*Problem statement*

Random intercept random slope model.

How many level 2 units (e.g. physicians) and level 1 units per level 2 unit (e.g. measurements) are needed to detect a statistical significant overall slope between outcome and explanatory variable .

Thus, for each level 2 unit there are the same number of paired measurements ) available

*Possible solution*

*Step 1*

The slope for physician has a standard error of

where is the number of pairs that is available for that physician, is the standard deviation of the and scores and is the explained variance of the regression line of that physician, i.e., is the correlation between and for that physician.

(<https://stats.stackexchange.com/questions/342632/how-to-understand-se-of-regression-slope-equation/342672>)

*Step 2*

These individual phyisicians’ slopes vary around with some standard deviation

. This reflects how ‘consistent’ the physicians are across each other.

The overall slope (fixed effect for in the random intercept/slope model) is the average of the physisicans’s slopes .

If we take equal , , , , this has a standard error of

From this a sample size calculation based on the precision of the slope can be calculated.

*Step 3*

Power calculation to detect a slope of with a power of at a two-sided significance level of

If the true slope is (not zero) then this slope is approximately normally distributed around with standard deviation . There is a power of at a two-sided significance level of to detect a slope of if:

|  |  |
| --- | --- |
|  |  |

i.e.,

This is also explained in:

<http://www.med.mcgill.ca/epidemiology/hanley/Reprints/SampleSizeWeichenthalBaumgartnerHanley.pdf>