Material de Apoyo Docente

Universidad de Talca

Facultad de Psicología

MODELOS LONGITUDINALES CON VARIABLES LATENTES PARA LA INVESTIGACIÓN EN PSICOLOGÍA

Modelos de Curva de Crecimiento Latente (LGCM)

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Paquetes a utilizar en esta sesión.

a. *lavaan*: Un paquete para la estimación de modelos de variables latentes como CFA, además permite realizar path analysis, modelación de ecuaciones estructurales, curvas de crecimiento latente, etc.
b. *psych*: Paquete que incluye funciones útiles para la investigación en psicología. *ggplot2*: Paquete que incluye funciones útiles gráficos
c. *MVN*: Paquete que usaremos para evaluar normalidad multivariada.

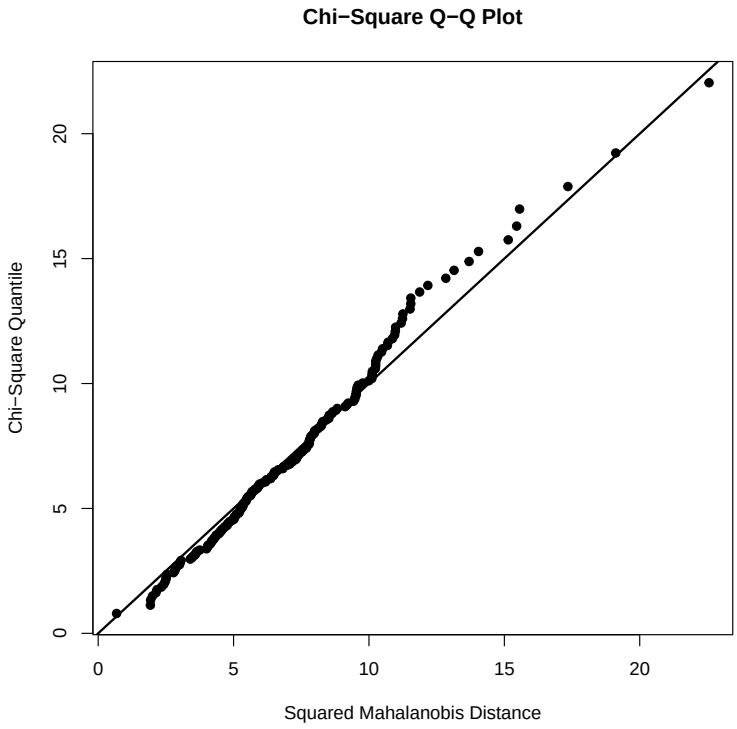
Durante esta sesión trabajaremos con una base de datos Tallerclase6.csv (extraídos de Hoffman, 2015). Esta contiene los datos de 200 adolescentes (12 a 18 años de edad) en los que se midieron, anualmente, sus conductas de riesgo (Risky12 a Risky18), su percepción de monitoreo materno (Monit12 a Monit18) y la actitud de sus madres hacia el consumo de alcohol y tabaco (Attitude12). El rango de respuesta de las conductas de riesgo va de 10 a 50 puntos y de 1 a 5 para el monitoreo materno (centrada en 3) y para las actitudes maternas (centrada en 4).

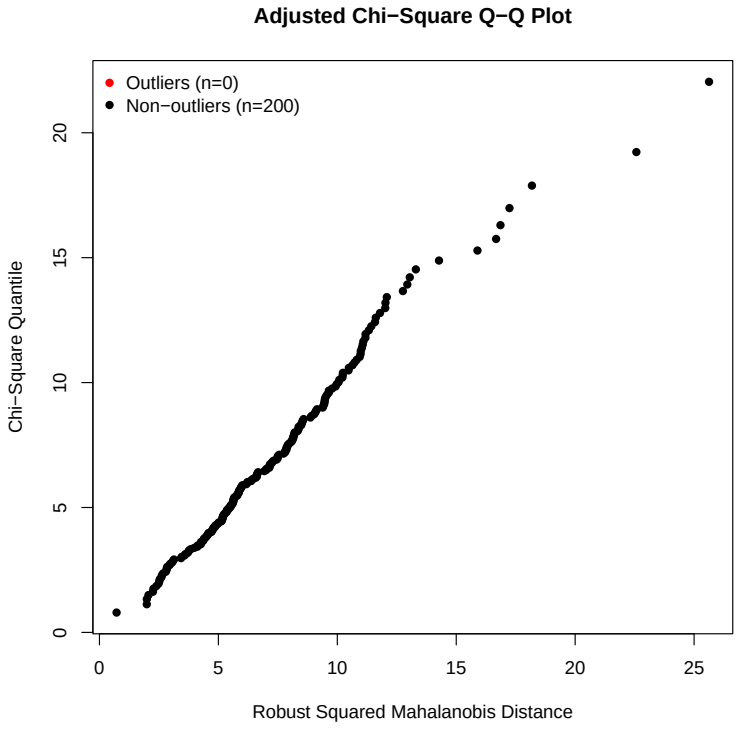
Análisis descriptivos e inspección de datos

```
## seteamos ambiente de trabajo
setwd("/Users/fa/Dropbox/Docencia/2024/Doctorado/Optativo Doctorado UTalca/Clases/Clase

## cargamos la base de datos
base<-read.csv("Taller_clase6.csv", header = T, sep = ";")

names(base)

##  [1] "id"        "actitud12" "age12"     "age13"     "age14"     "age15"
##  [7] "age16"     "age17"     "age18"     "riesgo12"  "riesgo13"  "riesgo14"
## [13] "riesgo15"  "riesgo16"  "riesgo17"  "riesgo18"  "monit12"   "monit13"
## [19] "monit14"   "monit15"   "monit16"   "monit17"   "monit18"

library(psych)
describe(base, skew = F)
```

```
##           vars   n   mean    sd median  min   max range   se
## id           1 200 100.50 57.88 100.50  1.0 200.0 199.0 4.09
## actitud12    2 200   3.95  0.60   3.90  2.4   5.0   2.6 0.04
## age12        3 200  11.99  0.17  12.00 11.5  12.4   0.9 0.01
## age13        4 200  13.02  0.17  13.00 12.4  13.4   1.0 0.01
## age14        5 200  14.01  0.18  14.00 13.5  14.8   1.3 0.01
## age15        6 200  15.01  0.18  15.00 14.5  15.6   1.1 0.01
## age16        7 200  15.96  0.18  16.00 15.4  16.4   1.0 0.01
## age17        8 200  17.01  0.17  17.00 16.5  17.4   0.9 0.01
## age18        9 200  18.00  0.15  18.00 17.6  18.3   0.7 0.01
## riesgo12    10 200  16.72  4.58  16.10 10.0  33.1  23.1 0.32
## riesgo13    11 200  17.18  4.43  17.00 10.0  29.2  19.2 0.31
## riesgo14    12 200  17.86  4.51  17.75 10.0  31.9  21.9 0.32
## riesgo15    13 200  18.98  4.57  19.20 10.0  29.6  19.6 0.32
## riesgo16    14 200  19.78  4.69  19.50 10.0  33.0  23.0 0.33
## riesgo17    15 200  21.65  5.22  21.95 10.1  32.0  21.9 0.37
## riesgo18    16 200  23.52  5.42  23.85 10.2  36.3  26.1 0.38
## monit12     17 200   3.08  0.81   3.15  1.0   5.0   4.0 0.06
## monit13     18 200   3.09  0.76   3.20  1.2   5.0   3.8 0.05
## monit14     19 200   3.07  0.67   3.10  1.0   5.0   4.0 0.05
## monit15     20 200   3.10  0.61   3.05  1.1   4.6   3.5 0.04
## monit16     21 200   3.07  0.54   3.10  1.3   4.6   3.3 0.04
## monit17     22 200   3.06  0.52   3.00  1.1   4.4   3.3 0.04
## monit18     23 200   3.07  0.56   3.00  1.3   4.4   3.1 0.04
```

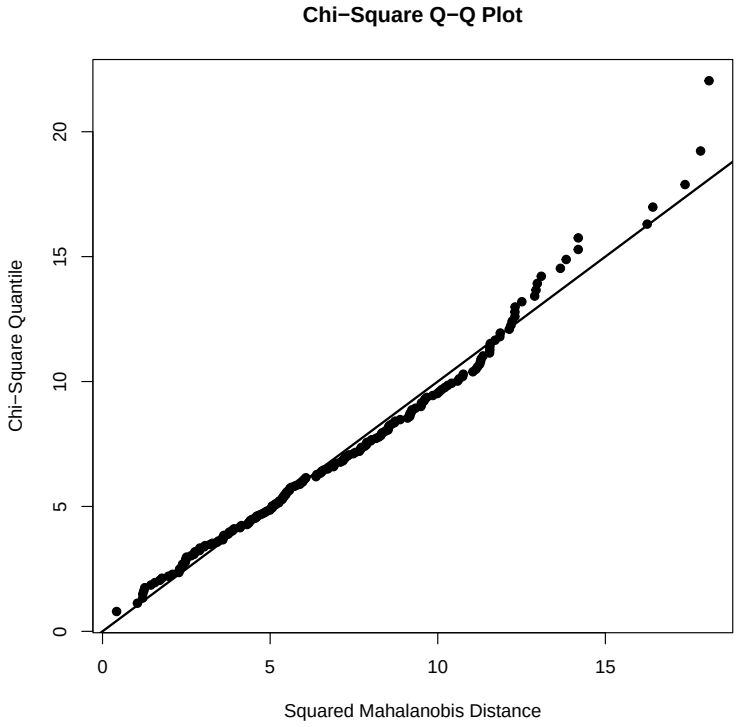
```
library(MVN)
#### Normalidad multivariada y outliers

# Conductas de riesgo
mvn(base[10:16], mvnTest = "mardia", multivariatePlot = "qq",
    multivariateOutlierMethod = "adj", desc = F )
```

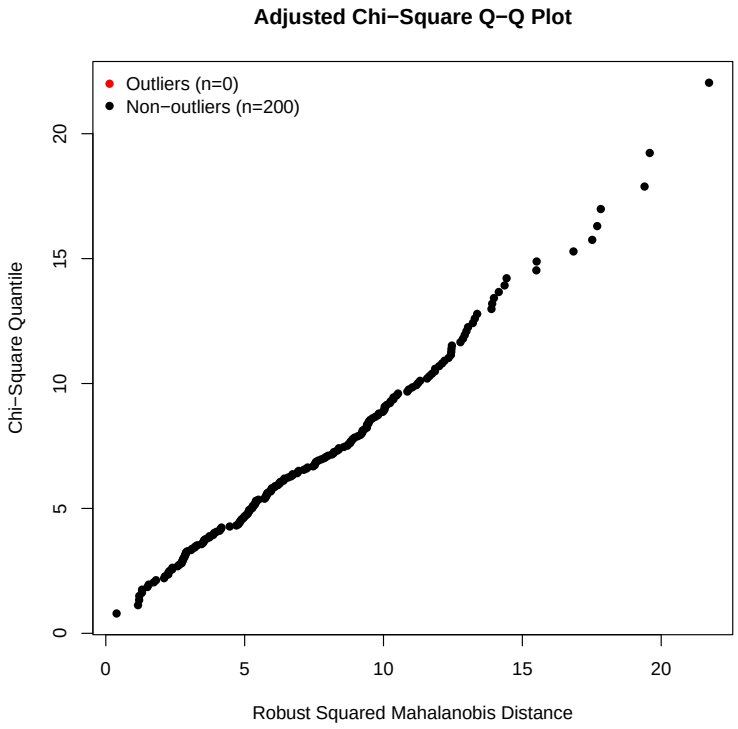

Chi−Square Q−Q Plot
Chi−Square Quantile
Squared Mahalanobis Distance
0
5
10
15
20


Adjusted Chi−Square Q−Q Plot
Outliers (n=0)
Non−outliers (n=200)
Chi−Square Quantile
Robust Squared Mahalanobis Distance
0
5
10
15
20
25

```
## $multivariateNormality
##              Test         Statistic             p value Result
## 1 Mardia Skewness  124.905208675733 0.00253404475614534     NO
## 2 Mardia Kurtosis -1.86497100927716  0.0621854679296971    YES
## 3             MVN              <NA>                <NA>     NO
##
## $univariateNormality
##               Test  Variable Statistic   p value Normality
## 1 Anderson-Darling riesgo12     1.4987    0.0007    NO
## 2 Anderson-Darling riesgo13     1.6361    0.0003    NO
## 3 Anderson-Darling riesgo14     0.7226    0.0586    YES
## 4 Anderson-Darling riesgo15     0.7622    0.0467    NO
## 5 Anderson-Darling riesgo16     0.4396    0.2895    YES
## 6 Anderson-Darling riesgo17     0.4625    0.2551    YES
## 7 Anderson-Darling riesgo18     0.2664    0.6866    YES
```

```r
# Monitoreo materno
mvn(base[17:23], mvnTest = "mardia", multivariatePlot = "qq",
    multivariateOutlierMethod = "adj", desc = F)
```






```
## $multivariateNormality
##              Test          Statistic           p value Result
## 1 Mardia Skewness    81.977332362302 0.542111758829815    YES
## 2 Mardia Kurtosis -0.343900555369817 0.730921074190066    YES
## 3             MVN               <NA>              <NA>    YES
##
## $univariateNormality
##               Test  Variable Statistic   p value Normality
## 1 Anderson-Darling  monit12     0.5563    0.1493    YES
## 2 Anderson-Darling  monit13     0.4503    0.2730    YES
## 3 Anderson-Darling  monit14     0.4013    0.3570    YES
## 4 Anderson-Darling  monit15     0.6865    0.0720    YES
## 5 Anderson-Darling  monit16     0.4584    0.2610    YES
## 6 Anderson-Darling  monit17     1.0053    0.0117    NO
## 7 Anderson-Darling  monit18     0.6318    0.0983    YES
```

Estimación de Modelos

Modelo Nulo

La estimación de un modelo nulo permite evaluar la pertinencia de modelar el cambio

```
library(lavaan)

## This is lavaan 0.6-19
## lavaan is FREE software! Please report any bugs.

##
## Attaching package: 'lavaan'

## The following object is masked from 'package:psych':
##
##     cor2cov

### Especificación del modelo para monitoreo materno
modelo0<- "# Intercepto aleatorio
           i=~ 1*monit12 + 1*monit13+ 1*monit14 + 1*monit15
           # Interceptos fijos en 0
           monit12 ~ 0*1
           monit13 ~ 0*1
           monit14 ~ 0*1
           monit15 ~ 0*1
           "
## Estimación del modelo
# Usaremos el comando growth() de lavaan
# "fiml" para tratamiento de datos perdidos
fit0<- growth(modelo0, data = base,
              missing="fiml", se="robust", estimator="ml")
summary(fit0, fit.measures= T, standardized=T)

## lavaan 0.6-19 ended normally after 30 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                         6
##
##   Number of observations                           200
##   Number of missing patterns                         1
##
```

```
## Model Test User Model:
##
##   Test statistic                                76.404
##   Degrees of freedom                                 8
##   P-value (Chi-square)                           0.000
##
## Model Test Baseline Model:
##
##   Test statistic                               791.167
##   Degrees of freedom                                 6
##   P-value                                        0.000
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                    0.913
##   Tucker-Lewis Index (TLI)                       0.935
##
##   Robust Comparative Fit Index (CFI)             0.913
##   Robust Tucker-Lewis Index (TLI)                0.935
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)               -499.578
##   Loglikelihood unrestricted model (H1)       -461.376
##
##   Akaike (AIC)                                1011.155
##   Bayesian (BIC)                              1030.945
##   Sample-size adjusted Bayesian (SABIC)       1011.936
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.207
##   90 Percent confidence interval - lower         0.166
##   90 Percent confidence interval - upper         0.250
##   P-value H_0: RMSEA <= 0.050                    0.000
##   P-value H_0: RMSEA >= 0.080                    1.000
##
##   Robust RMSEA                                   0.207
##   90 Percent confidence interval - lower         0.166
##   90 Percent confidence interval - upper         0.250
##   P-value H_0: Robust RMSEA <= 0.050             0.000
##   P-value H_0: Robust RMSEA >= 0.080             1.000
```

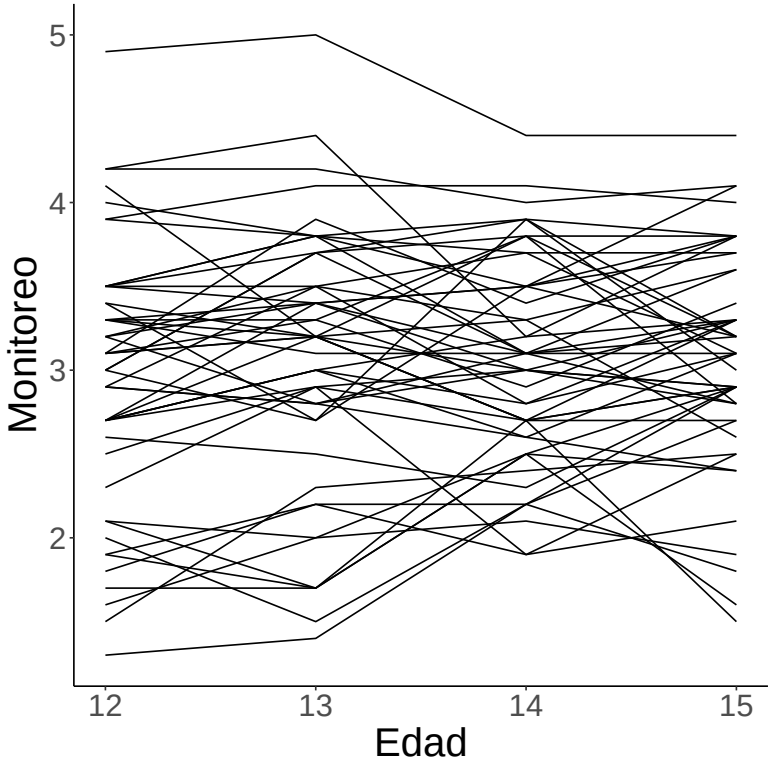
```
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.151
##
## Parameter Estimates:
##
##   Standard errors                             Sandwich
##   Information bread                           Observed
##   Observed information based on                Hessian
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   i =~
##     monit12          1.000                               0.638    0.890
##     monit13          1.000                               0.638    0.891
##     monit14          1.000                               0.638    0.910
##     monit15          1.000                               0.638    0.891
##
## Intercepts:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12          0.000                               0.000    0.000
##    .monit13          0.000                               0.000    0.000
##    .monit14          0.000                               0.000    0.000
##    .monit15          0.000                               0.000    0.000
##     i                3.083    0.046   66.446    0.000    4.834    4.834
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12          0.107    0.014    7.480    0.000    0.107    0.208
##    .monit13          0.105    0.015    7.126    0.000    0.105    0.206
##    .monit14          0.085    0.013    6.744    0.000    0.085    0.172
##    .monit15          0.105    0.014    7.715    0.000    0.105    0.206
##     i                0.407    0.044    9.194    0.000    1.000    1.000
```

Inspección gráfica de trayectorias de un subconjunto de datos

```
library(ggplot2)

##
## Attaching package: 'ggplot2'

## The following objects are masked from 'package:psych':
##
##     %+%, alpha

# seleccionamos 50 observaciones
data50 = base[sample(nrow(base),50),]
dim(data50)

## [1] 50 23

# cambiamos el formato de la base de datos de wide a long
# comando reshape()
data50L = reshape(data=data50, # subset de datos
                  idvar='id', # variable de identificación
                  varying=c('monit12','monit13','monit14','monit15'),
                  v.names = 'monitoreo', # nombre que agruará las medidas
                  times = c(12,13,14,15), # eje x
                  direction='long')

dim(data50L) ## revisamos que se haya creado el subset

## [1] 200  21

# Plot con comando ggplot()
plot_obs = ggplot(data=data50L,
                  aes(x=time, y=monitoreo, group=id)) +
  geom_line() +
  theme_bw() +
  scale_x_continuous(name = "Edad") +
  scale_y_continuous(name = "Monitoreo") +
  theme(
    plot.background = element_blank()
    ,panel.grid.major = element_blank()
    ,panel.grid.minor = element_blank()
    ,panel.border = element_blank()
    ,axis.line.x = element_line(color="black")
```

```
    ,axis.line.y = element_line(color="black")
    ,axis.text=element_text(size=20)
    ,axis.title=element_text(size=26)
  )
```

```
print(plot_obs) ## Para obtener el gráfico
```



Modelo Lineal

En este modelo el parámetro de cambio lineal es la pendiente o slope

```
modelo1<- "i=~ 1*monit12 + 1*monit13+ 1*monit14 + 1*monit15
           s=~ 0*monit12 + 1*monit13+ 2*monit14 + 3*monit15

           monit12 ~ 0*1
           monit13 ~ 0*1
           monit14 ~ 0*1
           monit15 ~ 0*1"
fit1<- growth(modelo1, data = base,
              missing="fiml", se="robust", estimator="ml")
summary(fit1, fit.measures= T, standardized=T)

## lavaan 0.6-19 ended normally after 46 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                         9
##
##   Number of observations                           200
##   Number of missing patterns                         1
##
## Model Test User Model:
##
##   Test statistic                                 1.938
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.858
##
## Model Test Baseline Model:
##
##   Test statistic                               791.167
##   Degrees of freedom                                 6
##   P-value                                        0.000
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                    1.000
##   Tucker-Lewis Index (TLI)                       1.005
##
##   Robust Comparative Fit Index (CFI)             1.000
##   Robust Tucker-Lewis Index (TLI)                1.005
```

```
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)               -462.345
##   Loglikelihood unrestricted model (H1)       -461.376
##
##   Akaike (AIC)                                 942.689
##   Bayesian (BIC)                               972.374
##   Sample-size adjusted Bayesian (SABIC)        943.861
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000
##   90 Percent confidence interval - lower         0.000
##   90 Percent confidence interval - upper         0.053
##   P-value H_0: RMSEA <= 0.050                    0.944
##   P-value H_0: RMSEA >= 0.080                    0.013
##
##   Robust RMSEA                                   0.000
##   90 Percent confidence interval - lower         0.000
##   90 Percent confidence interval - upper         0.053
##   P-value H_0: Robust RMSEA <= 0.050             0.944
##   P-value H_0: Robust RMSEA >= 0.080             0.013
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.019
##
## Parameter Estimates:
##
##   Standard errors                             Sandwich
##   Information bread                           Observed
##   Observed information based on                Hessian
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   i =~
##     monit12          1.000                               0.783    0.976
##     monit13          1.000                               0.783    1.034
##     monit14          1.000                               0.783    1.153
##     monit15          1.000                               0.783    1.294
##   s =~
```

```
##     monit12           0.000                               0.000    0.000
##     monit13           1.000                               0.126    0.167
##     monit14           2.000                               0.253    0.372
##     monit15           3.000                               0.379    0.627
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   i ~~
##     s               -0.077    0.013   -6.085    0.000   -0.780   -0.780
##
## Intercepts:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12           0.000                               0.000    0.000
##    .monit13           0.000                               0.000    0.000
##    .monit14           0.000                               0.000    0.000
##    .monit15           0.000                               0.000    0.000
##     i                 3.080    0.057   54.419    0.000    3.931    3.931
##     s                 0.003    0.011    0.286    0.775    0.026    0.026
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12           0.031    0.015    2.039    0.041    0.031    0.048
##    .monit13           0.098    0.012    7.921    0.000    0.098    0.172
##    .monit14           0.093    0.011    8.126    0.000    0.093    0.201
##    .monit15           0.072    0.015    4.920    0.000    0.072    0.197
##     i                 0.614    0.066    9.351    0.000    1.000    1.000
##     s                 0.016    0.004    4.191    0.000    1.000    1.000
```

Modelo cuadrático

En este modelo el parámetro de cambio cuadrático es el más relevante

```
modelo2<- "i=~ 1*monit12 + 1*monit13+ 1*monit14 + 1*monit15
           s=~ 0*monit12 + 1*monit13+ 2*monit14 + 3*monit15
           q=~ 0*monit12 + 1*monit13+ 4*monit14 + 9*monit15

           monit12 ~ 0*1
           monit13 ~ 0*1
           monit14 ~ 0*1
           monit15 ~ 0*1"
fit2<- growth(modelo2, data = base,
              missing="fiml", se="robust", estimator="ml")

## Warning: lavaan->lav_object_post_check():
##    some estimated ov variances are negative

## Warning: lavaan->lav_object_post_check():
##    covariance matrix of latent variables is not positive definite ; use
##    lavInspect(fit, "cov.lv") to investigate.

summary(fit2, fit.measures= T, standardized=T)

## lavaan 0.6-19 ended normally after 70 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        13
##
##   Number of observations                           200
##   Number of missing patterns                         1
##
## Model Test User Model:
##
##   Test statistic                                 0.836
##   Degrees of freedom                                 1
##   P-value (Chi-square)                           0.361
##
## Model Test Baseline Model:
##
##   Test statistic                               791.167
##   Degrees of freedom                                 6
```

```
##   P-value                                        0.000
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                    1.000
##   Tucker-Lewis Index (TLI)                       1.001
##
##   Robust Comparative Fit Index (CFI)             1.000
##   Robust Tucker-Lewis Index (TLI)                1.001
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)               -461.794
##   Loglikelihood unrestricted model (H1)       -461.376
##
##   Akaike (AIC)                                 949.588
##   Bayesian (BIC)                               992.466
##   Sample-size adjusted Bayesian (SABIC)        951.280
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000
##   90 Percent confidence interval - lower         0.000
##   90 Percent confidence interval - upper         0.181
##   P-value H_0: RMSEA <= 0.050                    0.470
##   P-value H_0: RMSEA >= 0.080                    0.394
##
##   Robust RMSEA                                   0.000
##   90 Percent confidence interval - lower         0.000
##   90 Percent confidence interval - upper         0.181
##   P-value H_0: Robust RMSEA <= 0.050             0.470
##   P-value H_0: Robust RMSEA >= 0.080             0.394
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.008
##
## Parameter Estimates:
##
##   Standard errors                             Sandwich
##   Information bread                           Observed
##   Observed information based on                Hessian
```

```
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   i =~
##     monit12          1.000                              0.819    1.019
##     monit13          1.000                              0.819    1.073
##     monit14          1.000                              0.819    1.231
##     monit15          1.000                              0.819    1.340
##   s =~
##     monit12          0.000                              0.000    0.000
##     monit13          1.000                              0.265    0.348
##     monit14          2.000                              0.530    0.798
##     monit15          3.000                              0.796    1.303
##   q =~
##     monit12          0.000                              0.000    0.000
##     monit13          1.000                              0.013    0.017
##     monit14          4.000                              0.052    0.079
##     monit15          9.000                              0.118    0.193
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   i ~~
##     s               -0.146    0.090   -1.619    0.105   -0.672   -0.672
##     q                0.017    0.022    0.780    0.435    1.610    1.610
##   s ~~
##     q               -0.009    0.017   -0.529    0.597   -2.629   -2.629
##
## Intercepts:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12          0.000                              0.000    0.000
##    .monit13          0.000                              0.000    0.000
##    .monit14          0.000                              0.000    0.000
##    .monit15          0.000                              0.000    0.000
##     i                3.079    0.057   53.819    0.000    3.761    3.761
##     s               -0.010    0.030   -0.348    0.728   -0.039   -0.039
##     q                0.005    0.010    0.509    0.611    0.377    0.377
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12         -0.025    0.077   -0.324    0.746   -0.025   -0.039
##    .monit13          0.117    0.025    4.644    0.000    0.117    0.201
##    .monit14          0.080    0.022    3.572    0.000    0.080    0.180
```

```
##    .monit15          0.114    0.061    1.875    0.061    0.114    0.305
##     i                0.670    0.102    6.546    0.000    1.000    1.000
##     s                0.070    0.084    0.837    0.403    1.000    1.000
##     q                0.000    0.003    0.050    0.960    1.000    1.000
```

Comparación de modelos

```
anova(fit0, fit1, fit2)

##
## Chi-Squared Difference Test
##
##      Df     AIC     BIC   Chisq Chisq diff   RMSEA Df diff Pr(>Chisq)
## fit2  1  949.59  992.47  0.8361
## fit1  5  942.69  972.37  1.9379      1.102 0.00000       4      0.894
## fit0  8 1011.16 1030.95 76.4037     74.466 0.34512       3  4.716e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Modelo para conductas de riesgo

```
# Modelo nulo
modelo0<- "i=~ 1*riesgo12 + 1*riesgo13+ 1*riesgo14 + 1*riesgo15

           riesgo12 ~ 0*1
           riesgo13 ~ 0*1
           riesgo14 ~ 0*1
           riesgo15 ~ 0*1"
fit0<- growth(modelo0, data = base,
              missing="fiml", se="robust", estimator="mlr")
summary(fit0, fit.measures= T, standardized=T)

## lavaan 0.6-19 ended normally after 40 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                         6
##
##   Number of observations                           200
##   Number of missing patterns                         1
##
## Model Test User Model:
##                                              Standard      Scaled
##   Test Statistic                               65.442      68.478
##   Degrees of freedom                                8           8
##   P-value (Chi-square)                          0.000       0.000
##   Scaling correction factor                                 0.956
##     Yuan-Bentler correction (Mplus variant)
##
## Model Test Baseline Model:
##
##   Test statistic                              276.175     329.034
##   Degrees of freedom                                6           6
##   P-value                                       0.000       0.000
##   Scaling correction factor                                 0.839
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                   0.787       0.813
##   Tucker-Lewis Index (TLI)                      0.841       0.860
##
##   Robust Comparative Fit Index (CFI)                        0.786
```

```
##   Robust Tucker-Lewis Index (TLI)                            0.840
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -2235.163   -2235.163
##   Scaling correction factor                                  0.859
##       for the MLR correction
##   Loglikelihood unrestricted model (H1)      -2202.443   -2202.443
##   Scaling correction factor                                  0.914
##       for the MLR correction
##
##   Akaike (AIC)                                4482.327    4482.327
##   Bayesian (BIC)                              4502.117    4502.117
##   Sample-size adjusted Bayesian (SABIC)       4483.108    4483.108
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.189       0.194
##   90 Percent confidence interval - lower         0.149       0.153
##   90 Percent confidence interval - upper         0.233       0.239
##   P-value H_0: RMSEA <= 0.050                    0.000       0.000
##   P-value H_0: RMSEA >= 0.080                    1.000       1.000
##
##   Robust RMSEA                                               0.190
##   90 Percent confidence interval - lower                     0.150
##   90 Percent confidence interval - upper                     0.233
##   P-value H_0: Robust RMSEA <= 0.050                         0.000
##   P-value H_0: Robust RMSEA >= 0.080                         1.000
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.118       0.118
##
## Parameter Estimates:
##
##   Standard errors                             Sandwich
##   Information bread                           Observed
##   Observed information based on                Hessian
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
```

```
##   i =~
##     riesgo12          1.000                               3.277    0.691
##     riesgo13          1.000                               3.277    0.736
##     riesgo14          1.000                               3.277    0.755
##     riesgo15          1.000                               3.277    0.670
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .riesgo12          0.000                               0.000    0.000
##    .riesgo13          0.000                               0.000    0.000
##    .riesgo14          0.000                               0.000    0.000
##    .riesgo15          0.000                               0.000    0.000
##     i                17.642    0.267   66.169    0.000    5.383    5.383
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .riesgo12         11.785    1.143   10.312    0.000   11.785    0.523
##    .riesgo13          9.076    0.968    9.373    0.000    9.076    0.458
##    .riesgo14          8.119    1.033    7.863    0.000    8.119    0.430
##    .riesgo15         13.176    1.405    9.375    0.000   13.176    0.551
##     i                10.742    1.533    7.008    0.000    1.000    1.000
```

Modelo Lineal

```
modelo1<- "i=~ 1*riesgo12 + 1*riesgo13+ 1*riesgo14 + 1*riesgo15
           s=~ 0*riesgo12 + 1*riesgo13+ 2*riesgo14 + 3*riesgo15

           riesgo12 ~ 0*1
           riesgo13 ~ 0*1
           riesgo14 ~ 0*1
           riesgo15 ~ 0*1"
fit1<- growth(modelo1, data = base,
              missing="fiml", se="robust", estimator="mlr")
summary(fit1, fit.measures= T, standardized=T)

## lavaan 0.6-19 ended normally after 63 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                         9
##
##   Number of observations                           200
##   Number of missing patterns                         1
##
## Model Test User Model:
##                                              Standard      Scaled
##   Test Statistic                                4.618       4.662
##   Degrees of freedom                                5           5
##   P-value (Chi-square)                          0.464       0.458
##   Scaling correction factor                                 0.991
##     Yuan-Bentler correction (Mplus variant)
##
## Model Test Baseline Model:
##
##   Test statistic                              276.175     329.034
##   Degrees of freedom                                6           6
##   P-value                                       0.000       0.000
##   Scaling correction factor                                 0.839
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                   1.000       1.000
##   Tucker-Lewis Index (TLI)                      1.002       1.001
##
##   Robust Comparative Fit Index (CFI)                        1.000
```

```
##   Robust Tucker-Lewis Index (TLI)                            1.002
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -2204.752   -2204.752
##   Scaling correction factor                                  0.872
##       for the MLR correction
##   Loglikelihood unrestricted model (H1)      -2202.443   -2202.443
##   Scaling correction factor                                  0.914
##       for the MLR correction
##
##   Akaike (AIC)                                4427.503    4427.503
##   Bayesian (BIC)                              4457.188    4457.188
##   Sample-size adjusted Bayesian (SABIC)       4428.675    4428.675
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000       0.000
##   90 Percent confidence interval - lower         0.000       0.000
##   90 Percent confidence interval - upper         0.094       0.095
##   P-value H_0: RMSEA <= 0.050                    0.706       0.700
##   P-value H_0: RMSEA >= 0.080                    0.103       0.107
##
##   Robust RMSEA                                               0.000
##   90 Percent confidence interval - lower                     0.000
##   90 Percent confidence interval - upper                     0.094
##   P-value H_0: Robust RMSEA <= 0.050                         0.704
##   P-value H_0: Robust RMSEA >= 0.080                         0.104
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.030       0.030
##
## Parameter Estimates:
##
##   Standard errors                             Sandwich
##   Information bread                           Observed
##   Observed information based on                Hessian
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
```

```
##   i =~
##     riesgo12          1.000                               3.654    0.801
##     riesgo13          1.000                               3.654    0.812
##     riesgo14          1.000                               3.654    0.829
##     riesgo15          1.000                               3.654    0.795
##   s =~
##     riesgo12          0.000                               0.000    0.000
##     riesgo13          1.000                               1.037    0.231
##     riesgo14          2.000                               2.075    0.471
##     riesgo15          3.000                               3.112    0.677
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   i ~~
##     s               -1.536    0.621   -2.475    0.013   -0.405   -0.405
##
## Intercepts:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .riesgo12          0.000                               0.000    0.000
##    .riesgo13          0.000                               0.000    0.000
##    .riesgo14          0.000                               0.000    0.000
##    .riesgo15          0.000                               0.000    0.000
##     i                16.576    0.309   53.695    0.000    4.537    4.537
##     s                 0.747    0.114    6.528    0.000    0.720    0.720
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .riesgo12          7.476    1.441    5.188    0.000    7.476    0.359
##    .riesgo13          8.876    0.932    9.525    0.000    8.876    0.439
##    .riesgo14          7.913    0.946    8.368    0.000    7.913    0.407
##    .riesgo15          7.322    1.335    5.485    0.000    7.322    0.346
##     i                13.350    2.318    5.759    0.000    1.000    1.000
##     s                 1.076    0.318    3.385    0.001    1.000    1.000
```

Modelo cuadrático

```
modelo2<- "i=~ 1*riesgo12 + 1*riesgo13+ 1*riesgo14 + 1*riesgo15
           s=~ 0*riesgo12 + 1*riesgo13+ 2*riesgo14 + 3*riesgo15
           q=~ 0*riesgo12 + 1*riesgo13+ 4*riesgo14 + 9*riesgo15

           riesgo12 ~ 0*1
           riesgo13 ~ 0*1
           riesgo14 ~ 0*1
           riesgo15 ~ 0*1"
fit2<- growth(modelo2, data = base,
              missing="fiml", se="robust", estimator="mlr")
summary(fit2, fit.measures= T, standardized=T)

## lavaan 0.6-19 ended normally after 89 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        13
##
##   Number of observations                           200
##   Number of missing patterns                         1
##
## Model Test User Model:
##                                              Standard      Scaled
##   Test Statistic                                0.059       0.059
##   Degrees of freedom                                1           1
##   P-value (Chi-square)                          0.809       0.809
##   Scaling correction factor                                 0.998
##     Yuan-Bentler correction (Mplus variant)
##
## Model Test Baseline Model:
##
##   Test statistic                              276.175     329.034
##   Degrees of freedom                                6           6
##   P-value                                       0.000       0.000
##   Scaling correction factor                                 0.839
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                   1.000       1.000
##   Tucker-Lewis Index (TLI)                      1.021       1.017
##
```

```
##   Robust Comparative Fit Index (CFI)                        1.000
##   Robust Tucker-Lewis Index (TLI)                           1.021
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -2202.472   -2202.472
##   Scaling correction factor                                  0.908
##       for the MLR correction
##   Loglikelihood unrestricted model (H1)      -2202.443   -2202.443
##   Scaling correction factor                                  0.914
##       for the MLR correction
##
##   Akaike (AIC)                                4430.944    4430.944
##   Bayesian (BIC)                              4473.822    4473.822
##   Sample-size adjusted Bayesian (SABIC)       4432.637    4432.637
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000       0.000
##   90 Percent confidence interval - lower         0.000       0.000
##   90 Percent confidence interval - upper         0.117       0.000
##   P-value H_0: RMSEA <= 0.050                    0.850       0.850
##   P-value H_0: RMSEA >= 0.080                    0.102       0.103
##
##   Robust RMSEA                                               0.000
##   90 Percent confidence interval - lower                     0.000
##   90 Percent confidence interval - upper                     0.117
##   P-value H_0: Robust RMSEA <= 0.050                         0.850
##   P-value H_0: Robust RMSEA >= 0.080                         0.102
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.003       0.003
##
## Parameter Estimates:
##
##   Standard errors                             Sandwich
##   Information bread                           Observed
##   Observed information based on                Hessian
##
## Latent Variables:
```

```
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   i =~
##     riesgo12          1.000                              3.406    0.746
##     riesgo13          1.000                              3.406    0.770
##     riesgo14          1.000                              3.406    0.757
##     riesgo15          1.000                              3.406    0.746
##   s =~
##     riesgo12          0.000                              0.000    0.000
##     riesgo13          1.000                              0.792    0.179
##     riesgo14          2.000                              1.585    0.352
##     riesgo15          3.000                              2.377    0.521
##   q =~
##     riesgo12          0.000                              0.000    0.000
##     riesgo13          1.000                              0.561    0.127
##     riesgo14          4.000                              2.244    0.499
##     riesgo15          9.000                              5.050    1.107
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   i ~~
##     s                 0.459    4.457    0.103    0.918    0.170    0.170
##     q                -0.459    1.107   -0.414    0.679   -0.240   -0.240
##   s ~~
##     q                -0.348    1.200   -0.290    0.772   -0.783   -0.783
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .riesgo12          0.000                              0.000    0.000
##    .riesgo13          0.000                              0.000    0.000
##    .riesgo14          0.000                              0.000    0.000
##    .riesgo15          0.000                              0.000    0.000
##     i                16.733    0.319   52.510    0.000    4.913    4.913
##     s                 0.251    0.322    0.779    0.436    0.317    0.317
##     q                 0.166    0.101    1.641    0.101    0.296    0.296
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .riesgo12          9.267    4.067    2.278    0.023    9.267    0.444
##    .riesgo13          7.702    1.299    5.927    0.000    7.702    0.394
##    .riesgo14          8.479    1.437    5.899    0.000    8.479    0.419
##    .riesgo15          2.367    4.189    0.565    0.572    2.367    0.114
```

```
##     i                11.601    4.024    2.883    0.004    1.000    1.000
##     s                 0.628    4.938    0.127    0.899    1.000    1.000
##     q                 0.315    0.354    0.890    0.374    1.000    1.000
```

Comparación de modelos

```
anova(fit0, fit1, fit2)

##
## Scaled Chi-Squared Difference Test (method = "satorra.bentler.2001")
##
## lavaan->lavTestLRT():
##    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)
## fit2  1 4430.9 4473.8  0.0585
## fit1  5 4427.5 4457.2  4.6183      4.612       4     0.3295
## fit0  8 4482.3 4502.1 65.4416     67.766       3  1.284e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Modelo autorregresivo con intercepto aleatorio

```
mod2<- [1522 chars quoted with '''']
fit2 <- sem(mod2, data = base,
               estimator="mlr", mimic = "mplus")
summary(fit2, fit.measures = TRUE, standardized = T)

## lavaan 0.6-19 ended normally after 153 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        39
##   Number of equality constraints                     2
##
##   Number of observations                           200
##   Number of missing patterns                         1
##
## Model Test User Model:
##                                              Standard      Scaled
##   Test Statistic                               16.325      16.987
##   Degrees of freedom                                7           7
##   P-value (Chi-square)                          0.022       0.017
##   Scaling correction factor                                 0.961
##     Yuan-Bentler correction (Mplus variant)
##
## Model Test Baseline Model:
##
##   Test statistic                             1151.344    1203.763
##   Degrees of freedom                               28          28
##   P-value                                       0.000       0.000
##   Scaling correction factor                                 0.956
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                   0.992       0.992
##   Tucker-Lewis Index (TLI)                      0.967       0.966
##
##   Robust Comparative Fit Index (CFI)                        0.992
##   Robust Tucker-Lewis Index (TLI)                           0.966
##
## Loglikelihood and Information Criteria:
##
```

```
##   Loglikelihood user model (H0)              -2629.980   -2629.980
##   Scaling correction factor                                  0.920
##       for the MLR correction
##   Loglikelihood unrestricted model (H1)      -2621.817   -2621.817
##   Scaling correction factor                                  0.969
##       for the MLR correction
##
##   Akaike (AIC)                                5333.960    5333.960
##   Bayesian (BIC)                              5455.998    5455.998
##   Sample-size adjusted Bayesian (SABIC)       5338.778    5338.778
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.082       0.084
##   90 Percent confidence interval - lower         0.029       0.032
##   90 Percent confidence interval - upper         0.134       0.138
##   P-value H_0: RMSEA <= 0.050                    0.135       0.119
##   P-value H_0: RMSEA >= 0.080                    0.572       0.607
##
##   Robust RMSEA                                               0.082
##   90 Percent confidence interval - lower                     0.030
##   90 Percent confidence interval - upper                     0.134
##   P-value H_0: Robust RMSEA <= 0.050                         0.130
##   P-value H_0: Robust RMSEA >= 0.080                         0.578
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.047       0.047
##
## Parameter Estimates:
##
##   Standard errors                             Sandwich
##   Information bread                           Observed
##   Observed information based on                Hessian
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   RI_monit =~
##     monit12          1.000                                0.583    0.726
##     monit13          1.000                                0.583    0.767
##     monit14          1.000                                0.583    0.909
```

```
##     monit15           1.000                                0.583    0.919
##   RI_riesgo =~
##     riesgo12          1.000                                3.000    0.657
##     riesgo13          1.000                                3.000    0.677
##     riesgo14          1.000                                3.000    0.680
##     riesgo15          1.000                                3.000    0.651
##   Wmonit12 =~
##     monit12           1.000                                0.387    0.482
##   Wmonit13 =~
##     monit13           1.000                                0.391    0.514
##   Wmonit14 =~
##     monit14           1.000                                0.263    0.410
##   Wmonit15 =~
##     monit15           1.000                                0.257    0.405
##   Wriesgo12 =~
##     riesgo12          1.000                                3.351    0.734
##   Wriesgo13 =~
##     riesgo13          1.000                                3.227    0.728
##   Wriesgo14 =~
##     riesgo14          1.000                                3.187    0.722
##   Wriesgo15 =~
##     riesgo15          1.000                                3.483    0.755
##
## Regressions:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   Wmonit13 ~
##     Wmonit12          0.532    0.078    6.812    0.000    0.527    0.527
##     Wriesgo12         0.005    0.010    0.479    0.632    0.041    0.041
##   Wmonit14 ~
##     Wmonit13          0.028    0.087    0.323    0.747    0.042    0.042
##     Wriesgo13         0.002    0.010    0.243    0.808    0.029    0.029
##   Wmonit15 ~
##     Wmonit14         -0.354    0.530   -0.668    0.504   -0.362   -0.362
##     Wriesgo14         0.017    0.022    0.810    0.418    0.216    0.216
##   Wriesgo13 ~
##     Wriesgo12         0.201    0.114    1.765    0.078    0.209    0.209
##     Wmonit12         -0.293    0.988   -0.297    0.766   -0.035   -0.035
##   Wriesgo14 ~
##     Wriesgo13         0.185    0.150    1.231    0.218    0.187    0.187
##     Wmonit13         -1.837    0.899   -2.044    0.041   -0.225   -0.225
##   Wriesgo15 ~
##     Wriesgo14         0.353    0.149    2.375    0.018    0.323    0.323
```

```
##     Wmonit14         -1.777    1.390   -1.278    0.201   -0.134   -0.134
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   RI_monit ~~
##     RI_riesg         -0.865    0.201   -4.313    0.000   -0.494   -0.494
##   Wmonit12 ~~
##     Wriesg12          0.026    0.176    0.149    0.881    0.020    0.020
##  .Wmonit13 ~~
##    .Wriesg13 (cov)    0.230    0.078    2.928    0.003    0.219    0.219
##  .Wmonit14 ~~
##    .Wriesg14 (cov)    0.230    0.078    2.928    0.003    0.284    0.284
##  .Wmonit15 ~~
##    .Wriesg15 (cov)    0.230    0.078    2.928    0.003    0.290    0.290
##   RI_monit ~~
##     Wmonit12          0.078    0.030    2.577    0.010    0.344    0.344
##     Wriesg12          0.280    0.192    1.461    0.144    0.143    0.143
##   RI_riesgo ~~
##     Wmonit12         -0.153    0.169   -0.904    0.366   -0.131   -0.131
##     Wriesg12          0.317    1.921    0.165    0.869    0.032    0.032
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12           3.081    0.057   54.229    0.000    3.081    3.835
##    .monit13           3.090    0.054   57.307    0.000    3.090    4.064
##    .monit14           3.067    0.047   65.232    0.000    3.067    4.777
##    .monit15           3.098    0.043   71.728    0.000    3.098    4.880
##    .riesgo12         16.720    0.323   51.762    0.000   16.720    3.660
##    .riesgo13         17.181    0.313   54.955    0.000   17.181    3.878
##    .riesgo14         17.864    0.318   56.177    0.000   17.864    4.046
##    .riesgo15         18.982    0.323   58.834    0.000   18.982    4.117
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12           0.000                               0.000    0.000
##    .monit13           0.000                               0.000    0.000
##    .monit14           0.000                               0.000    0.000
##    .monit15           0.000                               0.000    0.000
##    .riesgo12          0.000                               0.000    0.000
##    .riesgo13          0.000                               0.000    0.000
##    .riesgo14          0.000                               0.000    0.000
##    .riesgo15          0.000                               0.000    0.000
```

```
##     RI_monit          0.340    0.045    7.563    0.000    1.000    1.000
##     RI_riesgo         9.003    2.350    3.832    0.000    1.000    1.000
##     Wmonit12          0.150    0.029    5.163    0.000    1.000    1.000
##    .Wmonit13          0.110    0.011    9.679    0.000    0.720    0.720
##    .Wmonit14          0.069    0.026    2.615    0.009    0.997    0.997
##    .Wmonit15          0.057    0.050    1.139    0.255    0.864    0.864
##     Wriesgo12        11.231    2.110    5.322    0.000    1.000    1.000
##    .Wriesgo13         9.946    1.386    7.177    0.000    0.955    0.955
##    .Wriesgo14         9.433    1.753    5.382    0.000    0.929    0.929
##    .Wriesgo15        10.928    1.269    8.609    0.000    0.901    0.901
```

Modelo con restricciones

```
mod3<- [1530 chars quoted with '''']
fit3 <- sem(mod3, data = base,
               estimator="mlr", mimic = "mplus")
summary(fit3, fit.measures = TRUE, standardized = T)

## lavaan 0.6-19 ended normally after 101 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        35
##   Number of equality constraints                     6
##
##   Number of observations                           200
##   Number of missing patterns                         1
##
## Model Test User Model:
##                                              Standard      Scaled
##   Test Statistic                               74.087      83.843
##   Degrees of freedom                               15          15
##   P-value (Chi-square)                          0.000       0.000
##   Scaling correction factor                                 0.884
##     Yuan-Bentler correction (Mplus variant)
##
## Model Test Baseline Model:
##
##   Test statistic                             1151.344    1203.763
##   Degrees of freedom                               28          28
##   P-value                                       0.000       0.000
##   Scaling correction factor                                 0.956
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                   0.947       0.941
##   Tucker-Lewis Index (TLI)                      0.902       0.891
##
##   Robust Comparative Fit Index (CFI)                        0.947
##   Robust Tucker-Lewis Index (TLI)                           0.901
##
## Loglikelihood and Information Criteria:
##
```

```
##   Loglikelihood user model (H0)              -2658.861   -2658.861
##   Scaling correction factor                                  0.839
##       for the MLR correction
##   Loglikelihood unrestricted model (H1)      -2621.817   -2621.817
##   Scaling correction factor                                  0.969
##       for the MLR correction
##
##   Akaike (AIC)                                5375.722    5375.722
##   Bayesian (BIC)                              5471.373    5471.373
##   Sample-size adjusted Bayesian (SABIC)       5379.498    5379.498
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.140       0.151
##   90 Percent confidence interval - lower         0.109       0.119
##   90 Percent confidence interval - upper         0.173       0.186
##   P-value H_0: RMSEA <= 0.050                    0.000       0.000
##   P-value H_0: RMSEA >= 0.080                    0.999       1.000
##
##   Robust RMSEA                                               0.141
##   90 Percent confidence interval - lower                     0.111
##   90 Percent confidence interval - upper                     0.173
##   P-value H_0: Robust RMSEA <= 0.050                         0.000
##   P-value H_0: Robust RMSEA >= 0.080                         0.999
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.161       0.161
##
## Parameter Estimates:
##
##   Standard errors                             Sandwich
##   Information bread                           Observed
##   Observed information based on                Hessian
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   RI_monit =~
##     monit12          1.000                               0.622    0.866
##     monit13          1.000                               0.622    0.880
##     monit14          1.000                               0.622    0.874
```

```
##     monit15           1.000                                 0.622    0.880
##   RI_riesgo =~
##     riesgo12          1.000                                 3.027    0.654
##     riesgo13          1.000                                 3.027    0.675
##     riesgo14          1.000                                 3.027    0.691
##     riesgo15          1.000                                 3.027    0.672
##   Wmonit12 =~
##     monit12           1.000                                 0.360    0.501
##   Wmonit13 =~
##     monit13           1.000                                 0.336    0.475
##   Wmonit14 =~
##     monit14           1.000                                 0.345    0.485
##   Wmonit15 =~
##     monit15           1.000                                 0.336    0.475
##   Wriesgo12 =~
##     riesgo12          1.000                                 3.497    0.756
##   Wriesgo13 =~
##     riesgo13          1.000                                 3.305    0.737
##   Wriesgo14 =~
##     riesgo14          1.000                                 3.168    0.723
##   Wriesgo15 =~
##     riesgo15          1.000                                 3.332    0.740
##
## Regressions:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   Wmonit13 ~
##     Wmonit12   (a)    0.246    0.096    2.560    0.010    0.264    0.264
##     Wriesgo12         0.015    0.015    0.999    0.318    0.157    0.157
##   Wmonit14 ~
##     Wmonit13   (a)    0.246    0.096    2.560    0.010    0.239    0.239
##     Wriesgo13        -0.011    0.011   -1.074    0.283   -0.108   -0.108
##   Wmonit15 ~
##     Wmonit14   (a)    0.246    0.096    2.560    0.010    0.253    0.253
##     Wriesgo14         0.002    0.012    0.214    0.830    0.023    0.023
##   Wriesgo13 ~
##     Wriesgo12  (b)    0.243    0.076    3.222    0.001    0.258    0.258
##     Wmonit12         -0.749    1.022   -0.733    0.464   -0.082   -0.082
##   Wriesgo14 ~
##     Wriesgo13  (b)    0.243    0.076    3.222    0.001    0.254    0.254
##     Wmonit13         -1.403    0.969   -1.449    0.147   -0.149   -0.149
##   Wriesgo15 ~
##     Wriesgo14  (b)    0.243    0.076    3.222    0.001    0.231    0.231
```

```
##     Wmonit14         -1.847    1.136   -1.626    0.104   -0.191   -0.191
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   RI_monit ~~
##     RI_riesg         -0.862    0.227   -3.795    0.000   -0.458   -0.458
##   Wmonit12 ~~
##     Wriesg12          0.173    0.215    0.804    0.422    0.137    0.137
##  .Wmonit13 ~~
##    .Wriesg13 (cov)    0.225    0.055    4.130    0.000    0.222    0.222
##  .Wmonit14 ~~
##    .Wriesg14 (cov)    0.225    0.055    4.130    0.000    0.220    0.220
##  .Wmonit15 ~~
##    .Wriesg15 (cov)    0.225    0.055    4.130    0.000    0.217    0.217
##   RI_monit ~~
##     Wmonit12          0.000                              0.000    0.000
##     Wriesg12          0.000                              0.000    0.000
##   RI_riesgo ~~
##     Wmonit12          0.000                              0.000    0.000
##     Wriesg12          0.000                              0.000    0.000
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12           3.081    0.057   54.229    0.000    3.081    4.289
##    .monit13           3.090    0.054   57.307    0.000    3.090    4.374
##    .monit14           3.067    0.047   65.232    0.000    3.067    4.313
##    .monit15           3.098    0.043   71.728    0.000    3.098    4.385
##    .riesgo12         16.720    0.323   51.762    0.000   16.720    3.615
##    .riesgo13         17.181    0.313   54.955    0.000   17.181    3.834
##    .riesgo14         17.864    0.318   56.177    0.000   17.864    4.077
##    .riesgo15         18.982    0.323   58.834    0.000   18.982    4.217
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .monit12           0.000                              0.000    0.000
##    .monit13           0.000                              0.000    0.000
##    .monit14           0.000                              0.000    0.000
##    .monit15           0.000                              0.000    0.000
##    .riesgo12          0.000                              0.000    0.000
##    .riesgo13          0.000                              0.000    0.000
##    .riesgo14          0.000                              0.000    0.000
##    .riesgo15          0.000                              0.000    0.000
```

```
##     RI_monit          0.387    0.045    8.579    0.000    1.000    1.000
##     RI_riesgo         9.162    1.648    5.559    0.000    1.000    1.000
##     Wmonit12          0.129    0.028    4.679    0.000    1.000    1.000
##    .Wmonit13          0.101    0.014    7.257    0.000    0.895    0.895
##    .Wmonit14          0.112    0.017    6.608    0.000    0.943    0.943
##    .Wmonit15          0.105    0.015    7.225    0.000    0.933    0.933
##     Wriesgo12        12.229    1.310    9.332    0.000    1.000    1.000
##    .Wriesgo13        10.186    0.983   10.366    0.000    0.933    0.933
##    .Wriesgo14         9.340    1.184    7.890    0.000    0.931    0.931
##    .Wriesgo15        10.260    1.066    9.623    0.000    0.924    0.924
```

Comparación de modelos

```
anova(fit2, fit3)

##
## Scaled Chi-Squared Difference Test (method = "satorra.bentler.2001")
##
## lavaan->lavTestLRT():
##    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)
## fit2  7 5334.0 5456.0 16.325
## fit3 15 5375.7 5471.4 74.087     70.794       8  3.415e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```