Understanding Group Effects Using the Co-Partner Design

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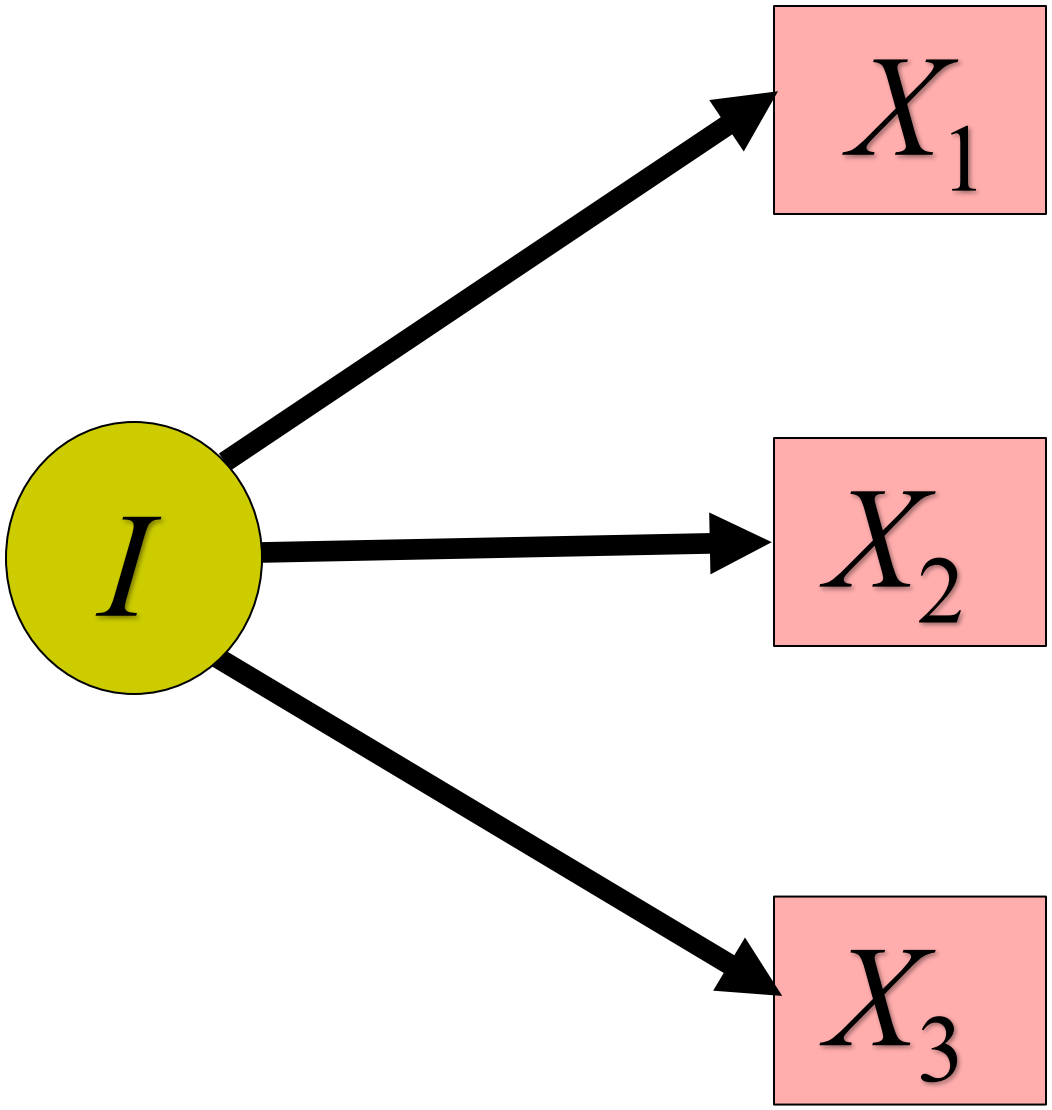
Overview

- Introduction
- Model Specification
- Design Examples
- Estimation
- Results
- Additional Issues

Group Effects: The Traditional Story

- A group effect is added to each group member's score
- Person *i* in group *j*: $Y_{ij} = m + I_j + e_{ij}$
- I_j is often called a *random intercept*.
- Analogous to the *common fate* effect in dyadic models.


X_1
I
X_2
X_3

Is that how group effects work? An alternative model: Partner Effects

- Imagine you are playing on golf team and you can add to your team one of two persons:

Alice

Ted

Alice

- Praises you when you make good shots and does not criticize you when play poorly.
- Plays quickly but does not rush you.
- Makes humorous comments and makes you laugh.

Ted

- Complains when you make a poor shot.
- Plays slow and is overly deliberate.
- Gets angry when he makes a bad shot.

How are you going to play?

- Perhaps you would play better with Alice and poorly with Ted.
- Perhaps how well you play depends on with whom you play: a partner effect.
- Partner effects as an alternative to the random intercept formulation of group effects.
- How can we model partner effects?

Model Specification

Model of Partner Effects

Three person group:

$$Y_{1j} = m + p_2 + p_3 + e_{1j}$$
$$Y_{2j} = m + p_1 + p_3 + e_{2j}$$
$$Y_{3j} = m + p_1 + p_2 + e_{3j}$$

Empirically, the partner effect model is indistinguishable from the random intercept model, unless …

Each Person in Multiple Groups

- That way you can see if people perform better when some people are in their group and worse if other people are in the group.
- Also in the model:
  - Actor effects: Some people perform better than others, regardless of whom is in their group.
  - Random intercepts

Co-Partner Model

$$X_{i(jk)m} = \mu + a_i + p_j + p_k + I_m + e_{i(jk)m}$$

μ: overall mean

a_i: actor effect

p_j and p_k: partner effects

I_m: random intercept

$e_{i(jk)m}$: error

Model Parameters

m: overall mean

σ_a^2: actor variance

σ_p^2: partner variance

σ_{ap}: actor-partner covariance

σ_I^2: group variance

σ_e^2: error variance

References for the Co-Partner Model

- Bond, C. F., Jr, & Kenny, D. A. (2002). The triangle of interpersonal models. *Journal of Personality & Social Psychology*, *83*, 355-366.
- Bond, C. F., Jr., & Cross, D. (2008). Beyond the dyad: Prospects for social development. In N. A. Card, J. P. Selig, & T. D. Little (Eds.), *Modeling dyadic and interdependent data in the developmental and behavioral sciences* (pp. 387–409). Routledge/Taylor & Francis Group,

Design Examples

Data Examples

- Problem Solving Groups
  - Hallmark (1991) Masters Thesis
  - 108 persons in 4 3-person groups
  - outcome: liking of others

- Golf Study
  - 45 golfers, 432 groups, over 58 days
  - 3- and 4-member teams
  - outcome: individual performance`

Multiple Group Designs: Balanced

- Rotation design used by Hallmark (1991)
- Group of size n; n^2 persons; each person in $n + 1$ groups
- Consider 9 persons: A,B,C,D,E,F,G,H,I

ABC	ADG	AEH	AFH
DEF	BEH	BFG	BDI
GHI	CFI	CDH	CEG

- Each person is in four groups and with each of the other eight persons.

Multiple Group Designs: Haphazard

- Ideally, each person is assigned to many groups
- Design used in Golf Study
  - 45 golfers
  - Teams with 3 or 4 members
  - The typical golfer was in 29 groups with 79 partners. Some were the same person, as there were 44 playing partners available.

Estimation

Estimation of the Partner Model: ANOVA with a Balanced Design

- Steps
  - Estimate actor, partner, group, and residual effects.
  - Compute their variance (mean squares) and the actor-partner covariance (mean cross-products).
  - Determine what the these quantities equal in terms of the models' parameters.
- Problematic with missing data and covariates

Estimation of the Partner Model: MLM with a Haphazard Design

- Adopts the strategy discussed in Snijders & Kenny (1999).
- Uses dummy variables {0,1} for actor and partner effects for each person.
- Constrains variance-covariance matrix of random effects (tau matrix).
- Requires SAS or MLwiN.

Covariance Matrix of Random Effects

a_1	s_a^2					
a_2	0	s_a^2				
a_3	0	0	s_a^2			
p_1	s_{ap}	0	0	s_p^2		
p_2	0	s_{ap}	0	0	s_p^2	
p_3	0	0	s_{ap}	0	0	s_p^2
	a_1	a_2	a_3	p_1	p_2	p_3

Files: Hallmark Study

- Data
  - davidakenny.net/doc/hallmark.sas7bdat
- SAS (MLM analysis)
  - davidakenny.net/doc/co_partner_SAS.pdf
- R (ANOVA analysis)
  - davidakenny.net/doc/co_partner_R.pdf

Results

Hallmark Study: Actor and Partner Effects

- Outcome: Sum of two measures across two partners
  - To what extent would you be willing to talk intimately with this person?
  - To what extent would you be willing to meet this person?
- Effects
  - Actor Effect: Does a person consistency like or dislike others in the group?
  - Partner Effect: Does having a particular person in the group lead to more or less liking of group members?
  - Group Effect: Do people in some groups get along better than people in other groups?

Hallmark Study: Liking of Others

Component	Percent Variance
Actor	51.6*
Partner	6.7*
Group	6.9*
Residual	34.8

Actor-Partner Correlation: .061 (ns)

Fixed effect of time: 0.11*

* $p < .05$

Golf Study: Actor and Partner Effects

- Outcome: Points earned: Stableford system
- Effects
  - Actor Effect: Does a golfer consistently play better or worse?
  - Partner Effect: Does playing with a particular golfer lead one to play better or worse?
  - Group Effects: Do some groups play better than others?
  - Day Effect: Do golfers play better on some days than others?

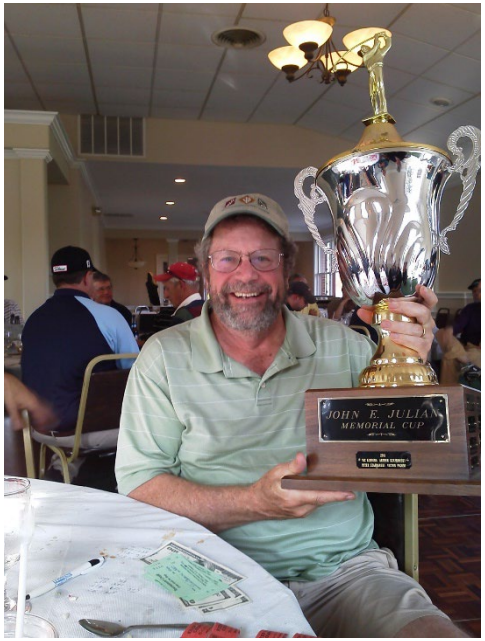
Golf Study: Points Earned

Component	Percent Variance
Actor	68.7*
Partner	0.1
Team	1.5*
Day	3.0*
Error	26.8

Actor-Partner Correlation: -.411 (ns)

* $p < .05$

Golfer DAK's Performance?



- Actor Effect: 16 out of 45
- Partner Effect: 38 out of 45

Additional Issues

Design Issues

- Distinguishable Members
  - Doctor, Nurse, Pharmacist
- Unequal Group Sizes: Effect of Partner
  - Sum
  - Average

Relation to the Social Relations Model

- For groups with two members, the model becomes the Social Relations Model.
  - The dyadic reciprocity in the Social Relations Model becomes the group effect in the Co-Partner Model.
- Can add dyadic terms to the model.
  - Dave plays better golf when Bruce is on his team, but others do not play better with Bruce.

Estimation Alternatives

- Partner effects could be estimated using "multiple membership" strategy; however, unable to estimate covariance of actor and partner effects.
- Possibility of using a strategy developed by Andrew Knight to use lmer in R to estimate the model.
- Bayesian Estimation

Thank You!

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