- **Overall regression vs. individual regressions.** Yes, I agree – the individual regression lines will not average out to the overall regression line if the data aren't balanced. Didn't think about that during our last meeting or the one before. I am surprised that the AUCs average out—they shouldn't, in general, since the coefficients don't average out (and for a simple linear model we can write the AUC as a function of the coefficients and min/max x values).

  I think the individuals with relatively steep negative slopes driving the average down is a feature of this estimate, not a bug. This sort of "unpooled" estimate is more affected by individual variance, because the lowest points for the restricted range individuals have more leverage. They would not be very influential in the global linear regression, but they are extremely influential in the individual regressions, driving down those slopes, which in turn drives down the average. But I'm curious to hear what Andreas thinks about this, maybe I am wrong again.

- **There is actual heterogeneity in the estimates, so maybe this shouldn't surprise us.** It's also possible for an individual with a restricted range to have a shallower slope, more in line with the global average regression line. But we see in the data we have that they do not. I'd assume that those people (pretending that no one repeated for ease of language) are from a year where the panel was really different for some reason. Is there some confounding factor that accounts for these people having much steeper slopes?? Or does everyone have the same dip around distance of 30 that just gets covered up by the fact that we're using a straight line for a model?

- **Calculating an interval that summarizes uncertainty in the individual regression lines.** Here's a sublist with some ways for doing something like this. I don't really like the plot in the second email from Saturday because what's normally shown as the confidence band around a regression model is the CI for the (conditional) mean of y, not just a combination of the slope and intercept CIs.

  - I think we could work through the formula (for the regular t-based CI) using means and means of means, but it's not immediately obvious to me whether it still "works" as an interval.
  - Construct a quantile-based interval by getting the (interpolated) predictions for each individual and taking the mean and quantiles at each (interpolation) point. It seems intuitively very bad to extrapolate the line beyond the observed range of data for each individual to me, and if we do not do that, we will end up with an interval where the sample size changes partway through. That isn't wrong, it's just sort of weird to think about and maybe hard to explain what we did to a non-technical audience. If you go to compute all those things for the quantile interval, it might be helpful to use `lme4::lmList()` to fit all of those models since it has a `predict` method for the output. This is a non-standard approach but I don't think it is wrong.
  - Use a multivariate meta-analytic method to construct an overall estimate, where the most precise estimates are given the most weight. This is basically a harder way to do partial pooling.
  - Estimate clustered sandwich SEs from the population regression model and use those to compute a CI.

- **Partial pooling.** Marginalizing to get an "overall" estimator from this type of "unpooled" estimate is something our group seems to encounter regularly without having a definitive answer for how to deal with. But maybe this isn't even something that makes sense to do? Maybe what we actually want here is the partially pooled regression line with its associated error, e.g. `lme4::lmer(titer ~ 1 + (1 | id) + distance)`? This estimate will in a sense be a compromise between the globally pooled estimate (overall regression line) and the unpooled estimate (average of individual regression lines). This also has the potential advantage of being able to say "the variance is from the linear regression." which non-technical reviewers may prefer.