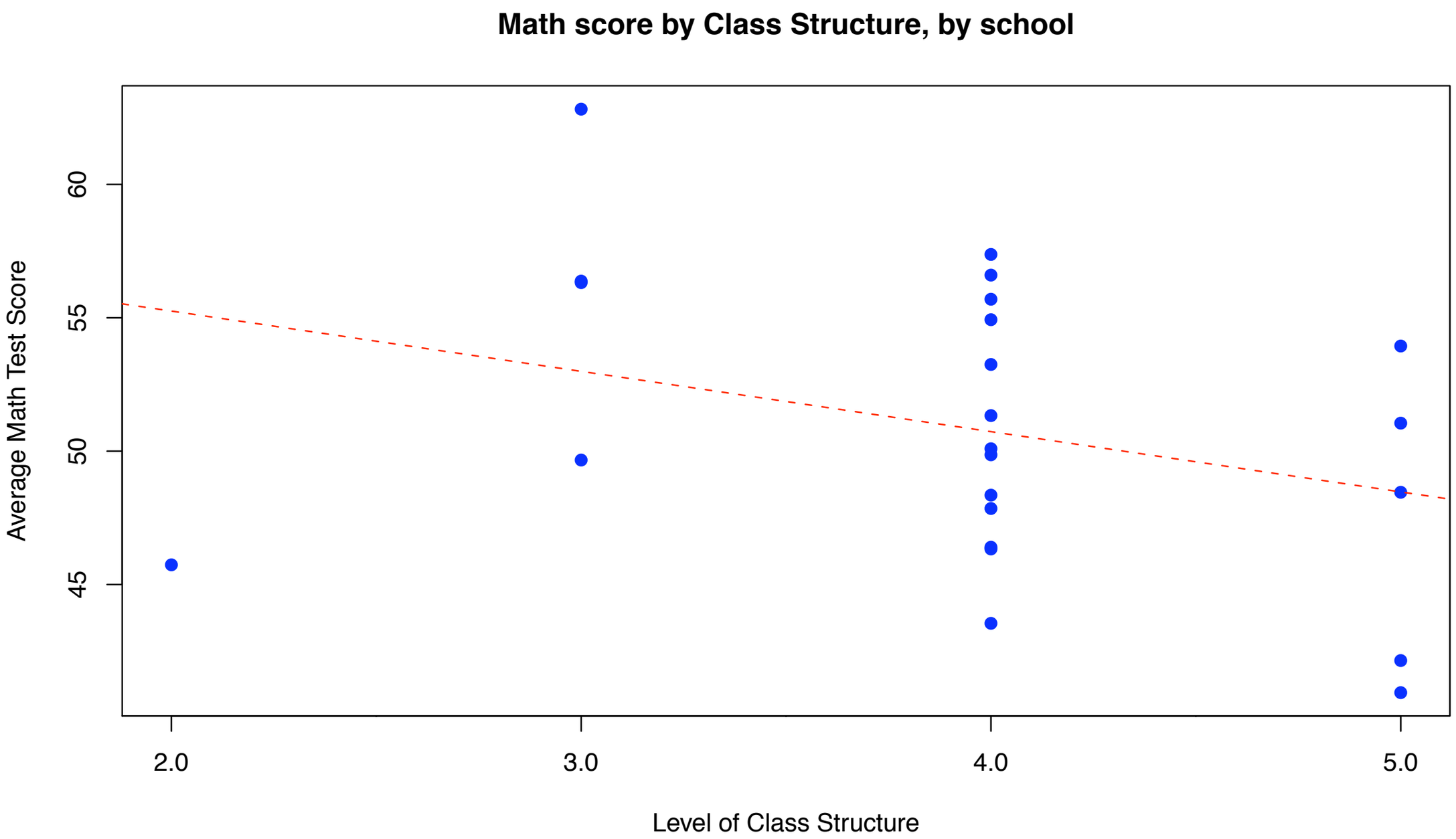

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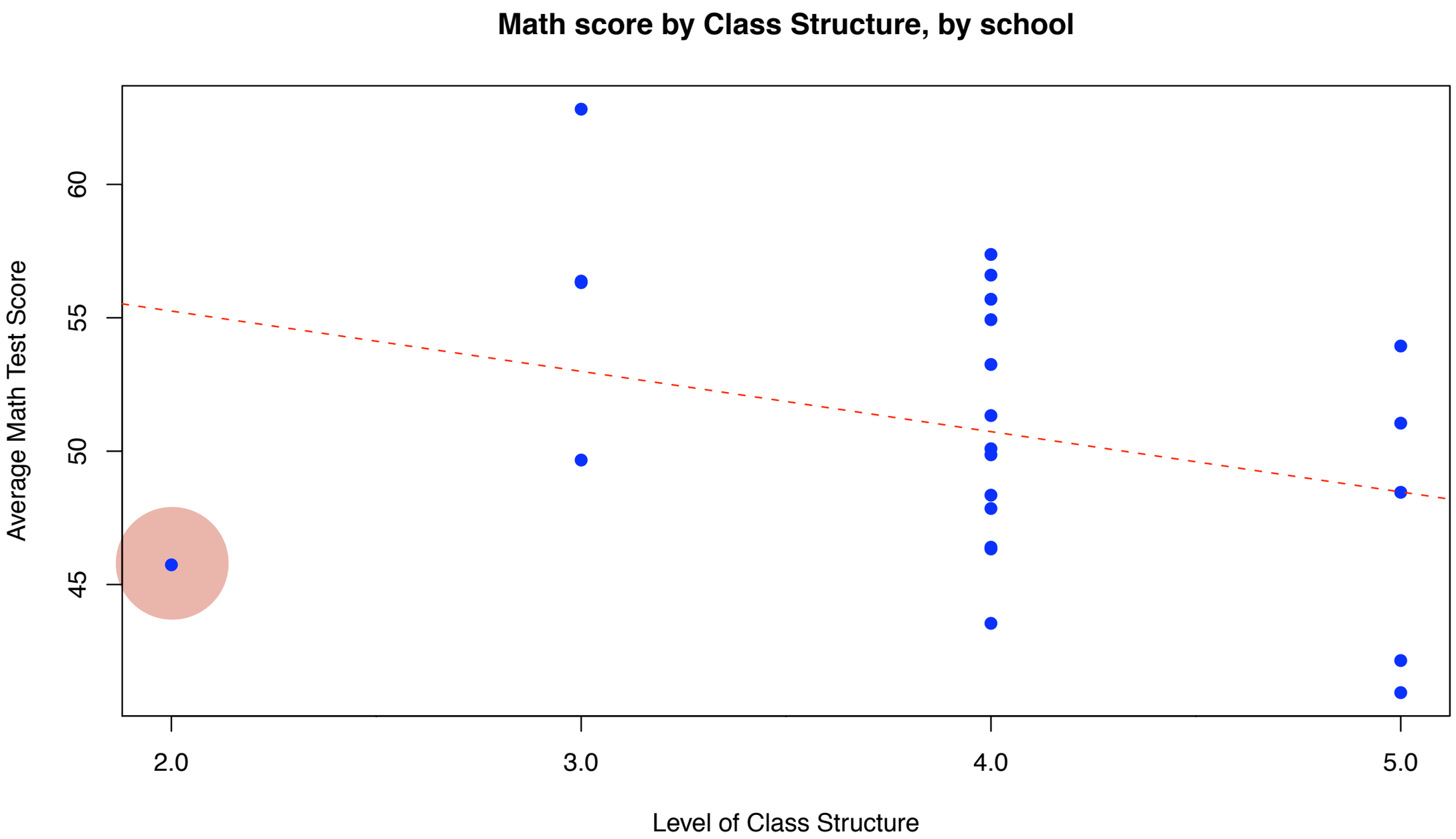

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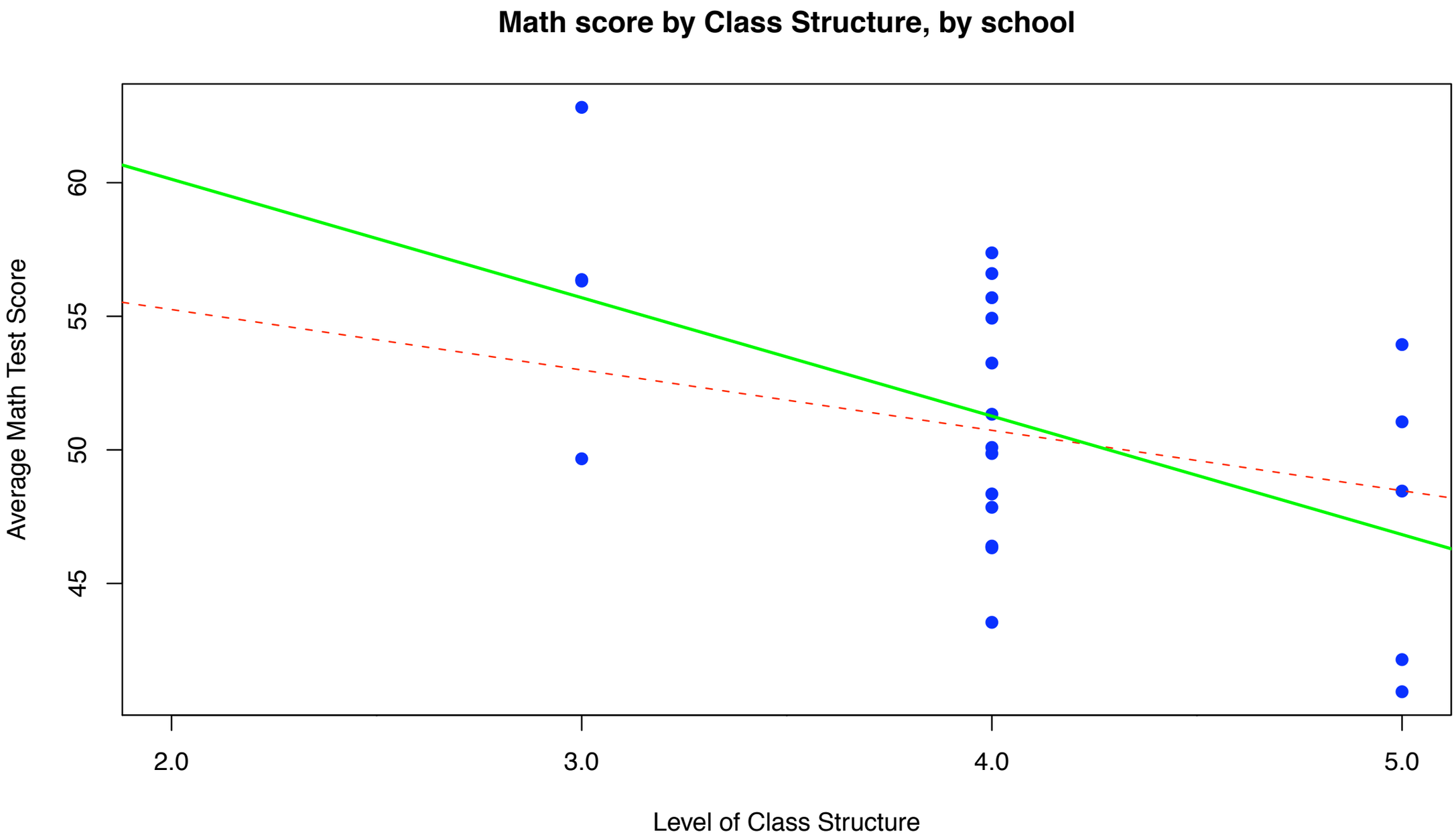

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  - Observations nested within “groups”
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- Small number of “groups” (van der Meer et al. 2009)
  - No country-comparative study exceeds 54 countries
  - Re-evaluation of risk for influential data

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- Improvement in influence.ME: cases not deleted, but influence neutralized by altered intercept + dummy variable (Langford & Lewis, 1998)

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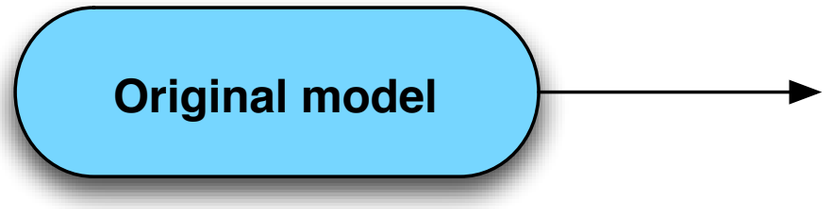

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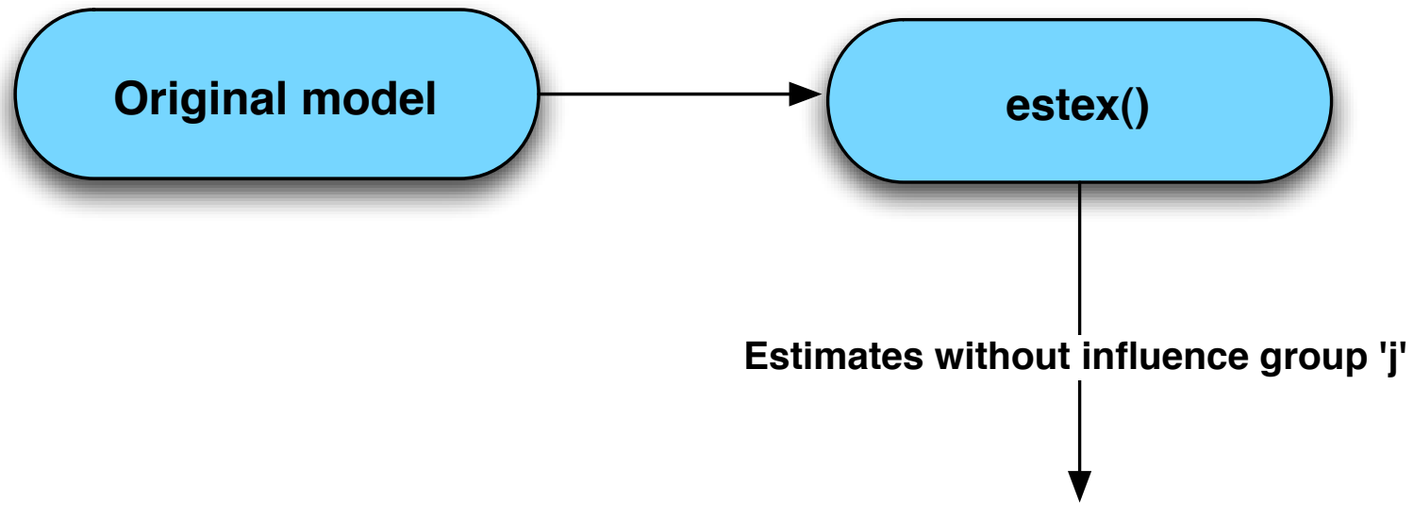

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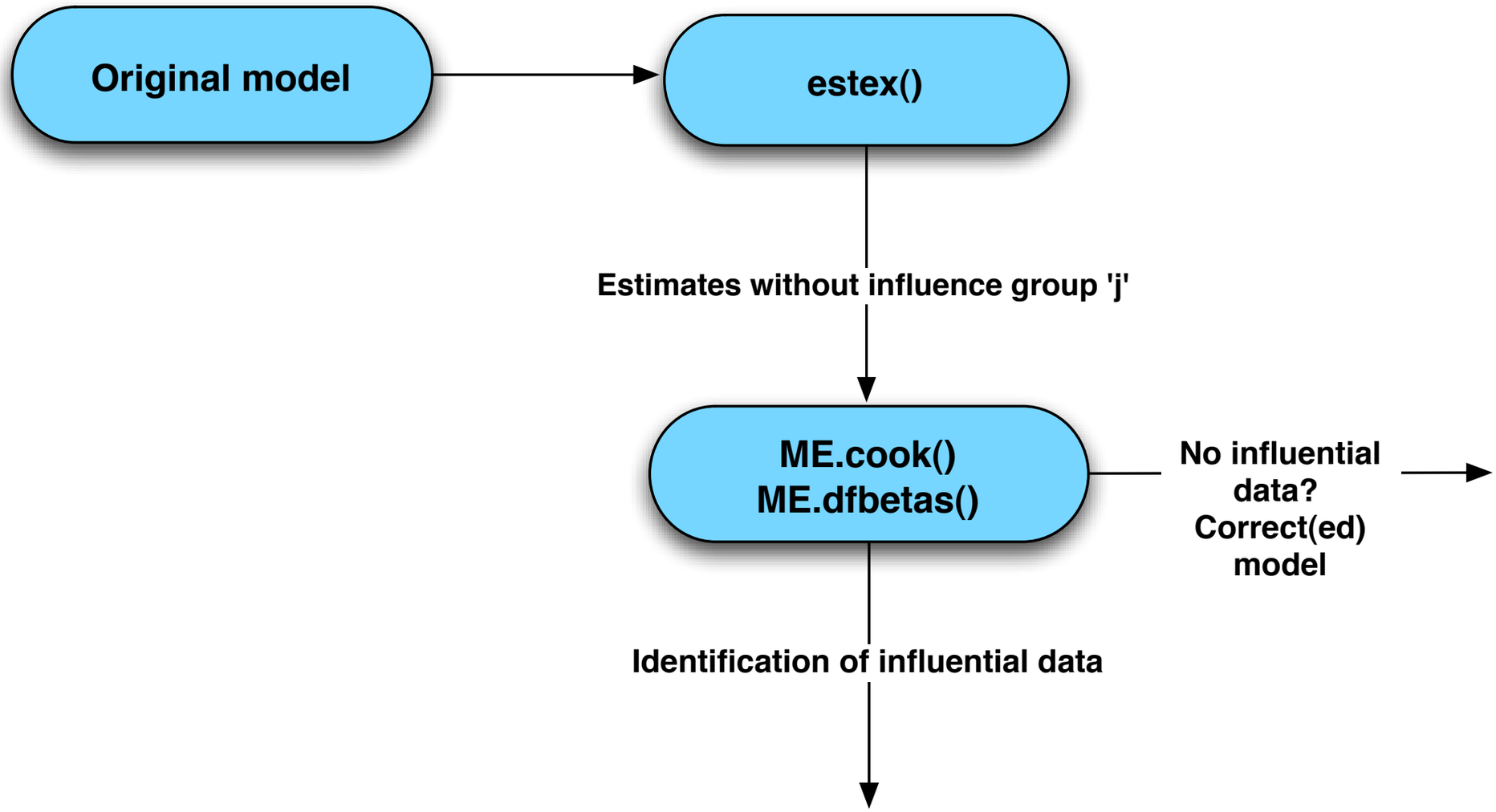

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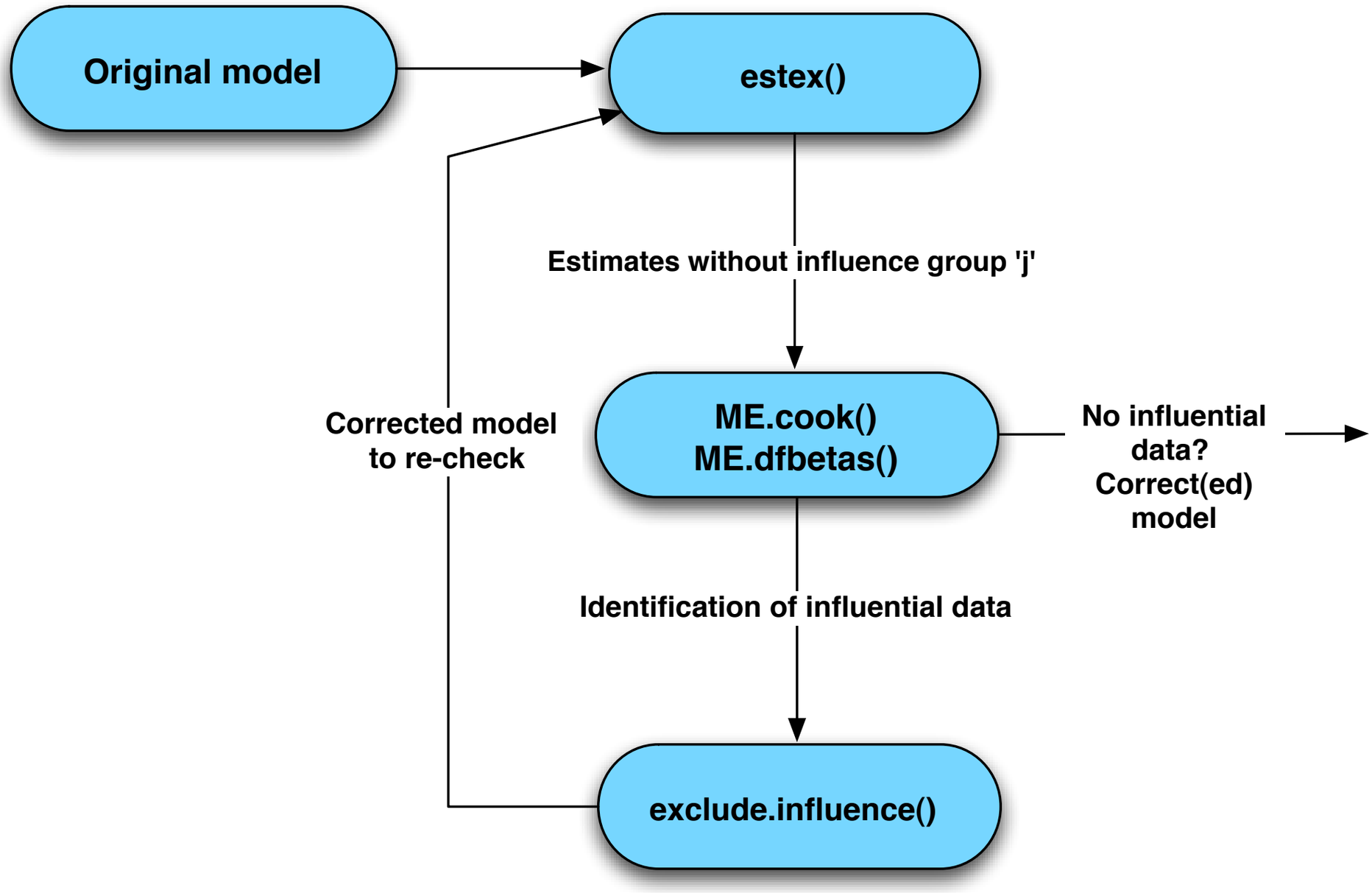
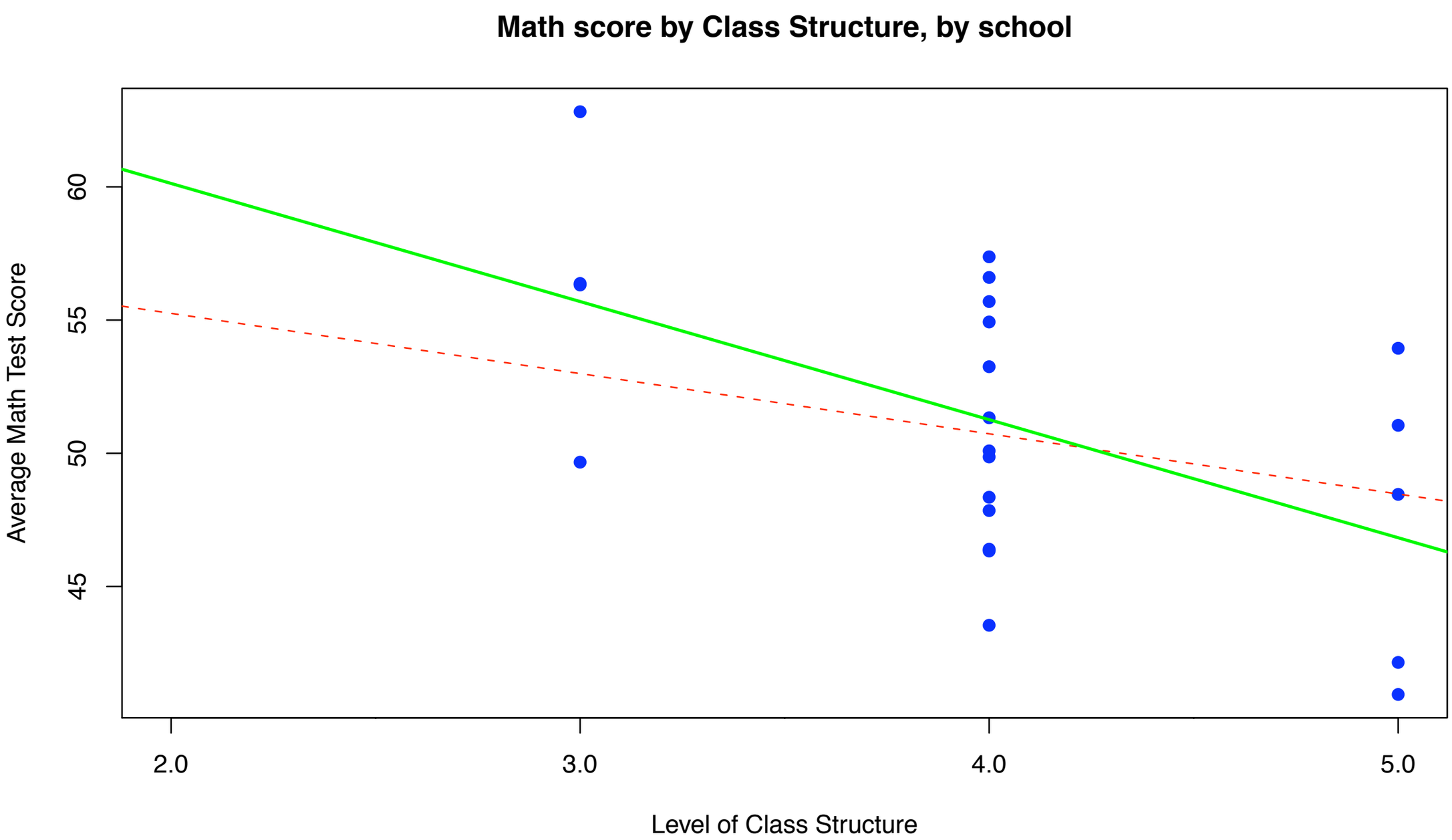


Again, a first indication something is wrong ...



Example: School 23 (Kreft & De Leeuw, 1998)

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Linear mixed model fit by REML
Formula: math ~ structure + (1 | school.ID)

Number of obs: 519, groups: school.ID, 23

Fixed effects:
             Estimate Std. Error t value
(Intercept)   60.002      5.853  10.252
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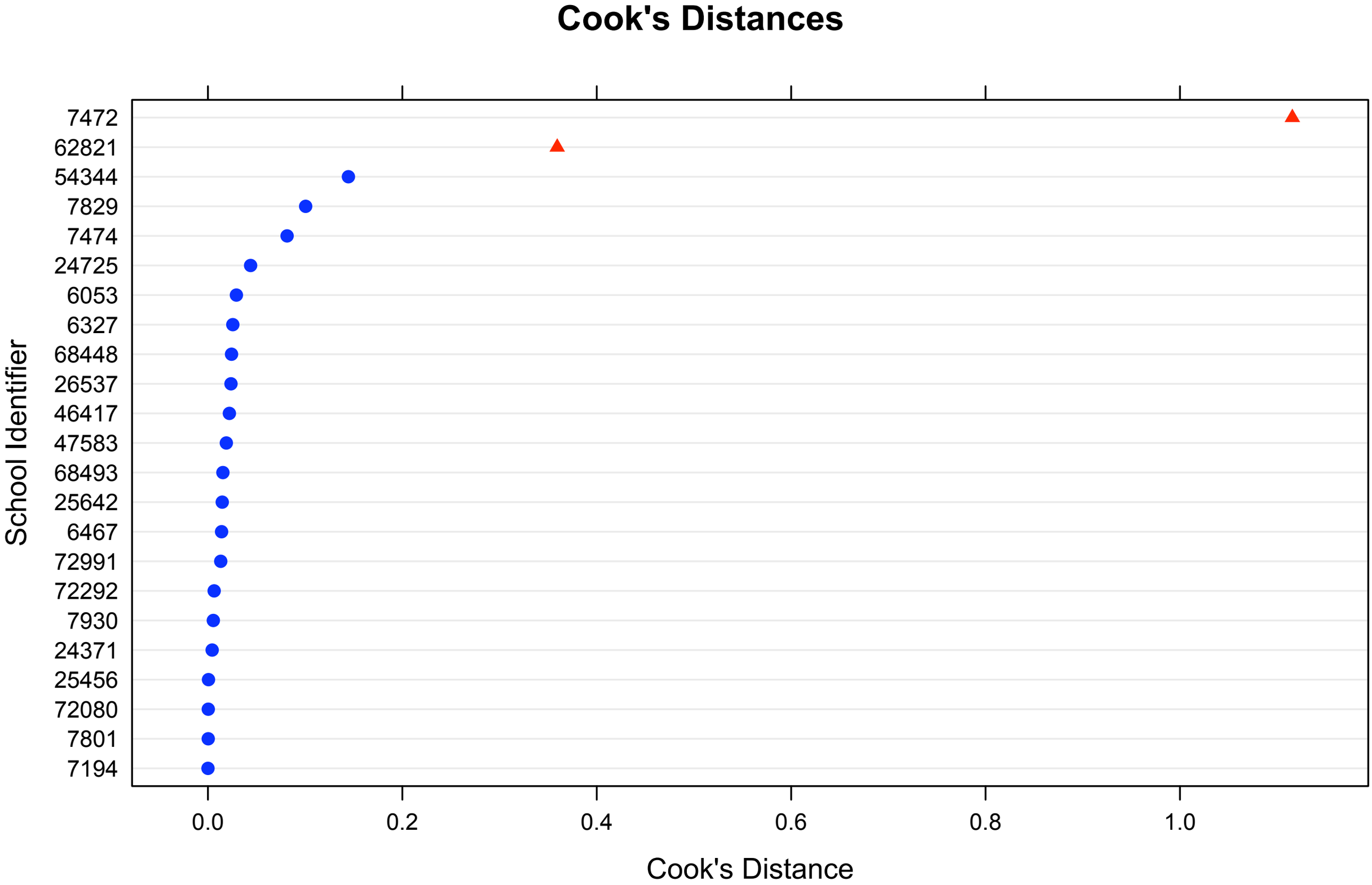
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School Identifier
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54344
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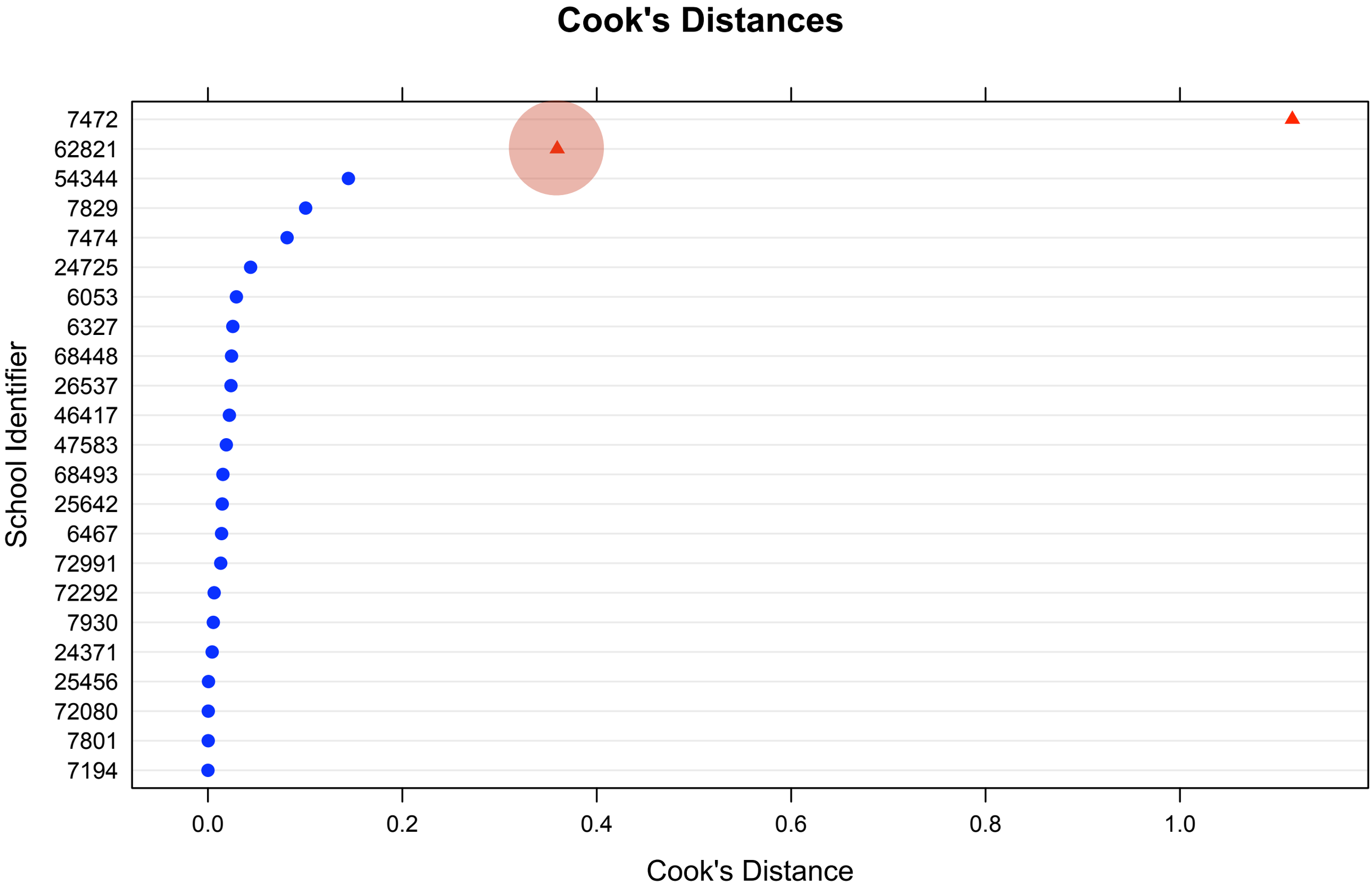
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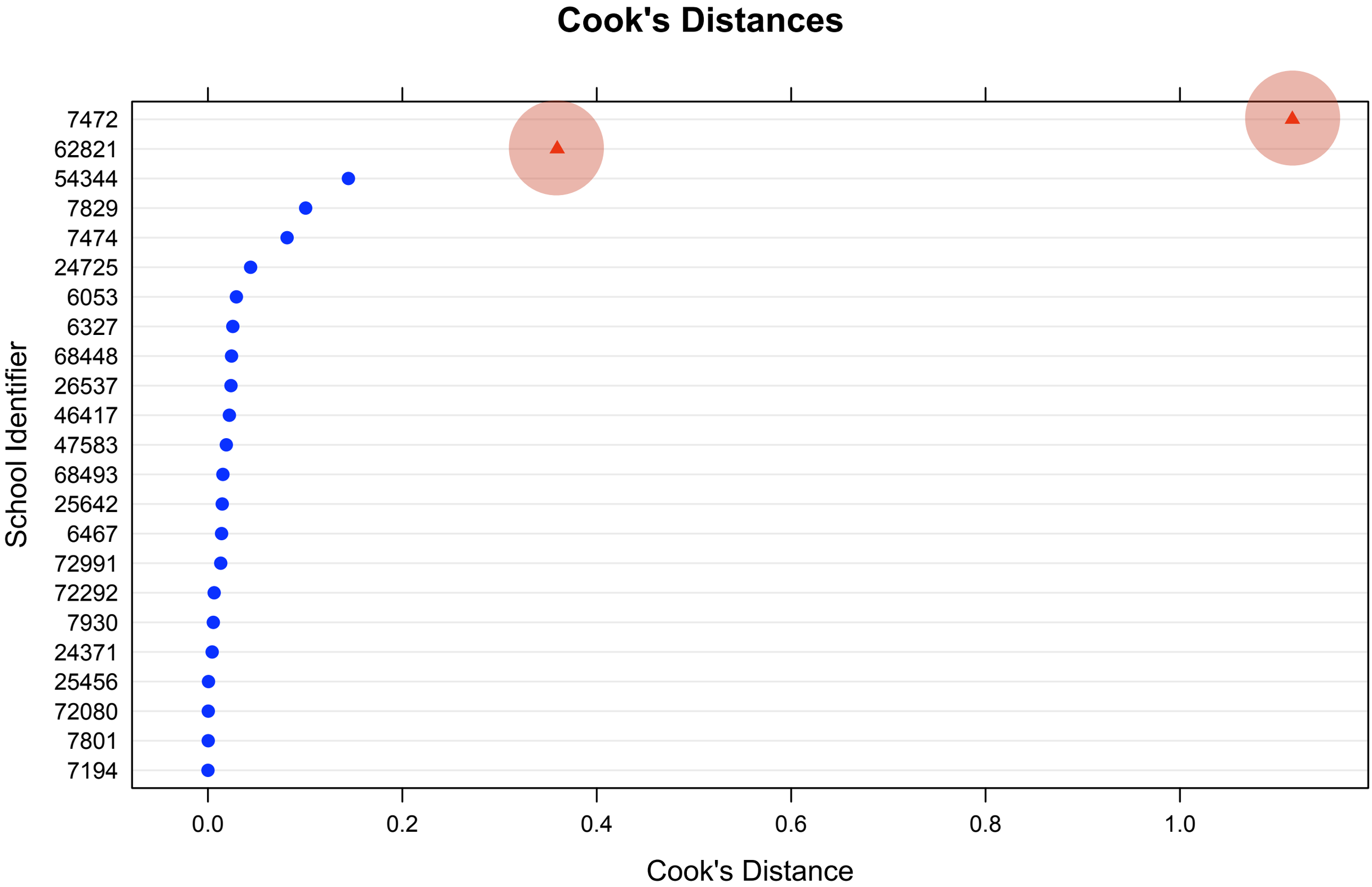
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Fixed effects:
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estex.62821      73.069      4.735  15.432
estex.7472       52.571      3.600  14.602
structure        -3.416      1.535  -2.226
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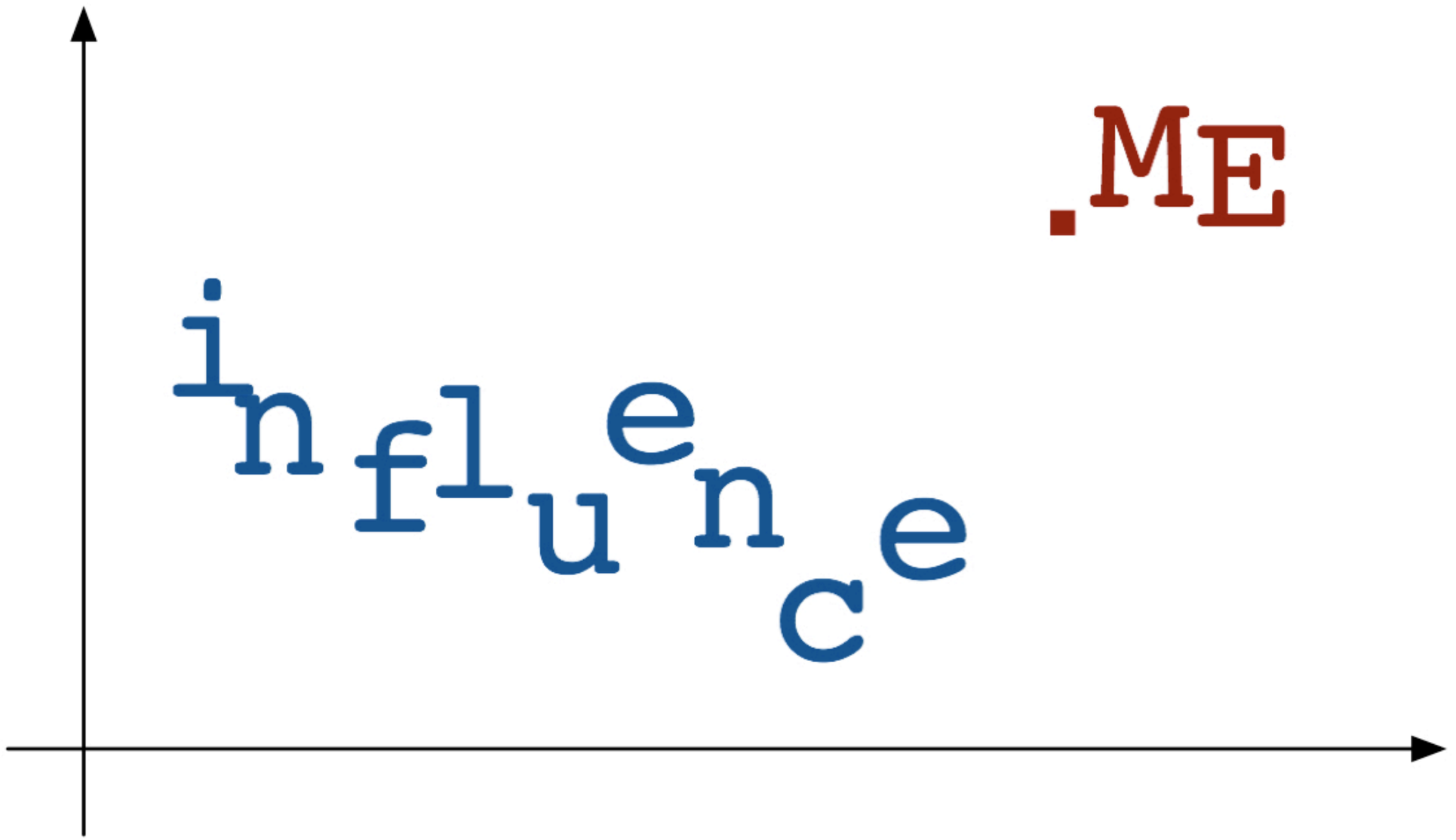
- Development continues in Rennes ...
  - Partial residual plots



http://www.rensenieuwenhuis.nl/r-project/influenceme/

Discussion on Influential Data in Sociology

- **Original Article:**
- **Ruiter**, Stijn and **De Graaf**, Nan Dirk. 2006. National context, religiosity, and volunteering: results from 53 countries. American Sociological Review 71: 191-210.

- **Research Note:**
- **Meer**, T. van der, te **Grotenhuis**, M., and **Pelzer**, B. (2010). Influential cases in multilevel modeling. a methodological comment on Ruiter and de Graaf (asr, 2006). *American Sociological Review*, accepted for publication.

- **Response to Research Note:**
- **Ruiter**, Stijn and **De Graaf**, Nan Dirk. (2010). National Religious Context and Volunteering:More Rigorous Tests Supporting the Association. *American Sociological Review,* accepted for publication.

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- **Bates**, D., **Maechler**, M., and **Dai**, B. (2008). *lme4: Linear mixed-effects models using S4 classes.* R package version 0.999375-28.
- **Belsley**, D. A., **Kuh**, E., and **Welsch**, R. E. (1980). *Regression Diagnostics. Identifying Influential Data and Sources of Collinearity*. Wiley.
- **Cook**, R. D. (1977). Detection of influential observation in linear regression. *Technometrics*, 19(1):15–18.
- **Kreft**, I. and **De Leeuw**, J. (1998). *Introducing Multilevel Modelling*. Sage Publications.
- **Langford**, I. H. and **Lewis**, T. (1998). Outliers in multilevel data. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 161:121–160.
- **Nieuwenhuis**, R., **Pelzer**, B., and **Te Grotenhuis**, M. (2009). *influence.ME: Tools for detecting influential data in mixed models*. R package version 0.7.
- **Meer**, T. van der, te **Grotenhuis**, M., and **Pelzer**, B. (2010). Influential cases in multilevel modeling. a methodological comment on ruiter and de graaf (asr, 2006). *American Sociological Review*, accepted for publication.
- **Snijders**, T. A. and **Berkhof**, J. (2008). Diagnostic checks for multilevel models. In De Leeuw, J. and Meijer, E., editors, *Handbook of Multilevel Analysis*, chapter 3, pages 141–175. Springer.

Formulae

DFBETAS: (Belsley et al., 1980)

$$dfbetas_{ij} = \frac{\hat{\gamma}_i - \gamma_{i(\hat{-j})}}{se(\gamma_{i(\hat{-j})})}$$

Cutoff: $2/\sqrt{n}$

Cook's distance: (Snijders & Berkhof, 2008)

$$\mathrm{C}_j^{0F} = \frac{1}{r+1}(\hat{\gamma} - \gamma_{(\hat{-j})})' \hat{\sum}_F^{-1} (\hat{\gamma} - \hat{\gamma}_{(-j)})$$

Cutoff: $\frac{4}{n}$