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#=====bayes=====
library(brms)
library(shinystan)
library(bayesplot)
library(tidybayes)
library(ggmcmc)

##=====modell1: disaster distress model=====
#pccopeR = parent communal coping (reverse coded); ppts = parent posttraumatic
stress symptoms;
#pcseR = parent coping self-efficacy (reverse coded); id = subject term;
#cccpeR = youth coping self-efficacy (reverse coded); cpts = youth posttraumatic
stress symptoms;
#ccseR = youth coping self-efficacy (reverse coded);

###parents
bfpcpe = bf(pccopeR ~ ppts + pcseR + (1 + ppts + pcseR|a|id))
bfpcse = bf(pcseR ~ ppts + (1 + ppts|b|id))

###children
bfccpe = bf(cccpeR ~ cpts + ccseR + (1 + cpts + ccseR|a|id))
bfccse = bf(ccseR ~ cpts + (1 + cpts|b|id))

###fit modell1
get_prior(bfpcpe + bfpcse + bfccpe + bfccse + set_rescor(F), data=data,
          family=hurdle_gamma(), control=list(adapt_delta=.9, max_treedepth=15))

priors = c(set_prior('normal(.21,.1)', class='b', coef='ccseR', resp='cccpeR'),
           set_prior('normal(.2,.2)', class='b', coef='cpts', resp='cccpeR'),
           set_prior('student_t(3,0,1)', class='Intercept', resp='cccpeR'),
           set_prior('student_t(3,0,1)', class='sd', resp='cccpeR'),
           set_prior('gamma(1,1)', class='shape', resp='cccpeR'),
           set_prior('normal(.36,.06)', class='b', coef='cpts', resp='ccseR'),
           set_prior('student_t(3,0,1)', class='Intercept', resp='ccseR'),
           set_prior('student_t(3,0,1)', class='sd', resp='ccseR'),
           set_prior('gamma(1,1)', class='shape', resp='ccseR'),
           set_prior('normal(.2,.2)', class='b', coef='ppts', resp='pccpeR'),
           set_prior('normal(.21,.1)', class='b', coef='pcseR', resp='pccpeR'),
           set_prior('student_t(3,0,1)', class='Intercept', resp='pccpeR'),
           set_prior('student_t(3,0,1)', class='sd', resp='pccpeR'),
           set_prior('gamma(1,1)', class='shape', resp='pccpeR'),
           set_prior('normal(.36,.06)', class='b', coef='ppts', resp='pcseR'),
           set_prior('student_t(3,0,1)', class='Intercept', resp='pcseR'),
           set_prior('student_t(3,0,1)', class='sd', resp='pcseR'),
           set_prior('gamma(1,1)', class='shape', resp='pcseR'))

mod1_1 = brm(bfpcpe + bfpcse + bfccpe + bfccse + set_rescor(F), data=data,
            iter=7500, chains=32, warmup=3750, seed=102, thin=4, autocor=NULL,
            normalize=T, cores=32, prior=priors, init=0, family=hurdle_gamma(),

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control=list(adapt_delta=.999, max_treedepth=15),
save_pars=save_pars(all=T))
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summary(mod1_1)
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plot(mod1_1)
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a = pp_check(mod1_1, resp='pccopeR', ndraws=500)
a + ggtitle('Parent Communal Coping') + xlim(0, 7.5)
b = pp_check(mod1_1, resp='cccpeR', ndraws=500)
b + ggtitle('Youth Communal Coping') + xlim(0, 7.5)
c = pp_check(mod1_1, resp='pcseR', ndraws=500)
c + ggtitle('Parent Coping Self-Efficacy') + xlim(0, 7.5)
d = pp_check(mod1_1, resp='ccseR', ndraws=500)
d + ggtitle('Youth Coping Self-Efficacy') + xlim(0, 7.5)
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##=====model2: communal coping model=====
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###parents
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bfpppts = bf(ppts ~ pccopeR + pcseR + (1 + pccopeR + pcseR|a|id))
bfpcse = bf(pcseR ~ pccopeR + (1 + pccopeR|b|id))
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###children
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```
bfccpts = bf(cpts ~ cccopeR + ccseR + (1 + cccopeR + ccseR|a|id))
bfccse = bf(ccseR ~ cccopeR + (1 + cccopeR|b|id))
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###fit model2
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get_prior(bfpppts + bfpcse + bfccpts + bfccse + set_rescor(F), data=data,
iter=1000, chains=4, warmup=250, cores=10, normalize=T, seed=103
control=list(adapt_delta=.9, max_treedepth=15))
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priors = c(set_prior('normal(.21,.1)', class='b', coef='cccpeR', resp='ccseR'),
set_prior('student_t(3,0,1)', class='Intercept', resp='ccseR'),
set_prior('student_t(3,0,1)', class='sd', resp='ccseR'),
set_prior('gamma(1,1)', class='shape', resp='ccseR'),
set_prior('normal(.2,.2)', class='b', coef='cccpeR', resp='cpts'),
set_prior('normal(.36,.06)', class='b', coef='ccseR', resp='cpts'),
set_prior('student_t(3,0,1)', class='Intercept', resp='cpts'),
set_prior('student_t(3,0,1)', class='sd', resp='cpts'),
set_prior('gamma(1,1)', class='shape', resp='cpts'),
set_prior('normal(.21,.1)', class='b', coef='pccopeR', resp='pcseR'),
set_prior('student_t(3,0,1)', class='Intercept', resp='pcseR'),
set_prior('student_t(3,0,1)', class='sd', resp='pcseR'),
set_prior('gamma(1,1)', class='shape', resp='pcseR'),
set_prior('normal(.36,.06)', class='b', coef='pcseR', resp='ppts'),
set_prior('normal(.2,.2)', class='b', coef='pccopeR', resp='ppts'),
set_prior('student_t(3,0,1)', class='Intercept', resp='ppts'),
set_prior('student_t(3,0,1)', class='sd', resp='ppts'),
set_prior('gamma(1,1)', class='shape', resp='ppts'))
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mod2_1 = brm(bfppts + bfpkse + bfcpts + bfccse + set_rescor(F), data=data,
            iter=7500, chains=32, warmup=3750, normalize=T, seed=103, cores=32,
            control=list(adapt_delta=.999, max_treedepth=15), prior=priors,
            init=0, family=hurdle_gamma(), autocor=NULL, thin=4,
            save_pars=save_pars(all=T))

summary(mod2_1)

plot(mod2_1)

e = pp_check(mod2_1, resp='ppts', ndraws=500)
e + ggtitle('Parent Posttraumatic Stress Symptoms') + xlim(0, 6)
f = pp_check(mod2_1, resp='cpts', ndraws=500)
f + ggtitle('Youth Posttraumatic Stress Symptoms') + xlim(0, 6)
g = pp_check(mod2_1, resp='pcseR', ndraws=500)
g + ggtitle('Parent Coping Self-Efficacy') + xlim(0, 7.5)
h = pp_check(mod2_1, resp='ccseR', ndraws=500)
h + ggtitle('Youth Coping Self-Efficacy') + xlim(0, 7.5)

##=====weakly informative priors: disaster distress model=====

###parents
bfpkope = bf(pckopeR ~ ppts + pcseR + (1 + ppts + pcseR|a|id))
bfpkse = bf(pckseR ~ ppts + (1 + ppts|b|id))

###children
bfckope = bf(ccckopeR ~ cpts + ccseR + Time_Dis + (1 + cpts + ccseR|a|id))
bfckse = bf(cckseR ~ cpts + (1 + cpts|b|id))

###fit
get_prior(bfpkope + bfpkse + bfckope + bfckse + set_rescor(F), data=data,
          family=hurdle_gamma(), iter=7500, chains=32, warmup=3750, seed=102,
          normalize=T, cores=32, prior=priors,
          control=list(adapt_delta=.999, max_treedepth=15))

priors = c(set_prior('student_t(3,0,1)', class='b', coef='ccseR', resp='ccckopeR'),
           set_prior('student_t(3,0,1)', class='b', coef='cpts', resp='ccckopeR'),
           set_prior('student_t(3,0,1)', class='Intercept', resp='ccckopeR'),
           set_prior('student_t(3,0,1)', class='sd', resp='ccckopeR'),
           set_prior('gamma(1,1)', class='shape', resp='ccckopeR'),
           set_prior('student_t(3,0,1)', class='b', coef='cpts', resp='ccseR'),
           set_prior('student_t(3,0,1)', class='Intercept', resp='ccseR'),
           set_prior('student_t(3,0,1)', class='sd', resp='ccseR'),
           set_prior('gamma(1,1)', class='shape', resp='ccseR'),
           set_prior('student_t(3,0,1)', class='b', coef='ppts', resp='pckopeR'),
           set_prior('student_t(3,0,1)', class='b', coef='pcseR', resp='pckopeR'),
           set_prior('student_t(3,0,1)', class='Intercept', resp='pckopeR'),
           set_prior('student_t(3,0,1)', class='sd', resp='pckopeR'),
           set_prior('gamma(1,1)', class='shape', resp='pckopeR'),
           set_prior('student_t(3,0,1)', class='b', coef='ppts', resp='pcseR'),
           set_prior('student_t(3,0,1)', class='Intercept', resp='pcseR'),

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set_prior('student_t(3,0,1)', class='sd', resp='pcseR'),
set_prior('gamma(1,1)', class='shape', resp='pcseR'))

mod1_2 = brm(bfpccope + bfpcse + bfcccope + bfccse + set_rescor(F), data=data,
family=hurdle_gamma(), iter=7500, chains=32, warmup=3750, seed=104,
normalize=T, cores=32, prior=priors, init=0,
control=list(adapt_delta=.999, max_treedepth=15), thin=4,
save_pars=save_pars(all=T))

summary(mod1_2)

plot(mod1_2)

a = pp_check(mod1_2, resp='pccopeR', ndraws=500)
a + ggtitle('Parent Communal Coping') + xlim(0, 7.5)
b = pp_check(mod1_2, resp='ccccopeR', ndraws=500)
b + ggtitle('Youth Communal Coping') + xlim(0, 7.5)
c = pp_check(mod1_2, resp='pcseR', ndraws=500)
c + ggtitle('Parent Coping Self-Efficacy') + xlim(0, 7.5)
d = pp_check(mod1_2, resp='ccseR', ndraws=500)
d + ggtitle('Youth Coping Self-Efficacy') + xlim(0, 7.5)

##=====model comparison=====
B_factor = brms::bayes_factor(mod1_1, mod2_1)

B_factor2 = brms::bayes_factor(mod1_1, mod1_2)

##=====test hypothesis=====
library(ggplot2)

h = c('pcseR_ppts*pccopeR_pcseR > 0.01', 'pcseR_ppts*pccopeR_pcseR > 0.0125',
'pcseR_ppts*pccopeR_pcseR > 0.015', 'pcseR_ppts*pccopeR_pcseR > 0.0175',
'pcseR_ppts*pccopeR_pcseR > 0.02', 'pcseR_ppts*pccopeR_pcseR > 0.0225',
'pcseR_ppts*pccopeR_pcseR > 0.025', 'pcseR_ppts*pccopeR_pcseR > 0.0275',
'pcseR_ppts*pccopeR_pcseR > 0.03', 'pcseR_ppts*pccopeR_pcseR > 0.0325',
'pcseR_ppts*pccopeR_pcseR > 0.035', 'pcseR_ppts*pccopeR_pcseR > 0.0375',
'pcseR_ppts*pccopeR_pcseR > 0.04', 'pcseR_ppts*pccopeR_pcseR > 0.0425',
'pcseR_ppts*pccopeR_pcseR > 0.045', 'pcseR_ppts*pccopeR_pcseR > 0.0475',
'pcseR_ppts*pccopeR_pcseR > 0.05', 'pcseR_ppts*pccopeR_pcseR > 0.0525')
h1 = hypothesis(mod1_1, h)
p_p = as.data.frame(h1$hypothesis$Post.Prob)
p_p$Beta = c(.010, .0125, .015, .0175, .020, .0225, .025, .0275, .030, .0325,
.035, .0375, .040, .0425, .045, .0475, .050, .0525)

ggplot(p_p, aes(y=h1$hypothesis$Post.Prob, x=Beta)) +
geom_line() +
labs(x='Beta Coefficient', y='Posterior Probability') +
ggtitle('Parents')

h = c('ccseR_cpts*ccccopeR_ccseR > 0.01', 'ccseR_cpts*ccccopeR_ccseR > 0.0125',

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'ccseR_cpts*cccoper_ccseR > 0.015', 'ccseR_cpts*cccoper_ccseR > 0.0175',
'ccseR_cpts*cccoper_ccseR > 0.02', 'ccseR_cpts*cccoper_ccseR > 0.0225',
'ccseR_cpts*cccoper_ccseR > 0.025', 'ccseR_cpts*cccoper_ccseR > 0.0275',
'ccseR_cpts*cccoper_ccseR > 0.03', 'ccseR_cpts*cccoper_ccseR > 0.0325',
'ccseR_cpts*cccoper_ccseR > 0.035', 'ccseR_cpts*cccoper_ccseR > 0.0375',
'ccseR_cpts*cccoper_ccseR > 0.04', 'ccseR_cpts*cccoper_ccseR > 0.0425',
'ccseR_cpts*cccoper_ccseR > 0.045', 'ccseR_cpts*cccoper_ccseR > 0.0475',
'ccseR_cpts*cccoper_ccseR > 0.05', 'ccseR_cpts*cccoper_ccseR > 0.0525',
'ccseR_cpts*cccoper_ccseR > 0.055', 'ccseR_cpts*cccoper_ccseR > 0.0575',
'ccseR_cpts*cccoper_ccseR > 0.06', 'ccseR_cpts*cccoper_ccseR > 0.0625',
'ccseR_cpts*cccoper_ccseR > 0.065', 'ccseR_cpts*cccoper_ccseR > 0.0675',
'ccseR_cpts*cccoper_ccseR > 0.07', 'ccseR_cpts*cccoper_ccseR > 0.0725')
h2 = hypothesis(mod1_1, h)
p_p = as.data.frame(h2$hypothesis$Post.Prob)
p_p$Beta = c(.010, .0125, .015, .0175, .020, .0225, .025, .0275, .030, .0325,
             .035, .0375, .040, .0425, .045, .0475, .050, .0525, .055, .0575,
             .060, .0625, .065, .0675, .070, .0725)

ggplot(p_p, aes(y=h2$hypothesis$Post.Prob, x=Beta)) +
  geom_line() +
  labs(x='Beta Coefficient', y='Posterior Probability') +
  ggtitle('Youths')

#=====bayes correlation=====
data <-
  data %>%
  mutate(ppts_s = scale(ppts),
         cpts_s = scale(cpts),
         pcse_s = scale(pcse),
         ccse_s = scale(ccse),
         pccope_s = scale(pccope),
         cccope_s = scale(cccope))

get_prior(bf(mvbind(ppts_s, cpts_s, pcse_s, ccse_s, pccope_s, cccope_s)~0,
               sigma~0) + set_rescor(T), data=data, chains=4, cores=4, seed=110,
          family=gaussian)

priors = set_prior('lkj(1)', class='rescor')

b_cor = brm(bf(mvbind(ppts_s, cpts_s, pcse_s, ccse_s, pccope_s, cccope_s)~0,
                  sigma~0) + set_rescor(T), data=data, chains=4, cores=4, seed=110,
            family=gaussian, prior=priors)

summary(b_cor)
plot(b_cor)
posterior_summary(b_cor)
mcmc_plot(b_cor, type='dens', fixed=T)

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