In Module 11, we will review calculating R-squared in multilevel models.

About the data:

The data are publically available as part of the r2mlm package on CRAN, Shaw, M., Rights, J.D., Sterba, S.K., & Flake, J.K. (2020, October 16). r2mlm: R-Squared Measures for Multilevel Models. 10.31234/osf.io/xc4sv. The R-squared framework is detailed in Rights, J. D., & Sterba, S. K. (2019). Quantifying explained variance in multilevel models: An integrative framework for defining R-squared measures. Psychological Methods, 24(3), 309–338.

For this data demo the question of interest is how teacher job satisfaction is related to salary and student-teacher ratio. Teachers are nested within schools. Salary is school-mean-centered (salary\_c), and student-teacher ratio is the number of students per teacher (higher = more students per teacher, larger classes).

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| --- | --- | --- | --- | --- |
| Variable | Mean | SD | Min | Max |
| schoolID | 150.50 | 86.61 | 1.00 | 300.00 |
| teacherID | 15.50 | 8.66 | 1.00 | 30.00 |
| satisfaction | 6.00 | 1.49 | 1.00 | 10.00 |
| control\_c | 0.00 | 1.58 | -3.68 | 3.48 |
| salary\_c | 0.00 | 8.66 | -23.04 | 23.59 |
| control\_m | 5.06 | 1.09 | 3.02 | 6.99 |
| salary\_m | 71.62 | 11.95 | 50.13 | 99.28 |
| s\_t\_ratio | 32.00 | 10.42 | 15.00 | 50.00 |

1. Load the data and packages we will use in this data demo: dplyr, lme4, lmerTest, r2mlm, and performance.
2. Run the null model with satisfaction as the outcome, school as the clustering variable, and REML as the estimator.
3. Calculate the ICC and interpret it.
4. Use r2mlm to calculate R-squared values for the null model.
5. Compare the r2mlm output with the ICC.
6. Write out the equation for the L1 model with centered salary as a predictor of satisfaction (just the fixed effect, no random slope). Run the model.
7. Interpret the parameters and their significance. What do they represent?
8. Let’s calculate R-squared values. Run r2mlm for the L1 model and interpret the output.
9. Calculate level-1 variance reduced and compare to r2mlm output.
10. Write out the equation for the L2 model with student-teacher ratio as a predictor of the intercept. Run the model.
11. Interpret the parameters and their significance.
12. Run r2mlm for the L2 model. Interpret the output.
13. Calculate level-2 variance reduced and compare to r2mlm output.
14. Compare variance explained by the L1 and L2 models using r2mlm\_comp() and the procedure in Table 1 of Rights & Sterba (2020).
15. The r2mlm function tries to extract information from your model and feed it to another function, r2mlm\_manual. Sometimes that process doesn’t work – your model doesn’t work with the code, or maybe you ran your model in another software. In those cases, you can input parameter information into r2mlm\_manual directly. Use the r2mlm\_manual function to reproduce the R-squared estimates for the l2 model from question 10.