**swb1.R**

# Subjective Well Being Model (Model 1, enter sample covariance matrix, fixed factor loadings)

# set work directory

setwd("C:/Users/wchan/Google Drive/stat6108/data")

# load the lavaan package

library(lavaan)

# enter sample covariance matrix in lower triangular form

swb\_lower <-

"198

82 86

54 28 24

52 30 18 151

16 10 7 44 28"

# convert the matrix into a full covariance matrix

swb\_cov <- getCov(swb\_lower, lower=TRUE, names=c("gls1","gls2","gls3","work1","work2"))

# specify the CFA model

swb1 <- "

# measurement equations

GLS =~ 1\*gls1 + gls2 + gls3

WORK =~ 1\*work1 + work2

# factor variances

GLS ~~ GLS

WORK ~~ WORK

# factor covariances

GLS ~~ WORK

# error variances

gls1 ~~ gls1

gls2 ~~ gls2

gls3 ~~ gls3

work1 ~~ work1

work2 ~~ work2

"

# model fitting

fit1 <- lavaan(swb1, estimator="ML", sample.cov=swb\_cov, sample.nobs=500)

# save the output

sink("swb1.out", split=TRUE)

inspect(fit1)

summary(fit1)

sink()

**swb1.out**

$lambda

GLS WORK

gls1 0 0

gls2 1 0

gls3 2 0

work1 0 0

work2 0 3

$theta

gls1 gls2 gls3 work1 work2

gls1 7

gls2 0 8

gls3 0 0 9

work1 0 0 0 10

work2 0 0 0 0 11

$psi

GLS WORK

GLS 4

WORK 6 5

lavaan 0.6-5 ended normally after 115 iterations

Estimator ML

Optimization method NLMINB

Number of free parameters 11

Number of observations 500

Model Test User Model:

Test statistic 7.625

Degrees of freedom 4

P-value (Chi-square) 0.106

Parameter Estimates:

Information Expected

Information saturated (h1) model Structured

Standard errors Standard

Latent Variables:

Estimate Std.Err z-value P(>|z|)

GLS =~

gls1 1.000

gls2 0.522 0.030 17.543 0.000

gls3 0.344 0.016 21.825 0.000

WORK =~

work1 1.000

work2 0.344 0.044 7.760 0.000

Covariances:

Estimate Std.Err z-value P(>|z|)

GLS ~~

WORK 52.699 7.741 6.808 0.000

Variances:

Estimate Std.Err z-value P(>|z|)

GLS 156.585 13.319 11.756 0.000

WORK 127.488 18.169 7.017 0.000

.gls1 41.019 5.888 6.966 0.000

.gls2 43.206 3.120 13.846 0.000

.gls3 5.436 0.714 7.615 0.000

.work1 23.210 15.607 1.487 0.137

.work2 12.819 2.014 6.365 0.000

**swb2.R**

# Subjective Well Being Model (Model 2, import covariance matrix)

# set work directory

setwd("C:/Users/wchan/Google Drive/stat6108/data")

# load the lavaan package

library(lavaan)

# enter sample covariance matrix in lower triangular form

swb\_lower <- scan("swb.cov")

# convert the matrix into a full covariance matrix

swb\_cov <- getCov(swb\_lower, lower=TRUE, names=c("gls1","gls2","gls3","work1","work2"))

# specify the CFA model

swb2 <- "

# measurement equations

GLS =~ gls1 + gls2 + gls3

WORK =~ work1 + work2

# factor covariances

GLS ~~ WORK

"

# model fitting

fit2 <- lavaan(swb2, sample.cov=swb\_cov, sample.nobs=500, auto.var=TRUE, auto.fix.first=TRUE)

# save the output

sink("swb2.out", split=TRUE)

inspect(fit2)

summary(fit2, fit.measures=TRUE, standardized=TRUE, rsquare=TRUE)

sink()

**swb2.out**

$lambda

GLS WORK

gls1 0 0

gls2 1 0

gls3 2 0

work1 0 0

work2 0 3

$theta

gls1 gls2 gls3 work1 work2

gls1 5

gls2 0 6

gls3 0 0 7

work1 0 0 0 8

work2 0 0 0 0 9

$psi

GLS WORK

GLS 10

WORK 4 11

lavaan 0.6-5 ended normally after 115 iterations

Estimator ML

Optimization method NLMINB

Number of free parameters 11

Number of observations 500

Model Test User Model:

Test statistic 7.625

Degrees of freedom 4

P-value (Chi-square) 0.106

Model Test Baseline Model:

Test statistic 1131.493

Degrees of freedom 10

P-value 0.000

User Model versus Baseline Model:

Comparative Fit Index (CFI) 0.997

Tucker-Lewis Index (TLI) 0.992

Loglikelihood and Information Criteria:

Loglikelihood user model (H0) -8300.448

Loglikelihood unrestricted model (H1) -8296.635

Akaike (AIC) 16622.895

Bayesian (BIC) 16669.256

Sample-size adjusted Bayesian (BIC) 16634.341

Root Mean Square Error of Approximation:

RMSEA 0.043

90 Percent confidence interval - lower 0.000

90 Percent confidence interval - upper 0.088

P-value RMSEA <= 0.05 0.537

Standardized Root Mean Square Residual:

SRMR 0.012

Parameter Estimates:

Information Expected

Information saturated (h1) model Structured

Standard errors Standard

Latent Variables:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

GLS =~

gls1 1.000 12.513 0.890

gls2 0.522 0.030 17.543 0.000 6.529 0.705

gls3 0.344 0.016 21.825 0.000 4.303 0.879

WORK =~

work1 1.000 11.291 0.920

work2 0.344 0.044 7.760 0.000 3.889 0.736

Covariances:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

GLS ~~

WORK 52.699 7.741 6.808 0.000 0.373 0.373

Variances:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

.gls1 41.019 5.888 6.966 0.000 41.019 0.208

.gls2 43.206 3.120 13.846 0.000 43.206 0.503

.gls3 5.436 0.714 7.615 0.000 5.436 0.227

.work1 23.210 15.607 1.487 0.137 23.210 0.154

.work2 12.819 2.014 6.365 0.000 12.819 0.459

GLS 156.585 13.319 11.756 0.000 1.000 1.000

WORK 127.488 18.169 7.017 0.000 1.000 1.000

R-Square:

Estimate

gls1 0.792

gls2 0.497

gls3 0.773

work1 0.846

work2 0.541

**swb3.R**

# Subjective Well Being Model (Model 3, fixed factor variance)

# set work directory

setwd("C:/Users/wchan/Google Drive/stat6108/data")

# load the lavaan package

library(lavaan)

# enter sample covariance matrix in lower triangular form

swb\_lower <- scan("swb.cov")

# convert the matrix into a full covariance matrix

swb\_cov <- getCov(swb\_lower, lower=TRUE, names=c("gls1","gls2","gls3","work1","work2"))

# specify the CFA model

swb3 <- "

# measurement equations

GLS =~ gls1 + gls2 + gls3

WORK =~ work1 + work2

# factor covariances

GLS ~~ WORK

"

# model fitting

fit3 <- lavaan(swb3, sample.cov=swb\_cov, sample.nobs=500, auto.var=TRUE, std.lv=TRUE)

mi <- modindices(fit3, sort.=TRUE)

# save the output

sink("swb3.out", split=TRUE)

inspect(fit3)

summary(fit3, fit.measures=TRUE, standardized=TRUE, rsquare=TRUE)

fitmeasures(fit3, c("gfi", "agfi", "nfi", "rfi", "nnfi", "ifi", "cfi", "srmr", "rmsea"))

mi

sink()

**swb3.out**

$lambda

GLS WORK

gls1 1 0

gls2 2 0

gls3 3 0

work1 0 4

work2 0 5

$theta

gls1 gls2 gls3 work1 work2

gls1 7

gls2 0 8

gls3 0 0 9

work1 0 0 0 10

work2 0 0 0 0 11

$psi

GLS WORK

GLS 0

WORK 6 0

lavaan 0.6-5 ended normally after 22 iterations

Estimator ML

Optimization method NLMINB

Number of free parameters 11

Number of observations 500

Model Test User Model:

Test statistic 7.625

Degrees of freedom 4

P-value (Chi-square) 0.106

Model Test Baseline Model:

Test statistic 1131.493

Degrees of freedom 10

P-value 0.000

User Model versus Baseline Model:

Comparative Fit Index (CFI) 0.997

Tucker-Lewis Index (TLI) 0.992

Loglikelihood and Information Criteria:

Loglikelihood user model (H0) -8300.448

Loglikelihood unrestricted model (H1) -8296.635

Akaike (AIC) 16622.895

Bayesian (BIC) 16669.256

Sample-size adjusted Bayesian (BIC) 16634.341

Root Mean Square Error of Approximation:

RMSEA 0.043

90 Percent confidence interval - lower 0.000

90 Percent confidence interval - upper 0.088

P-value RMSEA <= 0.05 0.537

Standardized Root Mean Square Residual:

SRMR 0.012

Parameter Estimates:

Information Expected

Information saturated (h1) model Structured

Standard errors Standard

Latent Variables:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

GLS =~

gls1 12.513 0.532 23.513 0.000 12.513 0.890

gls2 6.529 0.377 17.304 0.000 6.529 0.705

gls3 4.303 0.186 23.109 0.000 4.303 0.879

WORK =~

work1 11.291 0.805 14.034 0.000 11.291 0.920

work2 3.889 0.311 12.492 0.000 3.889 0.736

Covariances:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

GLS ~~

WORK 0.373 0.047 7.930 0.000 0.373 0.373

Variances:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

.gls1 41.019 5.888 6.966 0.000 41.019 0.208

.gls2 43.206 3.120 13.846 0.000 43.206 0.503

.gls3 5.436 0.714 7.615 0.000 5.436 0.227

.work1 23.210 15.607 1.487 0.137 23.210 0.154

.work2 12.819 2.014 6.365 0.000 12.819 0.459

GLS 1.000 1.000 1.000

WORK 1.000 1.000 1.000

R-Square:

Estimate

gls1 0.792

gls2 0.497

gls3 0.773

work1 0.846

work2 0.541

gfi agfi nfi rfi nnfi ifi cfi srmr rmsea

0.994 0.977 0.993 0.983 0.992 0.997 0.997 0.012 0.043

lhs op rhs mi epc sepc.lv sepc.all sepc.nox

27 gls3 ~~ work2 6.506 1.353 1.353 0.162 0.162

22 gls1 ~~ work2 5.792 -3.668 -3.668 -0.160 -0.160

26 gls3 ~~ work1 3.292 -2.230 -2.230 -0.199 -0.199

21 gls1 ~~ work1 1.760 4.689 4.689 0.152 0.152

16 WORK =~ gls1 0.633 -0.387 -0.387 -0.028 -0.028

23 gls2 ~~ gls3 0.633 -2.003 -2.003 -0.131 -0.131

20 gls1 ~~ gls3 0.542 5.197 5.197 0.348 0.348

17 WORK =~ gls2 0.542 0.273 0.273 0.029 0.029

24 gls2 ~~ work1 0.495 1.952 1.952 0.062 0.062

18 WORK =~ gls3 0.087 0.050 0.050 0.010 0.010

19 gls1 ~~ gls2 0.087 2.185 2.185 0.052 0.052

25 gls2 ~~ work2 0.030 -0.211 -0.211 -0.009 -0.009

**swb4.R**

# Subjective Well Being Model (Model 4, Modified model with error covariance)

# set work directory

setwd("C:/Users/wchan/Google Drive/stat6108/data")

# load the lavaan package

library(lavaan)

# enter sample covariance matrix in lower triangular form

swb\_lower <- scan("swb.cov")

# convert the matrix into a full covariance matrix

swb\_cov <- getCov(swb\_lower, lower=TRUE, names=c("gls1","gls2","gls3","work1","work2"))

# specify the CFA model

swb4 <- "

# measurement equations

GLS =~ gls1 + gls2 + gls3

WORK =~ work1 + work2

# factor covariances

GLS ~~ WORK

# error covariances

gls3 ~~ work2

"

# model fitting

fit4 <- lavaan(swb4, sample.cov=swb\_cov, sample.nobs=500, auto.var=TRUE, std.lv=TRUE)

mi <- modindices(fit4, sort.=TRUE)

# save the output

sink("swb4.out", split=TRUE)

inspect(fit4)

summary(fit4, fit.measures=TRUE, standardized=TRUE, rsquare=TRUE)

mi

sink()

**swb4.out**

$lambda

GLS WORK

gls1 1 0

gls2 2 0

gls3 3 0

work1 0 4

work2 0 5

$theta

gls1 gls2 gls3 work1 work2

gls1 8

gls2 0 9

gls3 0 0 10

work1 0 0 0 11

work2 0 0 7 0 12

$psi

GLS WORK

GLS 0

WORK 6 0

lavaan 0.6-5 ended normally after 33 iterations

Estimator ML

Optimization method NLMINB

Number of free parameters 12

Number of observations 500

Model Test User Model:

Test statistic 1.071

Degrees of freedom 3

P-value (Chi-square) 0.784

Model Test Baseline Model:

Test statistic 1131.493

Degrees of freedom 10

P-value 0.000

User Model versus Baseline Model:

Comparative Fit Index (CFI) 1.000

Tucker-Lewis Index (TLI) 1.006

Loglikelihood and Information Criteria:

Loglikelihood user model (H0) -8297.171

Loglikelihood unrestricted model (H1) -8296.635

Akaike (AIC) 16618.341

Bayesian (BIC) 16668.917

Sample-size adjusted Bayesian (BIC) 16630.828

Root Mean Square Error of Approximation:

RMSEA 0.000

90 Percent confidence interval - lower 0.000

90 Percent confidence interval - upper 0.049

P-value RMSEA <= 0.05 0.953

Standardized Root Mean Square Residual:

SRMR 0.010

Parameter Estimates:

Information Expected

Information saturated (h1) model Structured

Standard errors Standard

Latent Variables:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

GLS =~

gls1 12.558 0.531 23.640 0.000 12.558 0.893

gls2 6.521 0.377 17.285 0.000 6.521 0.704

gls3 4.290 0.186 23.007 0.000 4.290 0.877

WORK =~

work1 11.842 0.909 13.025 0.000 11.842 0.965

work2 3.710 0.328 11.323 0.000 3.710 0.702

Covariances:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

GLS ~~

WORK 0.355 0.048 7.391 0.000 0.355 0.355

.gls3 ~~

.work2 1.356 0.534 2.539 0.011 1.356 0.153

Variances:

Estimate Std.Err z-value P(>|z|) Std.lv Std.all

.gls1 39.905 5.878 6.788 0.000 39.905 0.202

.gls2 43.310 3.122 13.875 0.000 43.310 0.505

.gls3 5.550 0.715 7.768 0.000 5.550 0.232

.work1 10.461 19.332 0.541 0.588 10.461 0.069

.work2 14.193 2.098 6.764 0.000 14.193 0.508

GLS 1.000 1.000 1.000

WORK 1.000 1.000 1.000

R-Square:

Estimate

gls1 0.798

gls2 0.495

gls3 0.768

work1 0.931

work2 0.492

lhs op rhs mi epc sepc.lv sepc.all sepc.nox

21 gls1 ~~ gls3 0.699 5.985 5.985 0.402 0.402

18 WORK =~ gls2 0.699 0.295 0.295 0.032 0.032

23 gls1 ~~ work2 0.442 -1.634 -1.634 -0.069 -0.069

26 gls2 ~~ work2 0.442 0.848 0.848 0.034 0.034

24 gls2 ~~ gls3 0.217 -1.176 -1.176 -0.076 -0.076

17 WORK =~ gls1 0.217 -0.215 -0.215 -0.015 -0.015

25 gls2 ~~ work1 0.035 0.534 0.534 0.025 0.025

19 WORK =~ gls3 0.011 -0.017 -0.017 -0.003 -0.003

27 gls3 ~~ work1 0.011 -0.174 -0.174 -0.023 -0.023

20 gls1 ~~ gls2 0.011 -0.789 -0.789 -0.019 -0.019

22 gls1 ~~ work1 0.003 -0.229 -0.229 -0.011 -0.011