# Growth Curve Models

Growth Models - Agenda

- Individual growth curve models
  - Fixed and Random Effects
  - R Markdown Demo

- Dyadic growth curve models
  - Fixed and Random Effects
  - R Markdown Demo

Individual Growth Models

- Used to examine linear and nonlinear changes in the outcome variable over time.
- Time is the key predictor variable in growth models.
  - For every one unit increase in time, what is the increase (decrease) in the outcome?
- For growth modeling to make sense, the outcome MUST CHANGE over time
- Need enough time-points to model change

Basic Growth Curve Model
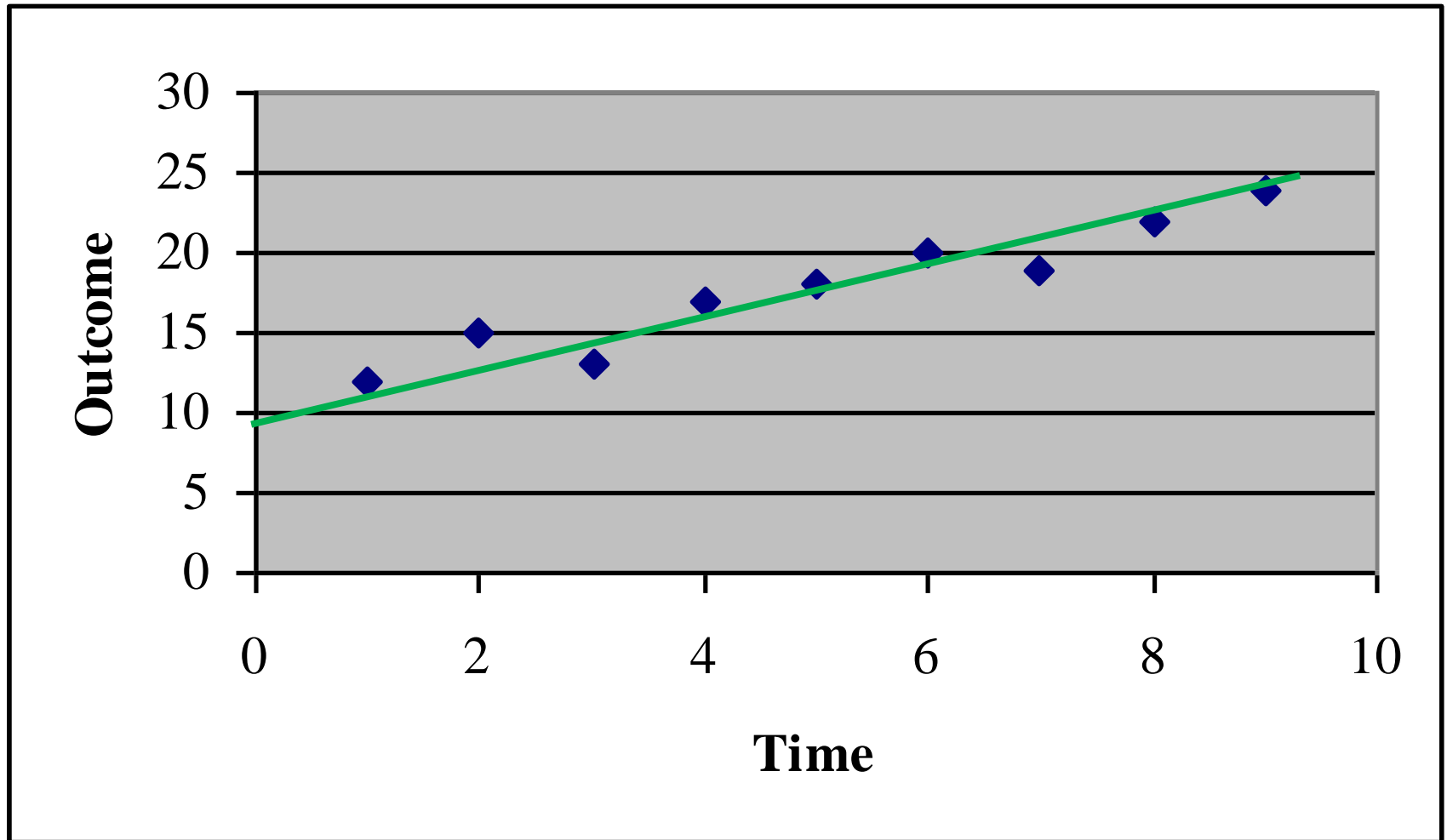
MLM & Individual Growth Models

- Recall that with over time data, there are repeated observations for each person.

- Data have hierarchical structure: Repeated observations (i.e., time points) are nested within individuals:

  - Upper-level unit: Person
  - Lower-level unit: Occasion

- Let's begin with data from only one person in the dyad (the men)

Defining Time Zero for Growth Models

- The intercept refers to the predicted score when time equals zero.

- Thus, the scaling of time affects the intercept's meaning.

Defining Time Zero for Growth Models

- Some common options for modeling the intercept
  - Initial measurement (the usual option)
  - Study midpoint
    - In the Kashy data set, 7.5 is subtracted off of each time since there are 14 time points
  - Time of intervention
  - Study endpoint

Defining Time Zero for Growth Models

- Time might be uniquely scaled for the dyad
  - Age of first child
  - Time since married
  - Time since diagnosed
  - Time before breakup

Choice of Time Zero

- If time is rescaled (meaning of zero changes) these values change:
  - Average intercept value
  - Variance of intercepts
  - Covariance between intercepts and slopes

- Does not affect other fixed or random effects.

Example: Men's satisfaction over time

- Using only men in the Kashy data set
- Research Questions:
  1. How satisfied are men at the study midpoint?
  2. Does men's satisfaction change across the 14-days of the study?
  3. Do men differ in their satisfaction at the study midpoint?
  4. Do men's satisfaction trajectories differ from one another?
  5. Do men who have higher satisfaction scores at the study midpoint change more rapidly (or slowly) than those with lower satisfaction scores at midpoint?

Men's satisfaction over time: Fixed Effects

Satisfaction = intercept + slope(time) + error

- Intercept interpretation: Predicted Satisfaction score at the study midpoint (when time = 0)

- Slope interpretation: Predicted change in satisfaction as time increases by 1 day
  - If the main effect of time is positive, then satisfaction is increasing over time and if it is negative, then satisfaction is decreasing.
- Error = the part of satisfaction that is not predicted by time.

Men's satisfaction over time: Random Effects

- Variance (sd) of the intercepts
  - How much men vary in satisfaction at study midpoint
- Variance (sd) of the slopes
  - How much men vary in their rate of linear change in satisfaction
- Correlation between the intercept and slope
  - The relationship between satisfaction level at the study midpoint and the rate of linear change in satisfaction

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Dyadic Growth Curve Modeling: Two Growth Curves

$$Y_{Wti} = c_{Wi} + b_{Wi}T_{ti} + e_{Wti}$$
$$Y_{Mti} = c_{Mi} + b_{Mi}T_{ti} + e_{Mti}$$

- Intercepts
  - c_{Wi} = Predicted value of women's satisfaction at study midpoint for dyad i
  - c_{Mi} = Predicted value of men's satisfaction at study midpoint for dyad i
- Slopes
  - b_{Wi} = Average change in women's satisfaction over time for dyad i
  - b_{Mi} = Average change in men's satisfaction over time for dyad i
- Errors at each time point
  - Women = e_{Wti}
  - Men = e_{Mti}

Random Effects: Variances

- There are six variances
  - two intercepts
    - Do men differ from each other in their "time zero" predicted score? Do women differ from each other…
  - two slopes for time
    - Do the slopes for men differ? Do the slopes for women diff?
  - two error (distance from the line) variances
    - Error variances (deviations from the slope) for men and women

Random Effects: Within-person Correlations

- Man intercept-slope correlation
  - If a man is highly satisfied at the study midpoint, is his change in satisfaction steeper?

- Woman intercept-slope correlation
  - If a woman is highly satisfied at the study midpoint, is her change in satisfaction steeper?

Random Effects: Between-person Correlations

- One correlation of the intercepts between partners
  - Overall, do women who have higher levels of satisfaction at the study midpoint tend to have male partners who are also higher in satisfaction at the study midpoint?
  - That is: Is there a correspondence between level of satisfaction?
- One correlation of the slopes
  - Do women who have steeper changes in satisfaction over time tend to have male partners who also have steeper changes?
  - That is: Is there a correspondence between linear change in satisfaction?
- Two slope-intercept correlations
  - Do women with higher levels of satisfaction have male partners who increase or decrease?
  - Do men with higher levels of satisfaction have female partners who increase or decrease ?

Correlation of the Residuals

- If the man reports more satisfaction for a particular day than would be expected given the overall effect of time, does the woman also report more satisfaction for that day?

Attachment Avoidance as a Moderator

- Actor Effects
  - Does Person A's avoidance moderate:
    - Person A's satisfaction at time 0 (effect on the intercept)
    - Person A's change in satisfaction? (effect on the slope)
- Partner Effects
  - Does Person A's avoidance moderate:
    - Person B's satisfaction at time 0 (effect on the intercept)
    - Person B's change in satisfaction? (effect on the slope)

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