Modelo de Medias Estructuradas (SMM)

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Tabla de contenidos

# 1. Carga de paquetes

library(tidyverse)

── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──  
✔ dplyr 1.1.4 ✔ readr 2.1.4  
✔ forcats 1.0.0 ✔ stringr 1.5.1  
✔ ggplot2 3.4.4 ✔ tibble 3.2.1  
✔ lubridate 1.9.3 ✔ tidyr 1.3.0  
✔ purrr 1.0.2   
── Conflicts ────────────────────────────────────────── tidyverse\_conflicts() ──  
✖ dplyr::filter() masks stats::filter()  
✖ dplyr::lag() masks stats::lag()  
ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors

library(lavaan)

This is lavaan 0.6-16  
lavaan is FREE software! Please report any bugs.

library(semTools)

###############################################################################  
This is semTools 0.5-6  
All users of R (or SEM) are invited to submit functions or ideas for functions.  
###############################################################################  
  
Attaching package: 'semTools'  
  
The following object is masked from 'package:readr':  
  
 clipboard

# 2. Importar datos

simData <- read\_csv("https://raw.githubusercontent.com/brianmsm/cap-medias-latentes/main/01\_data/processed/simData.csv")

Rows: 500 Columns: 16  
── Column specification ────────────────────────────────────────────────────────  
Delimiter: ","  
chr (1): Sexo  
dbl (15): y1, y2, y3, y4, y5, y6, y7, y8, y9, y10, y11, y12, y13, y14, y15  
  
ℹ Use `spec()` to retrieve the full column specification for this data.  
ℹ Specify the column types or set `show\_col\_types = FALSE` to quiet this message.

simData

# A tibble: 500 × 16  
 Sexo y1 y2 y3 y4 y5 y6 y7 y8 y9 y10 y11 y12  
 <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
 1 Mujer 3 4 3 3 3 3 3 3 3 3 3 3  
 2 Mujer 4 3 3 3 3 3 3 3 3 3 3 3  
 3 Mujer 2 2 2 3 2 3 2 2 2 2 2 2  
 4 Mujer 3 3 3 3 3 3 3 3 3 3 2 3  
 5 Mujer 5 3 3 3 3 3 3 3 4 3 3 3  
 6 Mujer 2 2 3 1 3 3 3 2 2 1 3 2  
 7 Mujer 3 3 3 3 3 3 3 3 3 3 3 2  
 8 Mujer 4 4 3 5 5 4 3 3 3 3 3 3  
 9 Mujer 3 3 3 3 4 3 3 3 3 3 3 4  
10 Mujer 3 3 3 3 3 2 3 2 3 3 4 4  
# ℹ 490 more rows  
# ℹ 3 more variables: y13 <dbl>, y14 <dbl>, y15 <dbl>

# 3. Establecer invarianza

model\_cfa <- "F1 =~ y1 + y2 + y3 + y4 + y5  
 F2 =~ y6 + y7 + y8 + y9 + y10  
 F3 =~ y11 + y12 + y13 + y14 + y15"

test.seq <- c("thresholds","loadings","intercepts", "residuals")  
name.test.seq <- c("thresholds", "metric", "scalar", "strict")  
inv <- list()  
for (i in 0:length(test.seq)) {  
 if (i == 0L) {  
 meq.label <- "configural"  
 group.equal <- ""  
 } else {  
 meq.label <- name.test.seq[i]  
 group.equal <- test.seq[1:i]  
 }  
 inv[[meq.label]] <- measEq.syntax(configural.model = model\_cfa,  
 data = simData,  
 ordered = TRUE,  
 estimator = "WLSMV",  
 parameterization = "theta",  
 ID.fac = "std.lv",  
 ID.cat = "Wu.Estabrook.2016",  
 group = "Sexo",  
 group.equal = group.equal,  
 return.fit = TRUE)  
}  
  
comparefit\_inv <- compareFit(inv)  
summary(comparefit\_inv)

################### Nested Model Comparison #########################  
  
Scaled Chi-Squared Difference Test (method = "satorra.2000")  
  
lavaan NOTE:  
 The "Chisq" column contains standard test statistics, not the  
 robust test that should be reported per model. A robust difference  
 test is a function of two standard (not robust) statistics.  
   
 Df AIC BIC Chisq Chisq diff Df diff Pr(>Chisq)   
inv.configural 174 110.33   
inv.thresholds 204 129.03 26.957 30 0.625541   
inv.metric 216 172.50 25.134 12 0.014200 \*   
inv.scalar 228 180.37 9.034 12 0.700051   
inv.strict 243 220.83 32.189 15 0.006067 \*\*  
---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
  
####################### Model Fit Indices ###########################  
 chisq.scaled df.scaled pvalue.scaled rmsea.scaled cfi.scaled tli.scaled srmr  
inv.configural 172.037† 174 .528 .000† 1.000† 1.001 .047†  
inv.thresholds 199.457 204 .577 .000† 1.000† 1.001† .047   
inv.metric 235.107 216 .177 .019 0.996 0.996 .052   
inv.scalar 244.249 228 .219 .017 0.996 0.997 .052   
inv.strict 278.401 243 .059 .024 .992 .993 .060   
  
################## Differences in Fit Indices #######################  
 df.scaled rmsea.scaled cfi.scaled tli.scaled srmr  
inv.thresholds - inv.configural 30 0.000 0.000 0.001 0.000  
inv.metric - inv.thresholds 12 0.019 -0.004 -0.005 0.005  
inv.scalar - inv.metric 12 -0.002 0.001 0.001 0.000  
inv.strict - inv.scalar 15 0.007 -0.004 -0.004 0.008

# 4. Liberación de carga

antools::identify\_items\_partial(inv$`metric`,  
 cutoff.value = 0.05)

# A tibble: 8 × 10  
 lhs op rhs X2 df p.value op1 group.x op2 group.y  
 <chr> <chr> <chr> <dbl> <dbl> <dbl> <chr> <int> <chr> <int>  
1 .p4. == .p133. 15.7 1 0.0000759 F1 =~ y4 1 F1 =~ y4 2  
2 .p13. == .p142. 11.3 1 0.000769 F3 =~ y13 1 F3 =~ y13 2  
3 .p30. == .p159. 8.61 1 0.00335 y4 | t3 1 y4 | t3 2  
4 .p15. == .p144. 8.47 1 0.00361 F3 =~ y15 1 F3 =~ y15 2  
5 .p65. == .p194. 6.53 1 0.0106 y13 | t2 1 y13 | t2 2  
6 .p29. == .p158. 6.00 1 0.0143 y4 | t2 1 y4 | t2 2  
7 .p7. == .p136. 5.26 1 0.0219 F2 =~ y7 1 F2 =~ y7 2  
8 .p5. == .p134. 4.37 1 0.0367 F1 =~ y5 1 F1 =~ y5 2

test.seq <- c("thresholds", "loadings", "intercepts", "residuals")  
name.test.seq <- c("thresholds", "metric", "scalar", "strict")  
inv2 <- list()  
  
for (i in 0:length(test.seq)) {  
 if (i == 0L) {  
 meq.label <- "configural"  
 group.equal <- ""  
 group.partial <- NULL  
 } else {  
 meq.label <- name.test.seq[i]  
 group.equal <- test.seq[1:i]  
 # Incluir group.partial solo si "metric" está en group.equal  
 if ("loadings" %in% group.equal) {  
 group.partial <- c("F3 =~ y13")  
 } else {  
 group.partial <- NULL  
 }  
 }  
 inv2[[meq.label]] <- measEq.syntax(configural.model = model\_cfa,  
 data = simData,  
 ordered = TRUE,  
 estimator = "WLSMV",  
 parameterization = "theta",  
 ID.fac = "std.lv",  
 ID.cat = "Wu.Estabrook.2016",  
 group = "Sexo",  
 group.equal = group.equal,  
 group.partial = group.partial,  
 return.fit = TRUE)  
}  
  
comparefit\_inv2 <- compareFit(inv2)   
summary(comparefit\_inv2)

################### Nested Model Comparison #########################  
  
Scaled Chi-Squared Difference Test (method = "satorra.2000")  
  
lavaan NOTE:  
 The "Chisq" column contains standard test statistics, not the  
 robust test that should be reported per model. A robust difference  
 test is a function of two standard (not robust) statistics.  
   
 Df AIC BIC Chisq Chisq diff Df diff Pr(>Chisq)   
inv2.configural 174 110.33   
inv2.thresholds 204 129.03 26.9567 30 0.625541   
inv2.metric 215 161.05 19.7442 11 0.048974 \*   
inv2.scalar 227 168.85 8.9651 12 0.705912   
inv2.strict 242 206.80 30.6049 15 0.009918 \*\*  
---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
  
####################### Model Fit Indices ###########################  
 chisq.scaled df.scaled pvalue.scaled rmsea.scaled cfi.scaled tli.scaled srmr  
inv2.configural 172.037† 174 .528 .000† 1.000† 1.001 .047†  
inv2.thresholds 199.457 204 .577 .000† 1.000† 1.001† .047   
inv2.metric 225.691 215 .295 .014 0.998 0.998 .051   
inv2.scalar 234.826 227 .347 .012 0.998 0.998 .051   
inv2.strict 267.673 242 .123 .021 .994 .995 .057   
  
################## Differences in Fit Indices #######################  
 df.scaled rmsea.scaled cfi.scaled tli.scaled srmr  
inv2.thresholds - inv2.configural 30 0.000 0.000 0.001 0.000  
inv2.metric - inv2.thresholds 11 0.014 -0.002 -0.003 0.004  
inv2.scalar - inv2.metric 12 -0.002 0.001 0.001 0.000  
inv2.strict - inv2.scalar 15 0.009 -0.004 -0.003 0.006

# 5. Comparación de grupos

Establecer sintaxis:

model\_comp <- "# Modelo de Medición  
 F1 =~ y1 + y2 + y3 + y4 + y5  
 F2 =~ y6 + y7 + y8 + y9 + y10  
 F3 =~ y11 + y12 + y13 + y14 + y15  
  
 # Establecer las medias latentes  
 F1 ~ c(M\_mf1, M\_vf1)\*1  
 F2 ~ c(M\_mf2, M\_vf2)\*1  
 F3 ~ c(M\_mf3, M\_vf3)\*1  
 M\_mf1 == 0 # Fijar la media en 0  
 M\_mf2 == 0 # Fijar la media en 0  
 M\_mf3 == 0 # Fijar la media en 0  
   
 # Calcular las diferencias  
 dif.v\_m.f1 := M\_vf1 - M\_mf1  
 dif.v\_m.f2 := M\_vf2 - M\_mf2  
 dif.v\_m.f3 := M\_vf3 - M\_mf3"

fit\_comp <- cfa(model = model\_comp,  
 data = simData,  
 estimator = "WLSMV",  
 ordered = TRUE,  
 group.equal = c("thresholds","loadings","intercepts"),  
 group = "Sexo",  
 std.lv = TRUE,  
 meanstructure = TRUE,  
 group.partial = "F3 =~ y13")  
  
summary(fit\_comp, fit.measures = TRUE, standardized = TRUE)

lavaan 0.6.16 ended normally after 62 iterations  
  
 Estimator DWLS  
 Optimization method NLMINB  
 Number of model parameters 180  
 Number of equality constraints 77  
  
 Number of observations per group:   
 Mujer 250  
 Varón 250  
  
Model Test User Model:  
 Standard Scaled  
 Test Statistic 168.848 234.826  
 Degrees of freedom 227 227  
 P-value (Chi-square) 0.999 0.347  
 Scaling correction factor 1.002  
 Shift parameter 66.280  
 simple second-order correction   
 Test statistic for each group:  
 Mujer 87.471 120.454  
 Varón 81.377 114.371  
  
Model Test Baseline Model:  
  
 Test statistic 8296.941 4540.862  
 Degrees of freedom 210 210  
 P-value 0.000 0.000  
 Scaling correction factor 1.867  
  
User Model versus Baseline Model:  
  
 Comparative Fit Index (CFI) 1.000 0.998  
 Tucker-Lewis Index (TLI) 1.007 0.998  
   
 Robust Comparative Fit Index (CFI) NA  
 Robust Tucker-Lewis Index (TLI) NA  
  
Root Mean Square Error of Approximation:  
  
 RMSEA 0.000 0.012  
 90 Percent confidence interval - lower 0.000 0.000  
 90 Percent confidence interval - upper 0.000 0.029  
 P-value H\_0: RMSEA <= 0.050 1.000 1.000  
 P-value H\_0: RMSEA >= 0.080 0.000 0.000  
   
 Robust RMSEA NA  
 90 Percent confidence interval - lower NA  
 90 Percent confidence interval - upper NA  
 P-value H\_0: Robust RMSEA <= 0.050 NA  
 P-value H\_0: Robust RMSEA >= 0.080 NA  
  
Standardized Root Mean Square Residual:  
  
 SRMR 0.051 0.051  
  
Parameter Estimates:  
  
 Standard errors Robust.sem  
 Information Expected  
 Information saturated (h1) model Unstructured  
  
  
Group 1 [Mujer]:  
  
Latent Variables:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 F1 =~   
 y1 (.p1.) 0.774 0.042 18.465 0.000 0.774 0.774  
 y2 (.p2.) 0.648 0.042 15.424 0.000 0.648 0.648  
 y3 (.p3.) 0.703 0.042 16.747 0.000 0.703 0.703  
 y4 (.p4.) 0.619 0.055 11.281 0.000 0.619 0.619  
 y5 (.p5.) 0.685 0.048 14.237 0.000 0.685 0.685  
 F2 =~   
 y6 (.p6.) 0.706 0.039 18.168 0.000 0.706 0.706  
 y7 (.p7.) 0.820 0.043 19.294 0.000 0.820 0.820  
 y8 (.p8.) 0.717 0.040 18.094 0.000 0.717 0.717  
 y9 (.p9.) 0.803 0.032 24.723 0.000 0.803 0.803  
 y10 (.10.) 0.744 0.037 20.330 0.000 0.744 0.744  
 F3 =~   
 y11 (.11.) 0.789 0.041 19.257 0.000 0.789 0.789  
 y12 (.12.) 0.845 0.039 21.882 0.000 0.845 0.845  
 y13 0.665 0.049 13.637 0.000 0.665 0.665  
 y14 (.14.) 0.732 0.038 19.269 0.000 0.732 0.732  
 y15 (.15.) 0.708 0.044 16.165 0.000 0.708 0.708  
  
Covariances:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 F1 ~~   
 F2 0.669 0.053 12.667 0.000 0.669 0.669  
 F3 0.522 0.054 9.659 0.000 0.522 0.522  
 F2 ~~   
 F3 0.497 0.055 9.020 0.000 0.497 0.497  
  
Intercepts:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 F1 (M\_m1) 0.000 0.000 0.000  
 F2 (M\_m2) 0.000 0.000 0.000  
 F3 (M\_m3) 0.000 0.000 0.000  
 .y1 0.000 0.000 0.000  
 .y2 0.000 0.000 0.000  
 .y3 0.000 0.000 0.000  
 .y4 0.000 0.000 0.000  
 .y5 0.000 0.000 0.000  
 .y6 0.000 0.000 0.000  
 .y7 0.000 0.000 0.000  
 .y8 0.000 0.000 0.000  
 .y9 0.000 0.000 0.000  
 .y10 0.000 0.000 0.000  
 .y11 0.000 0.000 0.000  
 .y12 0.000 0.000 0.000  
 .y13 0.000 0.000 0.000  
 .y14 0.000 0.000 0.000  
 .y15 0.000 0.000 0.000  
  
Thresholds:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 y1|t1 (.19.) -2.238 0.195 -11.462 0.000 -2.238 -2.238  
 y1|t2 (.20.) -0.953 0.089 -10.727 0.000 -0.953 -0.953  
 y1|t3 (.21.) 0.958 0.081 11.801 0.000 0.958 0.958  
 y1|t4 (.22.) 2.102 0.138 15.273 0.000 2.102 2.102  
 y2|t1 (.23.) -2.037 0.160 -12.725 0.000 -2.037 -2.037  
 y2|t2 (.24.) -1.098 0.092 -11.888 0.000 -1.098 -1.098  
 y2|t3 (.25.) 0.920 0.077 12.018 0.000 0.920 0.920  
 y2|t4 (.26.) 2.038 0.134 15.263 0.000 2.038 2.038  
 y3|t1 (.27.) -2.035 0.156 -13.037 0.000 -2.035 -2.035  
 y3|t2 (.28.) -1.025 0.089 -11.544 0.000 -1.025 -1.025  
 y3|t3 (.29.) 1.037 0.084 12.340 0.000 1.037 1.037  
 y3|t4 (.30.) 2.132 0.159 13.383 0.000 2.132 2.132  
 y4|t1 (.31.) -1.867 0.146 -12.755 0.000 -1.867 -1.867  
 y4|t2 (.32.) -0.926 0.086 -10.784 0.000 -0.926 -0.926  
 y4|t3 (.33.) 0.943 0.078 12.050 0.000 0.943 0.943  
 y4|t4 (.34.) 2.027 0.146 13.916 0.000 2.027 2.027  
 y5|t1 (.35.) -2.358 0.202 -11.679 0.000 -2.358 -2.358  
 y5|t2 (.36.) -1.126 0.094 -12.041 0.000 -1.126 -1.126  
 y5|t3 (.37.) 1.119 0.086 12.984 0.000 1.119 1.119  
 y5|t4 (.38.) 2.429 0.174 13.980 0.000 2.429 2.429  
 y6|t1 (.39.) -1.967 0.147 -13.397 0.000 -1.967 -1.967  
 y6|t2 (.40.) -1.060 0.085 -12.499 0.000 -1.060 -1.060  
 y6|t3 (.41.) 0.994 0.079 12.516 0.000 0.994 0.994  
 y6|t4 (.42.) 2.064 0.142 14.493 0.000 2.064 2.064  
 y7|t1 (.43.) -1.947 0.150 -12.978 0.000 -1.947 -1.947  
 y7|t2 (.44.) -1.052 0.091 -11.560 0.000 -1.052 -1.052  
 y7|t3 (.45.) 1.096 0.089 12.266 0.000 1.096 1.096  
 y7|t4 (.46.) 2.475 0.193 12.798 0.000 2.475 2.475  
 y8|t1 (.47.) -1.991 0.148 -13.468 0.000 -1.991 -1.991  
 y8|t2 (.48.) -1.052 0.088 -11.913 0.000 -1.052 -1.052  
 y8|t3 (.49.) 1.002 0.079 12.681 0.000 1.002 1.002  
 y8|t4 (.50.) 2.210 0.171 12.947 0.000 2.210 2.210  
 y9|t1 (.51.) -2.021 0.148 -13.617 0.000 -2.021 -2.021  
 y9|t2 (.52.) -0.968 0.087 -11.094 0.000 -0.968 -0.968  
 y9|t3 (.53.) 1.052 0.082 12.812 0.000 1.052 1.052  
 y9|t4 (.54.) 2.004 0.127 15.760 0.000 2.004 2.004  
 y10|t1 (.55.) -2.043 0.154 -13.308 0.000 -2.043 -2.043  
 y10|t2 (.56.) -1.094 0.088 -12.403 0.000 -1.094 -1.094  
 y10|t3 (.57.) 1.023 0.080 12.724 0.000 1.023 1.023  
 y10|t4 (.58.) 2.396 0.178 13.459 0.000 2.396 2.396  
 y11|t1 (.59.) -2.049 0.147 -13.976 0.000 -2.049 -2.049  
 y11|t2 (.60.) -1.044 0.087 -12.051 0.000 -1.044 -1.044  
 y11|t3 (.61.) 0.964 0.084 11.473 0.000 0.964 0.964  
 y11|t4 (.62.) 2.163 0.168 12.899 0.000 2.163 2.163  
 y12|t1 (.63.) -2.187 0.166 -13.168 0.000 -2.187 -2.187  
 y12|t2 (.64.) -1.039 0.088 -11.773 0.000 -1.039 -1.039  
 y12|t3 (.65.) 0.986 0.087 11.378 0.000 0.986 0.986  
 y12|t4 (.66.) 2.326 0.204 11.395 0.000 2.326 2.326  
 y13|t1 (.67.) -2.258 0.188 -12.034 0.000 -2.258 -2.258  
 y13|t2 (.68.) -1.039 0.083 -12.589 0.000 -1.039 -1.039  
 y13|t3 (.69.) 1.042 0.082 12.761 0.000 1.042 1.042  
 y13|t4 (.70.) 1.925 0.138 13.902 0.000 1.925 1.925  
 y14|t1 (.71.) -1.827 0.131 -13.898 0.000 -1.827 -1.827  
 y14|t2 (.72.) -1.141 0.089 -12.883 0.000 -1.141 -1.141  
 y14|t3 (.73.) 0.925 0.080 11.566 0.000 0.925 0.925  
 y14|t4 (.74.) 2.079 0.152 13.674 0.000 2.079 2.079  
 y15|t1 (.75.) -2.147 0.174 -12.365 0.000 -2.147 -2.147  
 y15|t2 (.76.) -1.041 0.084 -12.349 0.000 -1.041 -1.041  
 y15|t3 (.77.) 0.860 0.077 11.124 0.000 0.860 0.860  
 y15|t4 (.78.) 1.806 0.136 13.285 0.000 1.806 1.806  
  
Variances:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 .y1 0.401 0.401 0.401  
 .y2 0.581 0.581 0.581  
 .y3 0.505 0.505 0.505  
 .y4 0.617 0.617 0.617  
 .y5 0.531 0.531 0.531  
 .y6 0.502 0.502 0.502  
 .y7 0.327 0.327 0.327  
 .y8 0.485 0.485 0.485  
 .y9 0.355 0.355 0.355  
 .y10 0.447 0.447 0.447  
 .y11 0.378 0.378 0.378  
 .y12 0.286 0.286 0.286  
 .y13 0.558 0.558 0.558  
 .y14 0.464 0.464 0.464  
 .y15 0.499 0.499 0.499  
 F1 1.000 1.000 1.000  
 F2 1.000 1.000 1.000  
 F3 1.000 1.000 1.000  
  
Scales y\*:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 y1 1.000 1.000 1.000  
 y2 1.000 1.000 1.000  
 y3 1.000 1.000 1.000  
 y4 1.000 1.000 1.000  
 y5 1.000 1.000 1.000  
 y6 1.000 1.000 1.000  
 y7 1.000 1.000 1.000  
 y8 1.000 1.000 1.000  
 y9 1.000 1.000 1.000  
 y10 1.000 1.000 1.000  
 y11 1.000 1.000 1.000  
 y12 1.000 1.000 1.000  
 y13 1.000 1.000 1.000  
 y14 1.000 1.000 1.000  
 y15 1.000 1.000 1.000  
  
  
Group 2 [Varón]:  
  
Latent Variables:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 F1 =~   
 y1 (.p1.) 0.774 0.042 18.465 0.000 0.815 0.739  
 y2 (.p2.) 0.648 0.042 15.424 0.000 0.682 0.683  
 y3 (.p3.) 0.703 0.042 16.747 0.000 0.740 0.687  
 y4 (.p4.) 0.619 0.055 11.281 0.000 0.651 0.709  
 y5 (.p5.) 0.685 0.048 14.237 0.000 0.721 0.623  
 F2 =~   
 y6 (.p6.) 0.706 0.039 18.168 0.000 0.770 0.792  
 y7 (.p7.) 0.820 0.043 19.294 0.000 0.895 0.815  
 y8 (.p8.) 0.717 0.040 18.094 0.000 0.782 0.791  
 y9 (.p9.) 0.803 0.032 24.723 0.000 0.876 0.844  
 y10 (.10.) 0.744 0.037 20.330 0.000 0.811 0.771  
 F3 =~   
 y11 (.11.) 0.789 0.041 19.257 0.000 0.737 0.717  
 y12 (.12.) 0.845 0.039 21.882 0.000 0.790 0.770  
 y13 0.431 0.090 4.803 0.000 0.403 0.393  
 y14 (.14.) 0.732 0.038 19.269 0.000 0.685 0.755  
 y15 (.15.) 0.708 0.044 16.165 0.000 0.662 0.762  
  
Covariances:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 F1 ~~   
 F2 0.725 0.111 6.556 0.000 0.631 0.631  
 F3 0.543 0.088 6.164 0.000 0.552 0.552  
 F2 ~~   
 F3 0.719 0.105 6.882 0.000 0.705 0.705  
  
Intercepts:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 F1 (M\_v1) 0.581 0.111 5.224 0.000 0.552 0.552  
 F2 (M\_v2) 0.305 0.106 2.894 0.004 0.280 0.280  
 F3 (M\_v3) 0.086 0.102 0.846 0.398 0.092 0.092  
 .y1 0.000 0.000 0.000  
 .y2 0.000 0.000 0.000  
 .y3 0.000 0.000 0.000  
 .y4 0.000 0.000 0.000  
 .y5 0.000 0.000 0.000  
 .y6 0.000 0.000 0.000  
 .y7 0.000 0.000 0.000  
 .y8 0.000 0.000 0.000  
 .y9 0.000 0.000 0.000  
 .y10 0.000 0.000 0.000  
 .y11 0.000 0.000 0.000  
 .y12 0.000 0.000 0.000  
 .y13 0.000 0.000 0.000  
 .y14 0.000 0.000 0.000  
 .y15 0.000 0.000 0.000  
  
Thresholds:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 y1|t1 (.19.) -2.238 0.195 -11.462 0.000 -2.238 -2.030  
 y1|t2 (.20.) -0.953 0.089 -10.727 0.000 -0.953 -0.864  
 y1|t3 (.21.) 0.958 0.081 11.801 0.000 0.958 0.869  
 y1|t4 (.22.) 2.102 0.138 15.273 0.000 2.102 1.906  
 y2|t1 (.23.) -2.037 0.160 -12.725 0.000 -2.037 -2.043  
 y2|t2 (.24.) -1.098 0.092 -11.888 0.000 -1.098 -1.101  
 y2|t3 (.25.) 0.920 0.077 12.018 0.000 0.920 0.923  
 y2|t4 (.26.) 2.038 0.134 15.263 0.000 2.038 2.044  
 y3|t1 (.27.) -2.035 0.156 -13.037 0.000 -2.035 -1.889  
 y3|t2 (.28.) -1.025 0.089 -11.544 0.000 -1.025 -0.951  
 y3|t3 (.29.) 1.037 0.084 12.340 0.000 1.037 0.962  
 y3|t4 (.30.) 2.132 0.159 13.383 0.000 2.132 1.978  
 y4|t1 (.31.) -1.867 0.146 -12.755 0.000 -1.867 -2.033  
 y4|t2 (.32.) -0.926 0.086 -10.784 0.000 -0.926 -1.008  
 y4|t3 (.33.) 0.943 0.078 12.050 0.000 0.943 1.027  
 y4|t4 (.34.) 2.027 0.146 13.916 0.000 2.027 2.207  
 y5|t1 (.35.) -2.358 0.202 -11.679 0.000 -2.358 -2.036  
 y5|t2 (.36.) -1.126 0.094 -12.041 0.000 -1.126 -0.972  
 y5|t3 (.37.) 1.119 0.086 12.984 0.000 1.119 0.966  
 y5|t4 (.38.) 2.429 0.174 13.980 0.000 2.429 2.098  
 y6|t1 (.39.) -1.967 0.147 -13.397 0.000 -1.967 -2.022  
 y6|t2 (.40.) -1.060 0.085 -12.499 0.000 -1.060 -1.090  
 y6|t3 (.41.) 0.994 0.079 12.516 0.000 0.994 1.022  
 y6|t4 (.42.) 2.064 0.142 14.493 0.000 2.064 2.122  
 y7|t1 (.43.) -1.947 0.150 -12.978 0.000 -1.947 -1.775  
 y7|t2 (.44.) -1.052 0.091 -11.560 0.000 -1.052 -0.959  
 y7|t3 (.45.) 1.096 0.089 12.266 0.000 1.096 0.999  
 y7|t4 (.46.) 2.475 0.193 12.798 0.000 2.475 2.256  
 y8|t1 (.47.) -1.991 0.148 -13.468 0.000 -1.991 -2.013  
 y8|t2 (.48.) -1.052 0.088 -11.913 0.000 -1.052 -1.064  
 y8|t3 (.49.) 1.002 0.079 12.681 0.000 1.002 1.014  
 y8|t4 (.50.) 2.210 0.171 12.947 0.000 2.210 2.234  
 y9|t1 (.51.) -2.021 0.148 -13.617 0.000 -2.021 -1.946  
 y9|t2 (.52.) -0.968 0.087 -11.094 0.000 -0.968 -0.932  
 y9|t3 (.53.) 1.052 0.082 12.812 0.000 1.052 1.013  
 y9|t4 (.54.) 2.004 0.127 15.760 0.000 2.004 1.930  
 y10|t1 (.55.) -2.043 0.154 -13.308 0.000 -2.043 -1.941  
 y10|t2 (.56.) -1.094 0.088 -12.403 0.000 -1.094 -1.040  
 y10|t3 (.57.) 1.023 0.080 12.724 0.000 1.023 0.972  
 y10|t4 (.58.) 2.396 0.178 13.459 0.000 2.396 2.277  
 y11|t1 (.59.) -2.049 0.147 -13.976 0.000 -2.049 -1.993  
 y11|t2 (.60.) -1.044 0.087 -12.051 0.000 -1.044 -1.015  
 y11|t3 (.61.) 0.964 0.084 11.473 0.000 0.964 0.938  
 y11|t4 (.62.) 2.163 0.168 12.899 0.000 2.163 2.104  
 y12|t1 (.63.) -2.187 0.166 -13.168 0.000 -2.187 -2.131  
 y12|t2 (.64.) -1.039 0.088 -11.773 0.000 -1.039 -1.012  
 y12|t3 (.65.) 0.986 0.087 11.378 0.000 0.986 0.961  
 y12|t4 (.66.) 2.326 0.204 11.395 0.000 2.326 2.266  
 y13|t1 (.67.) -2.258 0.188 -12.034 0.000 -2.258 -2.200  
 y13|t2 (.68.) -1.039 0.083 -12.589 0.000 -1.039 -1.013  
 y13|t3 (.69.) 1.042 0.082 12.761 0.000 1.042 1.016  
 y13|t4 (.70.) 1.925 0.138 13.902 0.000 1.925 1.876  
 y14|t1 (.71.) -1.827 0.131 -13.898 0.000 -1.827 -2.016  
 y14|t2 (.72.) -1.141 0.089 -12.883 0.000 -1.141 -1.259  
 y14|t3 (.73.) 0.925 0.080 11.566 0.000 0.925 1.021  
 y14|t4 (.74.) 2.079 0.152 13.674 0.000 2.079 2.294  
 y15|t1 (.75.) -2.147 0.174 -12.365 0.000 -2.147 -2.469  
 y15|t2 (.76.) -1.041 0.084 -12.349 0.000 -1.041 -1.197  
 y15|t3 (.77.) 0.860 0.077 11.124 0.000 0.860 0.990  
 y15|t4 (.78.) 1.806 0.136 13.285 0.000 1.806 2.077  
  
Variances:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 .y1 0.552 0.552 0.454  
 .y2 0.530 0.530 0.533  
 .y3 0.613 0.613 0.528  
 .y4 0.420 0.420 0.497  
 .y5 0.821 0.821 0.612  
 .y6 0.353 0.353 0.373  
 .y7 0.403 0.403 0.335  
 .y8 0.366 0.366 0.374  
 .y9 0.311 0.311 0.288  
 .y10 0.449 0.449 0.406  
 .y11 0.514 0.514 0.486  
 .y12 0.429 0.429 0.407  
 .y13 0.890 0.890 0.845  
 .y14 0.353 0.353 0.429  
 .y15 0.317 0.317 0.420  
 F1 1.108 0.184 6.030 0.000 1.000 1.000  
 F2 1.189 0.181 6.580 0.000 1.000 1.000  
 F3 0.875 0.136 6.439 0.000 1.000 1.000  
  
Scales y\*:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 y1 0.907 0.060 15.237 0.000 0.907 1.000  
 y2 1.003 0.067 15.006 0.000 1.003 1.000  
 y3 0.928 0.065 14.212 0.000 0.928 1.000  
 y4 1.089 0.080 13.672 0.000 1.089 1.000  
 y5 0.864 0.059 14.571 0.000 0.864 1.000  
 y6 1.028 0.065 15.882 0.000 1.028 1.000  
 y7 0.911 0.062 14.813 0.000 0.911 1.000  
 y8 1.011 0.065 15.520 0.000 1.011 1.000  
 y9 0.963 0.061 15.842 0.000 0.963 1.000  
 y10 0.950 0.063 15.198 0.000 0.950 1.000  
 y11 0.973 0.063 15.394 0.000 0.973 1.000  
 y12 0.974 0.066 14.753 0.000 0.974 1.000  
 y13 0.975 0.070 13.924 0.000 0.975 1.000  
 y14 1.103 0.069 15.892 0.000 1.103 1.000  
 y15 1.150 0.071 16.282 0.000 1.150 1.000  
  
Defined Parameters:  
 Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
 dif.v\_m.f1 0.581 0.111 5.224 0.000 0.552 0.552  
 dif.v\_m.f2 0.305 0.106 2.894 0.004 0.280 0.280  
 dif.v\_m.f3 0.086 0.102 0.846 0.398 0.092 0.092  
  
Constraints:  
 |Slack|  
 M\_mf1 - 0 0.000  
 M\_mf2 - 0 0.000  
 M\_mf3 - 0 0.000

standardizedsolution(fit\_comp) %>%   
 filter(op == ":=")

lhs op rhs group label est.std se z pvalue ci.lower ci.upper  
1 dif.v\_m.f1 := M\_vf1-M\_mf1 0 dif.v\_m.f1 0.552 0.108 5.125 0.000 0.341 0.763  
2 dif.v\_m.f2 := M\_vf2-M\_mf2 0 dif.v\_m.f2 0.280 0.099 2.820 0.005 0.085 0.475  
3 dif.v\_m.f3 := M\_vf3-M\_mf3 0 dif.v\_m.f3 0.092 0.109 0.845 0.398 -0.122 0.306