welcome back!

PSYC 5143
"Advanced Descriptive Statistics"
Spring 2024
January 17, 2024

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plus ça change, plus c'est la même chose

- the class will proceed more or less the same as last semester
- one substantive change
  - there is a published book from which you can do readings if you'd like (it's the same as the recommended book from last semester)
- drills meet on Thursdays at 940 & 1100, in Memorial Hall 314
  - these start next week

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getting ready for polynomial/power predictors ("nonlinear" regression)

January 17, 2024

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reminders about interactions/ moderation

- the presence of an interaction in a model is a theoretical claim that the slope of a predictor varies as a function of the value of another predictor
- to test this claim, we include a parameter that allows this slope to vary

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a non-moderated model

$$Y = b_0 + b_1*X + b_2*Z$$

- both b_1 and b_2 have values that are the same regardless of the values of X and Z
- these slopes are constant
- the slopes have one (constant) value, a main or general effect

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a moderated model: adding a parameter to allow slopes to vary

$$Y = b_0 + b_1*X + (b_2 + b_3*X)*Z$$

- in this equation, b_1 is the slope of X and $(b_2 + b_3*X)$ is the slope of Z
- if we distribute Z over its slope, we can see why we use a product term as a new predictor in a moderated model

$$Y = b_0 + b_1*X + b_2*Z + b_3*X*Z$$

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a concrete example: non-moderated

- from Exam 2 last semester
- do TV watching and 'ability' predict achievement?
- summary (based on *M*-centered predictors)

```
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 50.09600    0.27978 179.052  < 2e-16 ***
tv.c        -0.51000    0.16216  -3.145  0.00176 **
ability.c    0.61800    0.03003  20.582  < 2e-16 ***
```

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a concrete example: moderated

- from Exam 2 last semester
- does TV watching predict achievement differently for different levels of ability?
- summary (based on *M*-centered predictors)

```
               Estimate Std. Error t value Pr(>|t|)
(Intercept)    49.75889    0.27137 183.364  < 2e-16 ***
tv.c           -0.35629    0.15634  -2.279   0.0231 *
ability.c       0.60896    0.02869  21.223  < 2e-16 ***
tv.c:ability.c -0.11548    0.01644  -7.026 7.06e-12 ***
```

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interpretation of slopes changes when there is an interaction!

- slopes for predictors are no longer "main" or general effects
- they are only about a single specific value (zero!) of the other variable
- this is why the "pick-a-point" method of probing an interaction involves centering predictors at a bunch of values → changes the meaning of 0
- the change in the interpretation of a slope when its predictor is involved in an interaction is not well-understood by many (not just some students, but researchers in general!)

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probing the TV × ability interaction

- center ability at its M and at M ± 1SD
- the slope of TV for low ability (M – 1SD) is 0.74
- the slope of TV for average ability (M) is -0.36
- the slope of TV for high ability (M + 1SD) is -1.45
- the slope of TV is not one thing anymore; it varies depending on the level of ability

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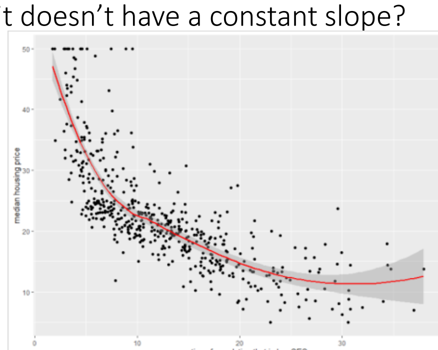
what if there's only one predictor but it doesn't have a constant slope?



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some terminology

- why is linear regression called *linear*?
- because the relationship between each predictor and the outcome is linear

$$Y = b_0 + b_1X$$

- as X increases, Y increases linearly
- the phrase often seen is that the model is "linear in the parameters"

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some terminology

- how can a nonlinear relationship be handled by a linear model?
- when a predictor is transformed (e.g., by squaring), the relationship between the transformed predictor and the outcome is linear

$$Y = b_0 + b_1X + b_2X^2$$

- as X^2 increases, Y increases linearly

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how does this new parameter work?

- the idea is that the slope of X changes as the value of X changes
- so we can take our two-parameter model

$$Y = b_0 + b_1X$$

- and alter it so the slope of X depends on X's value

$$Y = b_0 + (b_1 + b_2X)X$$
$$Y = b_0 + b_1X + b_2X^2$$

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slope interpretation

- what is the slope of X when $X = 0$?

$$Y = b_0 + b_1X + b_2X^2$$
$$Y = b_0 + (b_1 + b_2X)X$$

- it's b_1, **but only when $X = 0$**; this is the same kind of interpretation restriction the emerged with interactions
- slopes are (again) no longer main effects; they are simple/point slopes, interepretable at only a single value (of X, in this case)

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summary

- to model a non-constant slope, we will add a parameter to allow the slope to vary
- that parameter will be the slope of a power (X raised to some power)
- we'll talk next week about how to approach these models

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