HW3

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Homework

1. Run a series of models using a time-invariant nominal covariate.
2. where the time-invariant nominal covariate only predicts the intercept

Intercept= lmer(CONCON ~ Sex + Agecen+ (Agecen | ID), data = wide\_to\_long\_new)  
summary(Intercept)

## Linear mixed model fit by REML ['lmerMod']  
## Formula: CONCON ~ Sex + Agecen + (Agecen | ID)  
## Data: wide\_to\_long\_new  
##   
## REML criterion at convergence: -735.5  
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.40178 -0.61980 -0.03574 0.58213 3.06757   
##   
## Random effects:  
## Groups Name Variance Std.Dev. Corr  
## ID (Intercept) 0.0015372 0.03921   
## Agecen 0.0001936 0.01391 0.62  
## Residual 0.0051444 0.07172   
## Number of obs: 346, groups: ID, 136  
##   
## Fixed effects:  
## Estimate Std. Error t value  
## (Intercept) 0.265525 0.016357 16.233  
## Sex 0.021185 0.010512 2.015  
## Agecen 0.001950 0.004325 0.451  
##   
## Correlation of Fixed Effects:  
## (Intr) Sex   
## Sex -0.946   
## Agecen 0.158 -0.099

# A one unit change in sex (from girl(1) to boy (2)) is associated with 0.021185 increase in the intercept of CONCON connectivity. In other words, 0.021185 is the difference in intercept between boys and girls in connectivity.

1. time-invariant nominal covariate predicts both intercept and slope

Intercept\_slope= lmer(CONCON ~ Sex + Agecen + Sex\*Agecen +(Agecen | ID), data = wide\_to\_long\_new)  
summary(Intercept\_slope)

## Linear mixed model fit by REML ['lmerMod']  
## Formula: CONCON ~ Sex + Agecen + Sex \* Agecen + (Agecen | ID)  
## Data: wide\_to\_long\_new  
##   
## REML criterion at convergence: -727.9  
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.41611 -0.62544 -0.03518 0.58814 3.03904   
##   
## Random effects:  
## Groups Name Variance Std.Dev. Corr  
## ID (Intercept) 0.001547 0.03934   
## Agecen 0.000204 0.01428 0.62  
## Residual 0.005148 0.07175   
## Number of obs: 346, groups: ID, 136  
##   
## Fixed effects:  
## Estimate Std. Error t value  
## (Intercept) 0.264280 0.016829 15.704  
## Sex 0.021886 0.010754 2.035  
## Agecen -0.002250 0.013950 -0.161  
## Sex:Agecen 0.002730 0.008691 0.314  
##   
## Correlation of Fixed Effects:  
## (Intr) Sex Agecen  
## Sex -0.948   
## Agecen 0.264 -0.222   
## Sex:Agecen -0.227 0.202 -0.950

# A one unit change in centered age is associated with 0.002250 decrease in the slope/rate of CONCON connectivity and represents the difference in slopes. Residual variance does not change in any significant way.   
  
# 0.002730 is the indirect effect of sex on CONCON connectivity, as a function of centered age change.

1. is rescaled eg centering. For all models, how does your model change from model to model. What is your final model?

Sex\_centered= scale(wide\_to\_long\_new$Sex, center = TRUE, scale = FALSE)  
Intercept\_slope\_centered= lmer(CONCON ~ Sex\_centered + Agecen+ Sex\_centered\*Agecen + (Agecen | ID), data = wide\_to\_long\_new)  
summary(Intercept\_slope\_centered)

## Linear mixed model fit by REML ['lmerMod']  
## Formula:   
## CONCON ~ Sex\_centered + Agecen + Sex\_centered \* Agecen + (Agecen |   
## ID)  
## Data: wide\_to\_long\_new  
##   
## REML criterion at convergence: -727.9  
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.41611 -0.62544 -0.03518 0.58814 3.03904   
##   
## Random effects:  
## Groups Name Variance Std.Dev. Corr  
## ID (Intercept) 0.001547 0.03934   
## Agecen 0.000204 0.01428 0.62  
## Residual 0.005148 0.07175   
## Number of obs: 346, groups: ID, 136  
##   
## Fixed effects:  
## Estimate Std. Error t value  
## (Intercept) 0.296627 0.005374 55.19  
## Sex\_centered 0.021886 0.010754 2.04  
## Agecen 0.001784 0.004359 0.41  
## Sex\_centered:Agecen 0.002730 0.008691 0.31  
##   
## Correlation of Fixed Effects:  
## (Intr) Sx\_cnt Agecen  
## Sex\_centerd -0.010   
## Agecen 0.211 -0.114   
## Sx\_cntrd:Ag -0.115 0.202 -0.095

# centering sex did not change the intercept or the residual error . The above model (without centering of sex) is my final model.

1. Introduce a time-invariant continuous covariate and run models a-c from #1.
2. where the covariate (internalizing tendencies) only predicts the intercept

Intercept2= lmer(CONCON ~ INTERN + Agecen+ (Agecen | ID), data = wide\_to\_long\_new)  
summary(Intercept2)

## Linear mixed model fit by REML ['lmerMod']  
## Formula: CONCON ~ INTERN + Agecen + (Agecen | ID)  
## Data: wide\_to\_long\_new  
##   
## REML criterion at convergence: -651.2  
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.58820 -0.61862 -0.05835 0.55154 3.09947   
##   
## Random effects:  
## Groups Name Variance Std.Dev. Corr  
## ID (Intercept) 1.649e-03 0.040604   
## Agecen 3.518e-05 0.005931 1.00  
## Residual 5.334e-03 0.073032   
## Number of obs: 312, groups: ID, 134  
##   
## Fixed effects:  
## Estimate Std. Error t value  
## (Intercept) 0.304768 0.006853 44.47  
## INTERN -0.003780 0.002229 -1.70  
## Agecen 0.004326 0.004284 1.01  
##   
## Correlation of Fixed Effects:  
## (Intr) INTERN  
## INTERN -0.589   
## Agecen 0.163 -0.035

# A one unit change in interalizing tendencies is associated with 0.003780 decrease in the intercept of CONCON connectivity.

1. predicts both intercept and slope

Intercept\_slope2= lmer(CONCON ~ INTERN + Agecen + INTERN\*Agecen +(Agecen | ID), data = wide\_to\_long\_new)  
summary(Intercept\_slope2)

## Linear mixed model fit by REML ['lmerMod']  
## Formula: CONCON ~ INTERN + Agecen + INTERN \* Agecen + (Agecen | ID)  
## Data: wide\_to\_long\_new  
##   
## REML criterion at convergence: -640.5  
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.56664 -0.61971 -0.04977 0.54665 3.11747   
##   
## Random effects:  
## Groups Name Variance Std.Dev. Corr  
## ID (Intercept) 1.637e-03 0.040462   
## Agecen 4.097e-05 0.006401 1.00  
## Residual 5.356e-03 0.073182   
## Number of obs: 312, groups: ID, 134  
##   
## Fixed effects:  
## Estimate Std. Error t value  
## (Intercept) 0.3046223 0.0068647 44.38  
## INTERN -0.0037966 0.0022318 -1.70  
## Agecen 0.0023577 0.0055806 0.42  
## INTERN:Agecen 0.0008719 0.0016092 0.54  
##   
## Correlation of Fixed Effects:  
## (Intr) INTERN Agecen  
## INTERN -0.589   
## Agecen 0.156 -0.024   
## INTERN:Agcn -0.039 -0.003 -0.641

# A one unit change in centered age is associated with 0.0023577 increase in the slope/rate of CONCON connectivity. Residual variance increased sightly.   
# An interaction effect of internalizing tendencies and centered age is associated with a 0.0008719 slope increase of CONCON connectivity.

1. is rescaled eg centering.

Internalizing\_centered= scale(wide\_to\_long\_new$INTERN, center = TRUE, scale = FALSE)  
Intercept\_slope\_centered= lmer(CONCON ~ Internalizing\_centered + Agecen+ Internalizing\_centered\*Agecen + (Agecen | ID), data = wide\_to\_long\_new)  
summary(Intercept\_slope\_centered)

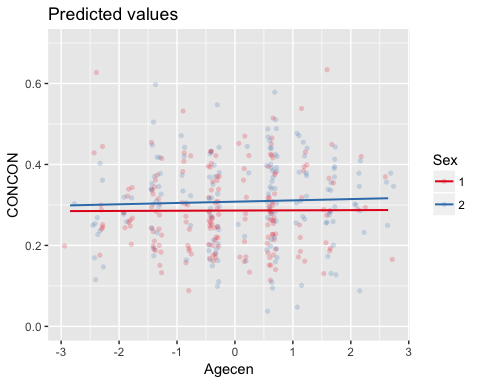
## Linear mixed model fit by REML ['lmerMod']  
## Formula:   
## CONCON ~ Internalizing\_centered + Agecen + Internalizing\_centered \*   
## Agecen + (Agecen | ID)  
## Data: wide\_to\_long\_new  
##   
## REML criterion at convergence: -640.5  
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.56664 -0.61971 -0.04977 0.54665 3.11747   
##   
## Random effects:  
## Groups Name Variance Std.Dev. Corr  
## ID (Intercept) 1.637e-03 0.040462   
## Agecen 4.097e-05 0.006401 1.00  
## Residual 5.356e-03 0.073182   
## Number of obs: 312, groups: ID, 134  
##   
## Fixed effects:  
## Estimate Std. Error t value  
## (Intercept) 0.2977549 0.0055484 53.67  
## Internalizing\_centered -0.0037966 0.0022318 -1.70  
## Agecen 0.0039348 0.0043337 0.91  
## Internalizing\_centered:Agecen 0.0008719 0.0016092 0.54  
##   
## Correlation of Fixed Effects:  
## (Intr) Intrn\_ Agecen  
## Intrnlzng\_c -0.001   
## Agecen 0.192 -0.033   
## Intrnlzn\_:A -0.050 -0.003 -0.154

# Centering internalizing tendencies did not make much of a difference in the starting value of CONCON connectivity; -0.003780 in the previous model to -0.0037966 in the current model. Will retain Intercept\_slope2 model for my final model

1. Graph both of your final models for the continuous and nominal models above.Calculate confidence intervals around your estimates for your final models

sjp.lmer(Intercept\_slope, type = "pred.fe", vars= c("Agecen", "Sex"), facet.grid = FALSE)

## Warning: package 'bindrcpp' was built under R version 3.2.5



#sjp.int(Intercept\_slope2, int.term="INTERN\*Agecen", type = "eff")

1. Calculate confidence intervals around your estimates for your final models

confint(Intercept\_slope, level = .95)

## for .sig02: falling back to linear interpolation

## 2.5 % 97.5 %  
## .sig01 0.020132124 0.04319061  
## .sig02 -1.000000000 1.00000000  
## .sig03 0.000000000 0.03020493  
## .sigma 0.065330692 0.07932792  
## (Intercept) 0.231200117 0.29809555  
## Sex 0.000358137 0.04298651  
## Agecen -0.029750039 0.02535692  
## Sex:Agecen -0.014634474 0.01986070

confint(Intercept\_slope2, level = .95)

## Warning in confint.thpr(pp, level = level, zeta = zeta): non-monotonic  
## profile for .sigma

## 2.5 % 97.5 %  
## .sig01 NA NA  
## .sig02 NA NA  
## .sig03 NA NA  
## .sigma NA NA  
## (Intercept) 0.291185103 0.3180210282  
## INTERN -0.008165103 0.0005645995  
## Agecen -0.008793120 0.0133902865  
## INTERN:Agecen -0.002295285 0.0040729241

1. Include both types of covariates (time invariant and time variant) in a single model. How does your interpretation of parameters change?

full\_model= lmer(CONCON ~ Sex + Agecen + INTERN + Sex\*Agecen\*INTERN + (Agecen | ID), data = wide\_to\_long\_new)  
summary(full\_model)

## Linear mixed model fit by REML ['lmerMod']  
## Formula:   
## CONCON ~ Sex + Agecen + INTERN + Sex \* Agecen \* INTERN + (Agecen |   
## ID)  
## Data: wide\_to\_long\_new  
##   
## REML criterion at convergence: -612.8  
##   
## Scaled residuals:   
## Min 1Q Median 3Q Max   
## -2.63917 -0.63334 -0.04663 0.54737 3.06733   
##   
## Random effects:  
## Groups Name Variance Std.Dev. Corr  
## ID (Intercept) 0.0013684 0.03699   
## Agecen 0.0001685 0.01298 0.59  
## Residual 0.0053741 0.07331   
## Number of obs: 312, groups: ID, 134  
##   
## Fixed effects:  
## Estimate Std. Error t value  
## (Intercept) 0.292627 0.021674 13.501  
## Sex 0.007439 0.013751 0.541  
## Agecen 0.008424 0.018396 0.458  
## INTERN -0.013038 0.006788 -1.921  
## Sex:Agecen -0.004588 0.011445 -0.401  
## Sex:INTERN 0.006940 0.004629 1.499  
## Agecen:INTERN -0.002331 0.005058 -0.461  
## Sex:Agecen:INTERN 0.002127 0.003299 0.645  
##   
## Correlation of Fixed Effects:  
## (Intr) Sex Agecen INTERN Sx:Agc S:INTE A:INTE  
## Sex -0.948   
## Agecen 0.239 -0.193   
## INTERN -0.596 0.580 -0.068   
## Sex:Agecen -0.196 0.161 -0.951 0.047   
## Sex:INTERN 0.540 -0.587 0.043 -0.943 -0.025   
## Agcn:INTERN -0.084 0.060 -0.632 0.031 0.614 -0.007   
## Sx:A:INTERN 0.058 -0.037 0.586 -0.007 -0.634 -0.019 -0.946

# Change in Agecen\*INTERN interaction is associated with a 0.002127 slope increase in CONCON connectivity across sex (females, males)