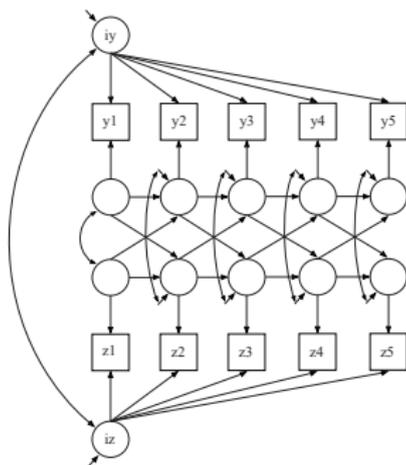
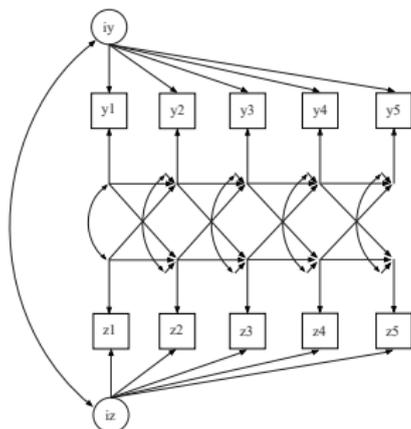


- Asparouhov & Muthén (2023). Residual Structural Equation Models. Structural Equation Modeling: A Multidisciplinary Journal - see Recent Papers on the Mplus home page
- \hat{Y} (Y-hat) representing the residual in regressions such as Y ON X or F BY Y
- Hats available only for single-level models (except with RDSEM)
- ML and WLSMV estimation using the Theta parameterization: Convenience feature
- Bayes estimation: Special algorithm (Bayes does not like variances fixed at zero)
- 3 application areas: Growth modeling, RI-CLPM, predicting from residuals

- Hamaker, Kuiper, Grasman (2015). A critique of the cross-lagged panel model. *Psychological Methods*
- Hamaker (2023). The within-between dispute in cross-lagged panel research and how to move forward. Forthcoming in *Psych Methods*



(a) Old approach using factors



(b) New approach using hats

Mplus Input for RI-CLPM: Old versus New

```
ANALYSIS: USEVARIABLES = y1-y5 z1-z5;  
          ESTIMATOR = ML;  
          MODEL = NOCOV;  
MODEL:    iy BY y1-y5@1;  
          iz BY z1-z5@1;  
          iy WITH iz;  
          ! Defining within factors:  
          fy1 BY y1;  
          fy2 BY y2;  
          fy3 BY y3;  
          fy4 BY y4;  
          fy5 BY y5;  
          fz1 BY z1;  
          fz2 BY z2;  
          fz3 BY z3;  
          fz4 BY z4;  
          fz5 BY z5;  
          y1-z5@0;  
          ! AR:  
          fy2-fy5 PON fy1-fy4;  
          fz2-fz5 PON fz1-fz4;  
          ! Cross-lags  
          fy2-fy5 PON fz1-fz4;  
          fz2-fz5 PON fy1-fy4;  
          Residual covariances:  
          fy1-fy5 PWITH fz1-fz5;
```

```
ANALYSIS: USEVARIABLES = y1-y5 z1-z5;  
          ESTIMATOR = ML;  
MODEL:    iy BY y1-y5@1;  
          iz BY z1-z5@1;  
          ! AR:  
          y2^-y5^ PON y1^-y4^;  
          z2^-z5^ PON z1^-z4^  
          ! Cross-lags  
          y2^-y5^ PON z1^-z4^;  
          z2^-z5^ PON y1^-y4^;  
          Residual covariances:  
          y1^-y5^ PWITH z1^-z5^;
```