Assignment 08

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I specified a multivariate latent growth model to examine the trajectories of insomnia severity and anxiety from baseline to post-test. More specifically, whether initial levels of anxiety were related to change in insomnia severity.

The model defined time-specific latent factors for insomnia and anxiety, each measured by seven items. The growth component for each construct was defined by an intercept factor (representing baseline levels, with loadings fixed at 1 for both time points on the respective latent factor) and a slope factor (representing the change from baseline to post-test, with loadings fixed at 0 for baseline and 1 for post-test). Given the ordered categorical nature of the items, I used the Diagonally Weighted Least Squares (DWLS) estimator.

The model demonstrated good overall fit to the data: (338) = 510.29, *p* < 0.001; CFI = 0.965; TLI = 0.961; RMSEA = 0.051 (90% CI [0.042, 0.060]); SRMR = 0.080. Addressing the primary research question, the covariance between baseline anxiety levels and the subsequent change in insomnia severity was not statistically significant ( = -0.006, SE = 0.015, *p* = 0.687). This suggests that initial anxiety levels did not predict the magnitude of change in insomnia severity from baseline to post-test in this sample.

library(lavaan)  
library(tidyr)  
library(dplyr)

dat <- read.csv("../data/clean\_data2.csv")  
  
mydata <- dplyr::filter(dat, redcap\_event\_name %in% c(  
 "elegibilidade\_arm\_1",   
 "desfechos\_arm\_1", "followup\_arm\_1")  
 ) |>   
 dplyr::mutate(  
 redcap\_event\_name = factor(dplyr::case\_when(  
 redcap\_event\_name == "elegibilidade\_arm\_1" ~ 1,  
 redcap\_event\_name == "desfechos\_arm\_1" ~ 2,  
 redcap\_event\_name == "followup\_arm\_1" ~ 3  
 ))) |>   
 dplyr::select(record\_id, redcap\_event\_name,  
 dplyr::starts\_with("igi"),  
 dplyr::starts\_with("ehad"))  
  
  
wide\_data <- mydata |>   
 tidyr::pivot\_wider(  
 id\_cols = "record\_id",  
 names\_from = "redcap\_event\_name",  
 names\_sep = ".",  
 values\_from = c(igi\_1a:ehad\_14)  
 )

## Multivariate Linear LGM  
  
MLlgm <- '  
insomnia\_severity1 =~ igi\_1a.1 + igi\_1b.1 + igi\_1c.1 + igi\_2.1 + igi\_3.1 + igi\_4.1 + igi\_5.1  
insomnia\_severity2 =~ igi\_1a.2 + igi\_1b.2 + igi\_1c.2 + igi\_2.2 + igi\_3.2 + igi\_4.2 + igi\_5.2  
  
anxiety1 =~ ehad\_1.1 + ehad\_3.1 + ehad\_5.1 + ehad\_7.1 + ehad\_9.1 + ehad\_11.1 + ehad\_13.1  
anxiety2 =~ ehad\_1.2 + ehad\_3.2 + ehad\_5.2 + ehad\_7.2 + ehad\_9.2 + ehad\_11.2 + ehad\_13.2  
  
#Level/Intercept (all constraint to 1)  
ItcI =~ 1\*insomnia\_severity1 + 1\*insomnia\_severity2   
ItcA =~ 1\*anxiety1 + 1\*anxiety2   
  
# Slope  
SlopeI =~ 0\*insomnia\_severity1 + 1\*insomnia\_severity2   
SlopeA =~ 0\*anxiety1 + 1\*anxiety2   
  
#Residuals (Equality constraints)  
insomnia\_severity1 ~~ In\*insomnia\_severity1  
insomnia\_severity2 ~~ In\*insomnia\_severity2  
  
  
anxiety1 ~~ An\*anxiety1  
anxiety2 ~~ An\*anxiety2  
  
  
#Intercept & slope means  
ItcI~1  
ItcA~1  
SlopeI~1  
SlopeA~1  
  
#Intercept & slope variances  
ItcI ~~ ItcI  
ItcI ~~ ItcA  
ItcI ~~ SlopeI  
ItcI ~~ SlopeA  
ItcA ~~ ItcA  
ItcA ~~ SlopeI  
ItcA ~~ SlopeA  
SlopeI ~~ SlopeI  
SlopeI ~~ SlopeA  
SlopeA ~~ SlopeA  
'  
  
#creating a new object 'MLlgm' & running a SEM model  
fit\_MLlgm <- lavaan(MLlgm, data=wide\_data, estimator = "DWLS",  
 auto.var=TRUE, auto.fix.first=TRUE, auto.cov.lv.x=TRUE,  
 meanstructure = TRUE, int.ov.free = TRUE)  
  
#getting summary of model estimates (fit & parameters)  
summary(fit\_MLlgm, fit.measures=TRUE)

## lavaan 0.6-19 ended normally after 62 iterations  
##   
## Estimator DWLS  
## Optimization method NLMINB  
## Number of model parameters 98  
## Number of equality constraints 2  
##   
## Used Total  
## Number of observations 199 227  
##   
## Model Test User Model:  
##   
## Test statistic 510.288  
## Degrees of freedom 338  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 5309.189  
## Degrees of freedom 378  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.965  
## Tucker-Lewis Index (TLI) 0.961  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.051  
## 90 Percent confidence interval - lower 0.042  
## 90 Percent confidence interval - upper 0.060  
## P-value H\_0: RMSEA <= 0.050 0.437  
## P-value H\_0: RMSEA >= 0.080 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.080  
##   
## Parameter Estimates:  
##   
## Standard errors Standard  
## Information Expected  
## Information saturated (h1) model Unstructured  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|)  
## insomnia\_severity1 =~   
## igi\_1a.1 1.000   
## igi\_1b.1 1.006 0.112 8.973 0.000  
## igi\_1c.1 0.589 0.093 6.316 0.000  
## igi\_2.1 0.666 0.075 8.846 0.000  
## igi\_3.1 1.188 0.126 9.398 0.000  
## igi\_4.1 1.280 0.141 9.089 0.000  
## igi\_5.1 1.082 0.118 9.162 0.000  
## insomnia\_severity2 =~   
## igi\_1a.2 1.000   
## igi\_1b.2 1.236 0.098 12.563 0.000  
## igi\_1c.2 1.040 0.090 11.572 0.000  
## igi\_2.2 1.231 0.097 12.710 0.000  
## igi\_3.2 1.283 0.100 12.818 0.000  
## igi\_4.2 1.065 0.087 12.262 0.000  
## igi\_5.2 1.606 0.121 13.264 0.000  
## anxiety1 =~   
## ehad\_1.1 1.000   
## ehad\_3.1 1.466 0.108 13.526 0.000  
## ehad\_5.1 0.914 0.073 12.453 0.000  
## ehad\_7.1 0.615 0.059 10.495 0.000  
## ehad\_9.1 1.054 0.087 12.089 0.000  
## ehad\_11.1 1.129 0.094 11.956 0.000  
## ehad\_13.1 0.940 0.077 12.275 0.000  
## anxiety2 =~   
## ehad\_1.2 1.000   
## ehad\_3.2 1.145 0.076 15.132 0.000  
## ehad\_5.2 1.211 0.077 15.773 0.000  
## ehad\_7.2 0.725 0.052 13.804 0.000  
## ehad\_9.2 0.956 0.064 15.006 0.000  
## ehad\_11.2 0.960 0.068 14.090 0.000  
## ehad\_13.2 0.685 0.049 13.867 0.000  
## ItcI =~   
## insomni\_svrty1 1.000   
## insomni\_svrty2 1.000   
## ItcA =~   
## anxiety1 1.000   
## anxiety2 1.000   
## SlopeI =~   
## insomni\_svrty1 0.000   
## insomni\_svrty2 1.000   
## SlopeA =~   
## anxiety1 0.000   
## anxiety2 1.000   
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|)  
## ItcI ~~   
## ItcA 0.106 0.013 8.205 0.000  
## SlopeI 0.036 0.024 1.550 0.121  
## SlopeA -0.014 0.013 -1.083 0.279  
## ItcA ~~   
## SlopeI -0.006 0.015 -0.403 0.687  
## SlopeA 0.041 0.014 2.972 0.003  
## SlopeI ~~   
## SlopeA 0.111 0.017 6.413 0.000  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|)  
## ItcI 0.000 0.021 0.000 1.000  
## ItcA 0.000 0.018 0.000 1.000  
## SlopeI 0.000 0.028 0.000 1.000  
## SlopeA 0.000 0.024 0.000 1.000  
## .igi\_1a.1 2.593 0.077 33.746 0.000  
## .igi\_1b.1 2.704 0.058 46.322 0.000  
## .igi\_1c.1 2.663 0.073 36.553 0.000  
## .igi\_2.1 3.553 0.046 76.852 0.000  
## .igi\_3.1 2.965 0.056 52.817 0.000  
## .igi\_4.1 1.879 0.066 28.284 0.000  
## .igi\_5.1 3.025 0.060 50.498 0.000  
## .igi\_1a.2 1.533 0.077 19.932 0.000  
## .igi\_1b.2 1.789 0.073 24.451 0.000  
## .igi\_1c.2 1.663 0.078 21.393 0.000  
## .igi\_2.2 2.362 0.073 32.438 0.000  
## .igi\_3.2 2.030 0.071 28.478 0.000  
## .igi\_4.2 1.236 0.071 17.302 0.000  
## .igi\_5.2 1.769 0.073 24.199 0.000  
## .ehad\_1.1 1.970 0.051 38.589 0.000  
## .ehad\_3.1 1.568 0.058 27.198 0.000  
## .ehad\_5.1 2.146 0.052 40.874 0.000  
## .ehad\_7.1 1.678 0.047 35.689 0.000  
## .ehad\_9.1 1.025 0.054 18.890 0.000  
## .ehad\_11.1 1.271 0.063 20.088 0.000  
## .ehad\_13.1 0.698 0.050 14.040 0.000  
## .ehad\_1.2 1.563 0.050 31.506 0.000  
## .ehad\_3.2 1.231 0.059 20.727 0.000  
## .ehad\_5.2 1.704 0.056 30.445 0.000  
## .ehad\_7.2 1.352 0.051 26.437 0.000  
## .ehad\_9.2 0.824 0.052 15.706 0.000  
## .ehad\_11.2 0.879 0.060 14.584 0.000  
## .ehad\_13.2 0.452 0.046 9.877 0.000  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|)  
## .insmn\_sv1 (In) 0.113 0.016 7.055 0.000  
## .insmn\_sv2 (In) 0.113 0.016 7.055 0.000  
## .anxiety1 (An) 0.055 0.009 6.314 0.000  
## .anxiety2 (An) 0.055 0.009 6.314 0.000  
## ItcI 0.140 0.032 4.431 0.000  
## ItcA 0.166 0.019 8.588 0.000  
## SlopeI 0.086 0.022 3.962 0.000  
## SlopeA 0.018 0.013 1.346 0.178  
## .igi\_1a.1 1.151 0.133 8.670 0.000  
## .igi\_1b.1 0.509 0.071 7.186 0.000  
## .igi\_1c.1 1.026 0.101 10.131 0.000  
## .igi\_2.1 0.318 0.096 3.307 0.001  
## .igi\_3.1 0.384 0.085 4.502 0.000  
## .igi\_4.1 0.753 0.118 6.386 0.000  
## .igi\_5.1 0.537 0.088 6.106 0.000  
## .igi\_1a.2 0.889 0.115 7.706 0.000  
## .igi\_1b.2 0.608 0.116 5.227 0.000  
## .igi\_1c.2 0.900 0.123 7.346 0.000  
## .igi\_2.2 0.597 0.109 5.497 0.000  
## .igi\_3.2 0.502 0.117 4.294 0.000  
## .igi\_4.2 0.653 0.103 6.357 0.000  
## .igi\_5.2 0.389 0.139 2.800 0.005  
## .ehad\_1.1 0.353 0.046 7.642 0.000  
## .ehad\_3.1 0.477 0.084 5.658 0.000  
## .ehad\_5.1 0.415 0.058 7.180 0.000  
## .ehad\_7.1 0.368 0.052 7.042 0.000  
## .ehad\_9.1 0.425 0.074 5.738 0.000  
## .ehad\_11.1 0.694 0.079 8.838 0.000  
## .ehad\_13.1 0.339 0.063 5.386 0.000  
## .ehad\_1.2 0.230 0.055 4.171 0.000  
## .ehad\_3.2 0.486 0.076 6.403 0.000  
## .ehad\_5.2 0.346 0.072 4.837 0.000  
## .ehad\_7.2 0.384 0.052 7.445 0.000  
## .ehad\_9.2 0.328 0.071 4.605 0.000  
## .ehad\_11.2 0.559 0.087 6.435 0.000  
## .ehad\_13.2 0.280 0.059 4.723 0.000

$$